Utah Point, Finucane Island
Port Hedland, Western Australia

STAGE 1 PRELIMINARY SITE INVESTIGATION

- Final
- February 2008

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Acronyms

AASS – Actual Acid Sulfate Soils

ADWG – Australian Drinking Water Guidelines

AHD – Australian Height Datum

ANZECC – Australia and New Zealand Environment and Conservation Council

AOC – Area of Concern

AOI – Area of Interest

ARMCANZ – Agriculture and Resource Management Council of Australia and New Zealand

ASS – Acid Sulfate Soils

ASSMP – Acid Sulfate Soil Management Plan

BHPBIO – BHP Billiton Iron Ore

BoM – Bureau of Meteorology

CALM – Department of Conservation and Land Management

CSIRO – Commonwealth Scientific and Industrial Research Organisation

DEC – Department of Environment and Conservation, Government of Western Australia

DLI – Department of Land Information, Government of Western Australia

DoE – Department of Environment

DoW - Department of Water, Government of Western Australia

EIL – Ecological Investigation Level

EPA – Environmental Protection Authority

FMG – Fortescue Metals Group

HIL – Health Investigation Level

NEPC – National Environmental Protection Council

NHMRC – National Health and Medical Research Council

NIOSH – National Institute for Occupational Safety and Health

NRMMC – Natural Resource Management Ministerial Council

NSW – New South Wales

PAOC – Potential Area of Concern

PASS – Potential Acid Sulfate Soils

PB – Parsons Brinkerhoff

PER – Public Environmental Review

PHPA – Port Hedland Port Authority

PM – Particulate Matter

PQL – Practical Quantitation Limit

PSI – Preliminary Site Investigation

SKM – Sinclair Knight Merz

TEC – Threatened Ecological Community

TWA – Time Weighted Average

USA – United States of America

WA – Western Australia

WCWA – Water Corporation Western Australia

Units and Symbols

° – degree

µg/L – micrograms per litre

µg/m^3 – micrograms per cubic metre

C – Celsius

cm – centimetre

Cr – chromium

Cr (III) – trivalent chromium

Cr (VI) – hexavalent chromium

ha – hectare

km – kilometres

km^2 – square kilometres

m – metres

m^3 – cubic metre

mg/kg – milligrams per kilogram

mg/m^3 – milligrams per cubic metre

mm – millimetres

Mn – manganese

Executive Summary

SKM has performed a Preliminary Site Investigation (PSI) of Stanley Point and Utah Point, Finucane Island, Port Hedland, WA (the Site) in general accordance with the DEC guideline entitled, *Reporting of Site Assessments* (DEC 2001) and SKM's proposal dated 28 March 2007. This PSI report has been prepared to document future, current and past operations conducted at the Site and to assess the potential and known impacts of these activities on the environmental condition of the Site and surrounding areas.

Based on the available information collected as part of this PSI, the Site is defined as a 22ha property that lies on Crown Land within the local government area of Port Hedland. The Site is vested with the Port Hedland Port Authority. The Site is currently undeveloped. Review of available historical aerial photography suggests that the Site has not been altered from its natural state. The DEC Contaminated Sites Database does not class the Site as contaminated.

During the site visit, conducted on 26 April 2007, it was observed that the Site consists of two regions; the calcarenite area, and the mangrove area. The calcarenite area is a hard substrate "limestone" sparsely covered in shrubs. The mangrove area surrounds the calcarenite area to the east, south and west. Dense foliage and mud in the mangrove area reduced access to the waters edge during the Site visit. The only structures observed on Site were three beacon towers and remnants from a fence in the central calcarenite area.

Given the information obtained as part of this PSI, SKM has identified five future PAOCs at the Site. These PAOCs are identified as follows:

- PAOC1: Settlement pond
- PAOC2: Workshop and fuel storage facility
- PAOC3: Ore stockpile
- PAOC4: Truck Wash facility
- PAOC5: Ablutions including water storage and treatment

In order to confirm that the quality of superficial and subsurface media at the Site has not been impacted by adjacent industrial activities and to provide baseline data, further site investigations are currently in progress. These investigations include sampling of superficial and subsurface soils, installation of groundwater bores and groundwater monitoring. Groundwater monitoring will be undertaken periodically to establish a baseline dataset and to monitor target analytes, such as manganese, chromium and other heavy metals. The findings of further investigations and groundwater monitoring will be reported separately.

The primary risk to the environment that has been identified as part of this PSI is the potential leaching of chromium and manganese from stockpiles and subsequently entering the underlying groundwater or adjacent marine environment.

The risk of these contaminants impacting on the environment will be substantially reduced by limiting the permeability of fill material used for the construction of the stockpile site by ensuring all surface water runoff is captured and treated within the stockpile area, through geotechnical barrier lining of potential risk areas, and by ensuring appropriate management of sediments. It is recommended that each of these design and management factors be taken into careful consideration during both construction and operations of the Utah Point Berth Project.

In the event that, during abnormal weather events or other emergency, sediment or stored water from the settlement pond enters the marine environment it is considered that the greatest risk exists from the turbidity generated by the introduction of sediments rather than the potential for leaching to take place of metals including manganese and chromium. It is therefore considered that the management systems to be included in the operations of the Site, which will manage the quantities of sediment or water stored at any given time particularly during seasons of extreme weather, will mitigate the potential for significant harm occurring to the environment.

Furthermore, it is expected the introduction of any dissolved metals will be significantly diluted by the receiving waters. The management of the facility should include for the regular maintenance of the settlement pond and drainage network and for the monitoring of receiving waters to maintain a watching brief on background environmental conditions.

1. Introduction

Sinclair Knight Merz (SKM) was commissioned by the Port Hedland Port Authority (PHPA) to conduct a Stage 1 Preliminary Site Investigation (PSI) for the property identified as Stanley Point and Utah Point, located on Finucane Island, which is situated in Port Hedland, Western Australia (WA) (hereafter referred to as the 'Site').

This PSI report has been prepared to document current and past operations conducted at the Site and to assess the background environmental condition of the development area and determine the potential for these operations to detrimentally impact the Site and surrounding areas. This report presents the findings and conclusions resulting from the inquiry into previous ownership and uses of the Site, the review of environmental record sources; historical and physical setting and surrounding land uses that may have, or have the potential in the future, to impact the site.

This PSI has been prepared in general accordance with the Government of Western Australia's Department of Environment and Conservation's (DEC) guideline entitled, Reporting of Site Assessments, and dated December 2001. This guideline forms part of a management series, identified as the Contaminated Sites Management Series (2002), developed by the DEC to provide guidance on the assessment and management of contaminated sites in Western Australia. The DEC describes a PSI as part of a staged approach to site assessments, with each progressive phase being more detailed. Furthermore, the findings of the PSI form the basis of all subsequent assessments and site investigations. As defined in the *Reporting of Site Assessments* (DEC, 2001) guideline, the PSI is:

> *"an investigation consisting of a desktop study, a detailed site inspection, and where applicable, a limited sampling. The preliminary site investigation should be of such scope as to indicate whether contamination is present, or likely to be present, and to determine whether a detailed site investigation should be conducted".*

Contaminated is defined by the DEC as follows:

> *"a substance that is detectable above natural background concentrations in the land or waters of a site at a high enough concentration that it presents, or has the potential to present, a risk to human health, the environment, or any environmental value".*

1.1 Scope of Work

As defined in SKM's proposal dated 28 March 2007, and in accordance with *Reporting of Site Assessments* (DEC 2001) guideline, the scope of work for this PSI included the following:

- Desktop study;
- A detailed site inspection;
- Review of publicly available documents; and
- Development of this report.

1.2 Report Organisation

This report has been organised such that figures and appendices are presented following the text. The following is a brief description of each section of the PSI:

- Section 2 identifies the Site, including location, describes Site conditions, and identifies proximate commercial and industrial properties.
- Section 3 summarises the history of the Site based on information derived from Certificates of Title, aerial photographs, and other relevant research derived information from sources such as previous reports.
- Section 4 provides Site information as obtained through file searches at various federal, state, and local government databases. This information includes a review of regulatory environmental, zoning, and heritage databases.
- Section 5 discusses the environmental setting of the Site, including geologic and hydrogeological characteristics and sensitive land uses.
- Section 6 presents a preliminary conceptual site model and provides a description of the Potential Areas of Concern (PAOCs) identified during the site assessment.
- Section 7 summarises conclusions based on the research conducted for this PSI.
- Section 8 provides references.

2. Site Identification

The intent of this section is to provide an overview of site information, a description of the Site, the results of the site visit, and background information pertinent to the Site. The Site location and surrounding properties is depicted on **Figure 1**. A footprint of the Site and general surface structures are illustrated on **Figure 2**. Relevant features, infrastructure, and environmentally significant features are depicted on **Figure 3.** All figures are provided in **Appendix A.**

2.1 Location

The site is a 22 hectare (ha) portion of land that extends over the southern arm of Finucane Island and is vacant Crown Land vested with the PHPA. The PHPA is the statutory body responsible for operating the port of Port Hedland and the local government authority for the Site and surrounding area is the Town of Port Hedland. Site coordinates at the southern most point of the portion of land are as follows: 20°19'32" south (latitude) and 118°34'02" east (longitude).

The Site is bound by the following streets, properties, and physical features as described below:

North: BHP Billiton Iron Ore (BHPBIO) stockpile and port berth facility (Berth C and D), and railway.

East: Man-made dredged shipping channel.

South: South West Creek.

West: West Creek.

2.2 Site Description

A detailed Site inspection was completed, by SKM personnel on 26 April 2007, to record characteristics of the Site and to gather information regarding potential sources of contamination associated with current and/or former operations conducted at the Site. As part of the Site inspection, photographs were taken for reference purposes and these have been summarised and provided in **Appendix B.**

Utah Point is an isthmus extending south eastward into a shipping channel and Stanley Point, which is a peninsula located at the southern end of Finucane Island, comprises the majority of the Site. At this time the majority of the Site is undeveloped.

Access to the Site is via the BHP facility, located immediately north of the Site (Refer to **Photograph 1**). An access road, comprised of limestone gravel, extending on-site to the northern part of the central portion of the Site.

For the purposes of this study, the Site has been divided into two areas, based primarily on their physical characteristics; namely: the Calcarenite Area; and Mangrove Area.

The following paragraphs provide a more detailed description of each of these areas.

Calcarenite Area

The Calcarenite Area is situated within the central portion of the Site (Refer to **Photograph 2**) and is generally unvegetated. Flora, low shrubs, sparsely covers the land surface (Refer to **Photograph 2**). The area is interspersed with deposits of shells. The density of shells in this central area increases towards the north at the intersection of Stanley Point and the rest of Finucane Island. The distribution pattern of the shells appears consistent with a tidally influenced dispersion.

There are three beacon towers located in this area (Refer to **Photograph 3**). The beacon tower footings appear to have "blue metal" surrounding the concrete bases. "Blue metal" is identified as a crushed rock used as gravel, and is located in areas elsewhere on-site (Refer to **Photograph 4**). The only other structure observed was remnants of a fence.

Mangrove Area

The Mangrove Area surrounds the Calcarenite Area and buffers the central portion of the Site from the surrounding marine waters and is heavily vegetated, predominantly by mangroves (Refer to **Photograph 5**). Due to heavy foliage and muddy conditions, a detailed site inspection of this area could not be completed during the visit and therefore debris noted in the aerial photographs could not be further investigated. Nevertheless, algal mat growth at the surface water edge was observed in a surface water body located in the far northern extent of this area (Refer to **Photograph 6**).

2.3 Proposed Landuse

2.3.1 Current Proposed Development

The proposed development of the Site has been detailed in the *PER Environmental Scoping Report* (SKM, 2007). Relevant portions of the proposed landuse, which relate to this PSI, are summarised in the following paragraphs.

The Site is part of the proposed development plan identified as the Utah Point Berth Project. Due to anticipated increase in trade at Port Hedland, the determination has been made by the PHPA that new port berths and improved infrastructure at the port of Port Hedland is required. The Utah Point Berth Project proposes to build a new bulk commodities berth, at the Site and wharf at Utah Point, a small isthmus that extends west from Finucane Island, and located immediately northwest of the Site. The Site represents 22ha of the total 25ha proposed development area.

PHPA proposes to allocate the use of this berth to the export of chromite, iron and manganese ores. This bulk commodities berth will be developed to accommodate upto small cape size vessels and will be designed to handle a maximum of 20 million tonnes per annum (Mtpa).

The footprint for the entire 25ha proposed development area consists of the following:

- Stockyard area (to store chromite, manganese ore and iron ore);
- Dedicated access road to Finucane Island, including causeway over West Creek and truck washdown facility;
- Seawalls around perimeter road to protect from storm surge and neap tides;
- Workshops, security control room, fuel storage, offices and associated infrastructure;
- Power supply, potable water, dust suppression, fire protection, settlement pond and miscellaneous services; and
- Conveyor system transfer towers and sample station.

The stockyards area is illustrated on **Figure 3**. It will be comprised of approximately 20ha and situated on Stanley Point. As these proposed stockyards will be located within an intertidal zone, it will require a minimum of 1.5m of fill. The stockyards will be surrounded by a 1.5m high elevated perimeter road of 10 m width with a surrounding seawall. This will extend a further 1m above the outside edge of the perimeter road at sufficient height to avoid breaching during cyclone tidal surges. The seawalls will be designed to minimise buttressing and therefore minimise clearing of mangroves in the Mangrove Area. Specifically, the development design provides for little or no loss of the dense closed canopy mangroves.

In addition, 2ha at Utah Point will be used to accommodate services and materials handling infrastructure.

The ore will be transported via truck along a dedicated access road. The access road will be within a 50m wide road and services corridor east of the existing overhead power supply line. The road will extend across a widened Finucane Island causeway over West Creek to the stockyard area.

Drainage from the Site will ultimately be directed to Port Hedland Harbour or to West Creek; however, discharges will be controlled through a combination of techniques such as bunding, evaporation, treatment and re-use.

2.3.2 Alternative Proposed Development

The Hope Downs Iron Ore Project gained environmental approval for a port berth at Utah Point in November 2002. The port berth for the Hope Downs proposal is located adjacent to the berth proposed for this development, with the Hope Downs proposal stockyards located on the mainland.

The approvals for the Hope Downs proposal will lapse in November 2007 and the project, as approved by the Minister for the Environment in 2002, will not proceed as per the current design.

PHPA, as manager of the Port of Port Hedland, have determined that the Hope Downs proposal, in its current approved location is not sustainable for the long term interests of the Port of Port Hedland. The level of mangrove loss associated with the Hope Downs proposal is significant and reductions in mangrove loss can be achieved by relocating Hope Downs to another site within Port Hedland Harbour. PHPA has revised its long term planning strategy to better utilise the areas available on the western side of the harbour to accommodate potential future development.

Revisions to PHPA's Ultimate Development Plan 2003 have the Hope Downs berths relocated to South West Creek with their stockyards moved southwards out of the dense mangroves areas, with the Utah Point berth allocated for future development by BHP Billiton Iron Ore connected to their existing infrastructure. This eliminates the need for any development to the west of West Creek and moves the Hope Downs stockpile area which results in a significant decrease in the level of mangrove loss. The proposed future development scenario is likely to see benefits in air quality improvement by increasing the separation distance of the proposed Hope Downs stockpile areas from the Port Hedland town area.

2.4 Surrounding Landuse

The site is located within the Port Hedland Harbour area, to the west of the PHPA and BHP Billiton Iron Ore (BHPBIO) port facilities at Nelson Point. To the north of the proposed development are is the BHPBIO Finucane Island stockpile and port berth facility, and to the south-east is the site for the proposed Fortescue Metals Group (FMG) stockpile and port berth facility at Anderson Point.

In the immediate and surrounding area, there are a number of approved planning developments that have either commenced construction as in the case of Fortescue Metals Group (FMG) or have not commenced and are understood to be subject to further planning negotiations such as the Hope Downs Iron Ore Project.

3. Site History

This section incorporates a summary of background information pertinent to the Site such as a description of the historical development and operational activities and an interpretation of information derived from a review of historic aerial photographs.

3.1 Certificate of Title

Copies of the Certificates of Title for the site were obtained from Landgate, the Western Australian Land Information Authority. As documented in Volume LR3118, Folio 753 of the Western Australian Office of Titles, the Site holds a Certificate of Crown Land Title, dated 29 April 2003. In accordance with this legal title, the Site is identified as Forrest Location 370 on Land Administration Diagram 35619. The previous title is documented as Volume LR3060, Folio 706, Volume LR3060, Folio 708 and Volume LR3059, Folio 579. Information provided on the current Certificate of Title includes a Vesting Order for the Site. In 2003, a Vesting Order (Reference I461275) directed that Forrest Location 370 be vested in and held by the Port Hedland Port Authority. The current Certificate of Title and Vesting Order documentation are provided in **Appendix C**.

3.2 Aerial Photographs

To identify past site use, aerial photographs obtained from Landgate were reviewed, for the following years: 1971, 1976, 1977, 1979, 1985, 1993, 2004 and 2005. In some cases the aerial photographs were shot at high altitude and accordingly the resulting images are at varying scales, making the identification and interpretation of structures and surficial features difficult. A summary of information obtained from the photographs is presented in the following table. Copies of the aerial photographs are provided in **Appendix D**.

Table 1: Aerial Photograph Summary

Date	Map Details	Observations
14 September 1971	*Scale:* 1:250,000 *Photograph:* Black and white	*Site: T*he Site appears to be undeveloped and mangroves appear to cover most of the Site, except where calcarenite formations, a strip in the central portion of the Site, and a small patch of calcarenite near the southern end of Stanley Point are present (these formations are unvegetated). A track is also evident along the northeast side of Utah Point. *Adjacent Sites:* There are roads, cleared areas and some structures to the north of the Site. A berth is located to the northeast and areas of shallow mud, followed by the port are present to the east, south and west of the Site. Port Hedland Town is present to the east and further south and west the areas are predominantly undeveloped, with mudflats, mangroves and creeks. Northwest of the Site is the BHP Finucane Road, connecting Finucane Island to the mainland.
24 September 1976	*Scale:* 1:16,000 *Photograph:* Black and white	*Site:* The Site is in a similar condition to the 1971 photograph. Some debris is visible in the mangroves at the western boundary of the Site, approximately half way between the access road and the end of the point. White exposed calcarenite areas in the un-vegetated regions of the Site are evident in this photograph. *Adjacent Sites:* The surrounding areas are in a similar condition to the 1971 photograph. There has been some development north of the Site. There is some debris in the tidal mud area west of the Site.
4 August 1977	*Scale:* 1:25,000 *Photograph:* Black and white	*Site:* The Site is in a similar condition to the 1976 photograph. The debris on the western side of the Site is still visible. *Adjacent Sites:* The surrounding areas are in a similar condition to the 1976 photograph.
22 July 1979	*Scale:* 1:16,000 *Photograph:* Black and white	*Site:* Only the northern portion of the Site is visible in this photograph. The Site is in a similar condition to the 1977 photograph. Debris is still visible on the western side of the Site. *Adjacent Sites:* The surrounding areas are in a similar condition to the 1977 photograph.
7 July 1985	*Scale:* 1:25,000 *Photograph:* Colour	*Site:* The Site appears to be in a similar condition to the 1977 and 1979 photographs. An access track may be present on the Site in the central, un-vegetated region, but it is difficult to distinguish. The track along the northeast side of Utah Point is better defined than in previous photographs. The debris on the western side of the Site is still visible. *Adjacent Sites:* The surrounding areas are in a similar condition to the 1977 and 1979 photographs. There are more tracks present north of the Site.
4 August 1993	*Scale:* 1:50,000 *Photograph:* Black and white	*Site:* No changes to the Site can be determined in this photograph. *Adjacent Sites:* No changes to the surrounding areas can be determined in this photograph.
31 July 2004	*Scale:* 1:25,000 *Photograph:* Colour	*Site:* The Site appears to be in a similar condition to the 1993 photograph. The track in the central region of the Site can be seen in this photograph. The debris on the western side of the Site is still visible. *Adjacent Sites:* There has been more development to the north of the Site since the 1993 photograph. Some clearing of vegetation immediately north of the Site has occurred. The areas to the east, south and west remain in a similar condition.

Date	Map Details	Observations
29 August 2005	*Scale:* 1:10,000 *Photograph:* Colour	*Site:* The Site is in a similar condition to the 2004 photograph. The debris on the western side of the Site is still visible. *Adjacent Sites:* The surrounding areas are in a similar condition to 2004.

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4. Records Review

A file review was performed at the local and state agencies in an attempt to obtain information regarding past Site and immediate surrounding property land use and activities in an effort to present a complete record of the environmental condition and land use of the Site. The following sections detail the results of the state and local government regulatory file review.

4.1 Town of Port Hedland

In assessing current and proposed land uses for the Site and immediate surrounding properties, an effort was made to determine the zoning criteria. However, based on information obtained from the Town of Port Hedland's website, it appears that a town planning scheme is currently under community consultation. Furthermore, the potential exists that Finucane Island may not be zoned as it is vested directly under the PHPA, and as such, may be designated for harbour purposes only.

4.2 Department of Environment and Conservation

The DEC was established on 1 July 2006, bringing together the Department of Environment (DoE) and Department of Conservation and Land Management (CALM). As part of the historical document search and in accordance with the DEC's *Contaminated Sites Management Series* guidelines, inquiries were made to the DEC on the Contaminated Sites Database and the Reported Sites Register. Furthermore, a search of the CALM Threatened Ecological Community (TEC) database was conducted. The following paragraphs document the results of the DEC regulatory database search

4.2.1 Contaminated Sites Database

The DEC has established a publicly accessible database, identified as the Contaminated Sites Database, which provides recorded information on contaminated sites in WA. Only sites that have been classified by the DEC as 'contaminated-restricted use', contaminated-remediation required', or 'remediated for restricted use' are listed on the database. A review of the database by SKM indicated that the Site is not listed.

4.2.2 Reported Sites Register

Sites that have classifications identified as 'report not substantiated', 'possibly contaminated-investigation required', 'decontaminated', and 'not contaminated-unrestricted use' are separately registered by the DEC on the Reported Sites Register. A request was submitted to the DEC to ascertain whether the Site was on the Reported Sites Register. The DEC responded to the request, and as the information currently held on the Site is insufficient for the DEC to classify it, the DEC was unable to provide a Summary of Records for the Site. A copy of the response is included in **Appendix E**.

4.3 Department of Water

Information regarding registered groundwater bores at the Site and surrounding properties was requested at the DoW. A search was completed of the DoW WIN Database for any sites with registered groundwater bores within a 2.2km radius of the centre of the Site. A map documenting locations of the groundwater bores was provided to SKM and attached as part of **Appendix E**. A review of the DoW map indicated that there are no registered groundwater boreholes on the Site. However, there are three registered locations within a 2.2km radius of the Site. A more detailed review of the DoW map indicates that potentially surface water, and not groundwater, is being assessed at one of these registered locations.

4.4 Heritage

The Pilbara region is home to a number of different indigenous tribes, and is rich in Aboriginal heritage sites. The Aboriginal tribes indigenous to the Port Hedland area are the Kariyarra and Nyamal peoples, with these people maintaining a long standing association with the area.

Various studies have been undertaken throughout the Pilbara and the Port Hedland area to identify the location of Aboriginal heritage sites, with several sites identified on Finucane Island. One significant burial site has been identified within the BHPBIO site on the island, with indigenous representatives requiring continued access to the coastline and beaches from BHPBIO.

Previous surveys have identified an Aboriginal heritage site on Finucane Island, within the proposed footprint of the development. The site, named ‘Sounness Drive Camp’ requires further investigation to clarify the exact location and characteristics of the site. For further information, refer to the *PER Environmental Scoping Report* (SKM, 2007).

5. Environmental Setting

This section discusses the general physical and environmental setting of the Site and surrounding area to provide a background against which to relate the specific physical and environmental characteristics presented in this PSI.

5.1 Pilbara Region and Port Hedland

The Pilbara region extends over an area of approximately 500,000km^2, with the coastal extent stretching from the Exmouth Gulf to Cape Keraudren, north of Port Hedland and supports a diverse range of marine and terrestrial environments, many of which are isolated and rugged and are recognised for their high conservation value. Port Hedland is a major town and one of three ports operating in the Pilbara region.

Through public consultation, the DoE have developed environmental quality objectives (EQO) and have created a set of environmental values (EV) that should be applied throughout the region. From these parameters a marine environmental quality management plan is being developed.

Finucane Island has been defined as an area of high ecological protection. The limits of acceptable change designated to this area require that “very low levels of contaminants” are to be detected, and these levels should not cause any “detectable change from natural variation”. The inner Port Hedland harbour has been defined as an area of moderate ecological protection.

5.2 Climate

The Pilbara region is located in the arid-tropics, with low and variable rainfall experienced throughout the area. Bureau of Meteorology (BoM, 2007) data indicates that annual rainfall totals vary from 250 millimetres (mm) to 400mm, with many years reporting no significant rainfalls. The area experiences hot temperatures and high humidity during the summer months. Monthly average maximum temperatures range from approximately 30 degrees Celsius (°C) to 37°C.

The coastline between Port Hedland and the Exmouth Gulf is the most cyclone prone in Australia, with several severe cyclones causing significant damage in the past 30 years. These cyclones occur predominantly between January and March and account for the majority of rainfall in the region.

5.3 Topography

The Pilbara landscape is typically flat and highly weathered with low rangelands occurring in the interior, representing a landscape that has remained largely unchanged for 100 million years. The coast has generally low relief with gently sloping beaches, numerous headlands and many offshore islands. The inner, near shore marine waters are relatively turbid, being subject to disturbance by strong tidal flows and episodic run off from adjacent rivers.

Port Hedland is located at the confluence of five creeks which create a natural anchorage at the port. Port Hedland area consists of flat sandy lowlands, with broad areas of bare coastal mudflats, intertidal mudflats and tidal creeks, and a significantly altered open harbour at Port Hedland.

The topography of the Site is flat and low-lying. The central area, otherwise referred to herein as the Central Calcarenite Area, has an elevation of approximately 7.5m Chart Datum. The elevation drops to the western and eastern side of the Site, to elevations of approximately 4.0m and 4.5m respectively (Coffey, 2007).

The highly variable nature of rainfall in the region results in varied surface water flows, with fresh water runoff tending to occur as sheet flow, particularly during high rain periods in the wet season (Hope Downs Management Services, 2002).

5.4 Ecology

Port Hedland is surrounded by a large area of arid zone mangroves associated with the creeks systems running into the harbour. Mangroves are conspicuous and extensive in association with muddy substrates, in some case forming small complex mangals (i.e. a community of mangroves). These arid mangals are of great scientific significance as they are rarely found elsewhere (Semeniuk, 1993). The whole mangrove system in the area is considered important as it maintains the nutrient cycles and productivity of the coastal zone.

The mangroves prevent coastal erosion and the subsequent silting of offshore reefs, as well as providing nurseries for some juvenile marine species (CSIRO, 2001). These mangroves are specifically protected through the EPA Guidance Statement No. 1, the *Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline* (EPA, 2001). The mangroves are also protected under the EPA Guidance Statement No. 29, *Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment* (EPA, 2004).

The mangroves in the vicinity of the proposed development area have been surveyed previously and the species and assemblages were shown to follow similar patterns to those observed elsewhere in the region (Hope Downs Management Services, 2002).

Extensive intertidal flats are usually situated between the fringing mangroves and the marine waters. These communities sustain a rich diversity of flora and fauna including burrowing invertebrates and provide feeding grounds for migratory birds.

A wide range of coral reef communities, seagrass meadows and algal mats are also found in the coastal environment surrounding Port Hedland. These communities support a plethora of organisms including turtles, dugongs and herbivorous fish.

5.5 Geology

The Port Hedland area is located on the Holocene-age Bossut Formation, a body of unconsolidated sedimentary soils described as sandy calcarenite, oolite and calcilutite, which outcrops discontinuously near the coast. Locally, the calcarenite is often referred to as "limestone". The dune, beach ridge, beach and offshore bar deposits are predominantly marine with the exception of the barrier dune system which is of Aeolian origin. The geology of the Site and surrounding area is depicted on the Port Hedland 1:50,000 geological sheet indicate younger beach and dune shelly sand and mobile dunes.

A previous geotechnical investigation of the Site determined that the subsurface profile (in the area of the proposed stockyards) consists of mangrove mud, which was not encountered to greater than 1.7m below the surface, and calcarenite. The mangrove mud was described as brown to grey, sandy clay to clayey sand with a soft consistency. The calcarenite was described as well-cemented, coarse grained and white (Coffey, 2007).

5.5.1 Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring wetland soils and unconsolidated sediments that contain iron sulfides that, when exposed to atmospheric oxygen in the presence of water, form sulfuric acid. ASS form in protected low energy environments such as barrier estuaries and coastal lakes and commonly occur in low lying coastal lands, marine muds and sands. In their undisturbed state these soils are benign and are therefore referred to as Potential Acid Sulfate Soils (PASS). From mapping undertaken to date, the DEC have recorded the highest risk areas of encountering PASS as localities generally below 5 metres Australian Height Datum (AHD).When disturbed, the PASS can react with the atmosphere. From this reaction sulfuric acid can be produced. As a consequence of this acid production, metals may be released from the soils into underlying groundwater or other nearby aquatic environments. These metals include iron, aluminium, manganese and other heavy metals. Such disturbed soils are referred to as Actual Acid Sulfate Soils (AASS).

Potential Acid Sulfate Soils have been recorded at the Site and recommendations have been made, by Coffey Geotechnics in 2007, that an ASS management plan (ASSMP) should be devised prior to the initiation of any ground disturbing activities being commenced. An ASSMP should establish management procedures and controls to be followed by the project team when encountering potential acid sulfate soils at the Site. The main objectives of the plan should include to:

- Minimise disturbance of the soil in known ASS areas;
- Contain, mitigate and avoid impacts from ASS;
- Provide appropriate management procedures for ASS disturbed by the project activities; and
- Achieve compliance with regulatory requirements as they relate to ASS.

It should be noted that any management plan requires the continuing involvement of an experienced ASS consultant to monitor the correct implementation of this plan and address changes in site conditions. The ASSMP must be prepared in accordance with the DEC Acid Sulfate Soils Guidelines Series (DEC, 2006).

5.6 Hydrogeology

Regionally, a shallow water aquifer system exists in recent and Aeolian unconsolidated sediments (shelly, silty sand). The water quality in this system is brackish to saline. Regional hydraulic gradient is interpreted to be to the north towards the Indian Ocean (PB, 2002). The water level in this aquifer is reported to be tidally influenced (PB, 2002). Tidally affected hydraulic pressures can build up in the aquifer where confined by marine clays. Where confined the water quality is more saline than in the unconfined areas (PB, 2002).

Groundwater levels at the Site were measured during a previous geotechnical investigation completed within the region of the proposed stockyards. In this area, the depth to groundwater ranged from 0.1m to 0.9m, and the approximate level of groundwater ranged from 5.2m to 7.9m Chart Datum (Coffey, 2007). From the limited groundwater levels measured during this investigation, the direction of groundwater flow could not be inferred.

The Site specific groundwater quality is currently unknown, as no studies investigating this in the immediate area of the Site are known to date.

5.7 Surface Water

The Port Hedland area consists of broad areas of intertidal and coastal mudflats and mangroves, which are periodically inundated by seawater during storm surges or particularly high tides. This inundation plays a key role in reducing the salinity of the groundwater adjacent to the creeks, therefore enabling the mangroves to survive. There are also numerous intertidal creeks which converge at the port, including West Creek, South West Creek, South Creek, South East Creek and Stingray Creek.

The east, south and western boundaries of the Site are all intertidal areas that are submerged during high tides. Further east of the Site is the deeper part of the Port. West Creek runs along the western boundary of the Site, and converges with South West Creek near the southern end of the Site.

5.8 Air Quality

Air quality is a key concern for residents in Port Hedland, primarily due to the proximity of residential areas and other sensitive receptors to port operations. In particular, dust emissions from manganese and chromium ores have raised public health concerns due to the potential toxicological impacts of exposure to elevated concentrations of these metals (discussed further in **Section 6**).

A recent report commissioned by the Department of Health, Western Australia, showed that although manganese was present in particulates in the Port Hedland area, there was “no evidence that manganese was of particular importance” with respect to human health (DOH, 2006). This study also showed that iron oxide particulates had little impact on human health. However, the study did not assess potential impacts of chromite ore being transported through Port Hedland.

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6. Preliminary Conceptual Site Model

A Conceptual Site Model (CSM) is generally defined as an organised approach, using narrative, pictorial, and/or graphical representation to describe existing site conditions in relation to suspected or known contamination. To effectively evaluate contaminant distribution and migration at the Site, it is necessary to develop a CSM which describes the condition and processes at the Site that are likely to influence contaminant fate and transport and explain the observed distribution pattern of contaminants in the subsurface.

The CSM is fundamental to the data evaluation process and is used to ensure that all relevant contaminant sources, release mechanisms, affected environmental media, exposure and migration pathways, and targets and receptors (Source, Pathway, and Receptor analysis) are properly evaluated and used to determine that the data collected may be appropriately employed as part of the risk assessment. As the CSM is an evolving process, it is intended to expand, change, and become more comprehensive through the progression of assessments and investigations.

Potential Areas of Concern (PAOC)s are identified as either geographic areas where activities were conducted or are being conducted that have the potential to affect the quality of soil and/or groundwater or are known to contain impacted media. In the context of this PSI, a PAOCs would refer to the presence or likely presence of contamination resulting from an existing release, a past release, or material threat of a release of any hazardous substances or petroleum products into the ground, or groundwater at the Site. Primary release mechanisms include infiltration of contaminants into the soil and leaching of contaminants from the soil, with transport to shallow groundwater, or transport and/or degradation of constituents in groundwater, with subsequent dilution, dispersion, adsorption, and/or other attenuation mechanisms occurring. Known Areas of Concern (AOCs) are areas in which known contamination is present. Areas of Interest (AOIs) are those areas that require further investigation to determine status but are not considered to be high risk.

In respect of the findings of this study, and notwithstanding the presence of Potential Acid Sulfate Soils, the key areas of concern being considered by this report relate to future activities that have potential environmental risks associated with them.

6.1 Potential Areas of Concern

Based on the information currently available regarding the planned construction of infrastructure on the Site, five areas of future PAOCs have been identified. General concerns are also discussed, which have arisen based on the current construction design of the proposed facilities. These future PAOCs are presented in **Figure 3** and should be viewed in conjunction with this text.

6.1.1 PAOC1: Settlement Pond

The settlement pond, connected to sumps situated at the stockyards via drains, will be developed along the north-eastern portion of the Site. The primary risk from the settlement pond is the potential transfer of sediment and potential dissolved contaminants from the settlement pond into the adjacent marine environment during high wind or storm events. However, assuming that the construction and operation of this facility is managed appropriately, the environmental impact of this activity is considered to be minimal. The potential impact from ore materials is discussed more fully in PAOC3.

6.1.2 PAOC2: Workshop and Fuel Storage Facility

The storage of fuels associated with the proposed development is a PAOC due to the potential for release of fuels or oils into the soil and water or marine environment. With the adoption of an appropriate environmental management plan the potential for releases will be minimised. Management strategies should comply with all relevant guidelines and regulations and should include protective measures such as bunding and spill response kits.

6.1.3 PAOC3: Ore Stockpiles

The proposed development will provide a storage facility for chromium, manganese and iron ores.

Chromium ore – Chromite ($FeCr_2O_4$)

Manganese ore – Manganese oxide (MnO_2)

Iron ores – Iron Oxide (Fe_2O_3 or Fe_3O_4) and Titanium Iron Oxide (Ti-Fe_3O_4 or Fe_2TiO_4)

It has been assessed that the key potential contaminants at the Site, based on the proposed stockpiles, are chromium (Cr) and manganese (Mn). The following sections provide details of these two elements and discuss their occurrence, potential transformations in the environment and the potential impact they may have on the site and surrounding area. The assessment of the potential risks relates to the potential for the contaminants of concern being leached from the ores under possible environmental conditions and assumes that risks from transport of contaminants attached to soil and/or sediments will be managed on-site through the use of sediment traps.

Chromium

Chromium generally exists in two forms in the environment: chromium (III) and chromium (IV). Chromium (III) compounds are not usually considered health hazards. Chromium (III) is an essential nutrient that helps the body use sugar, protein, and fat. However, hexavalent chromium (i.e. chromium (VI)) compounds can be toxic if orally ingested or inhaled. Most chromium (VI) compounds are irritating to eyes, skin and mucous membranes. Chronic exposure to chromium (VI)

compounds can cause permanent eye injury, unless properly treated. Chromium (VI) is an established human carcinogen.

In chromite, (chromium-iron oxide - $FeCr_2O_4$), chromium exists as chromium (III). Chromium (III) is relatively insoluble, in contrast to chromium (VI) which is the most mobile form of chromium in the environment (Becker et al., 2006, Kotas & Stasicka, 2000). If present in aqueous form in soil or sediments, chromium (III) usually becomes strongly attached to soil particles and organic matter, and therefore generally has limited solubility and/or leachability in this media. Similarly, if chromium (III) is not sorbed to soil particles and organic matter it will generally hydrolyse to the hydroxide and precipitate (Kimbrough et al., 1999). However, chromium (III) nitrates, sulfates and chlorides can also form which are soluble.

There is much evidence to show that chromium can be taken up by biota from the air, water and soil. Chromium (III) is considered to have moderate acute toxicity to aquatic life and whereas chromium (VI) is considered to have high acute toxicity to aquatic life. Both chromium (III) and chromium (VI) are considered to have high chronic toxicity to aquatic life (DEW, 2005).

In general, biological transformations generally reduce chromium (VI) to chromium (III) and chromium predominantly occurs as chromium (III) in natural environments. However, in sea water chromium (VI) is the dominant form of chromium, which usually occurs at extremely low concentrations (DEW, 2005).

Manganese

Manganese is an essential trace element nutrient that plays a role in bone mineralization; protein and energy metabolism; metabolic regulation; cellular protection from damaging free radical species; and, the activation of enzymes (ATSDR, 2000). However, long term exposure to manganese dust is known to be associated with neurological damage (Myers et al., 2003a, Myers et al., 2003b, Lucchini et al., 1999).

Manganese commonly exists as Mn(II), Mn(III) and Mn(IV). In manganese oxide (MnO_2), manganese exists as manganese (IV). Manganese oxide is insoluble in water and only soluble in acidic conditions (DEW, 2004). In general, manganese is considered to have moderate acute and chronic toxicity to aquatic life (DEW, 2004).

Assessment Criteria

Table 2 below provides a summary of guideline concentrations for chromium (III), chromium (VI) and manganese in drinking water, fresh water and marine water, as given in the National Health and Medical Research Council (NHMRC) Australian Drinking Water Guidelines (2004) and the ANZECC Guidelines for Fresh and Marine Water Quality (2000).

- **Table 2: Selected Chromium and Manganese Guidelines**

Guideline	Chromium (III)	Chromium (VI)	Manganese
NHMRC Australian Drinking Water Guidelines (2004)	NA	0.05 mg/L (health)	0.5 mg/L (health) 0.1 mg/L (aesthetic)
ANZECC Fresh Water Quality Guidelines (Aquatic Ecosystems) (2000)	NA	0.006 mg/L* 0.00001 mg/L**	2.5 mg/L* 1.2 mg/L**
ANZECC Marine Water Quality Guidelines (Aquatic Ecosystems) (2000)	0.050 mg/L* 0.008 mg/L**	0.020 mg/L* 0.00014 mg/L**	NA

NA: Not Applicable, no guideline given due to insufficient data.

* Values quoted for 90% level of species protection, which is considered appropriate for ecosystems assigned a moderate level of ecological protection.

** Values quoted for 99% level of species protection, which is considered appropriate for ecosystems assigned a high level of ecological protection.

Leaching of Chromium and Manganese

Port Hedland Port Authority commissioned URS Australia Pty Ltd to undertake a chromium and manganese toxicity study during 2006. The scope of this study consisted of leaching the chromium and manganese ores in distilled water and comparing the concentrations of chromium (III) and manganese against available guidelines to assess bioavailability to marine organisms. The study showed that chromium (III) and manganese did leach from both ores, yet leachable concentrations of chromium (III) and manganese were below ANZECC guidelines (marine guidelines for chromium and fresh water guidelines for manganese) for 99% species protection (refer to **Appendix F**).

However, as chromium (VI), the more toxic species, was not assessed as part of the URS investigation, the determination was made to undertake further evaluation of chromium (III), chromium (VI) and manganese in the ores to be stored at the Site. As part of this evaluation one primary and one duplicate sample were collected by PHPA from the chromium and manganese ores and submitted to ALS for laboratory analysis. The sample identifiers for the ores were as follows:

Chromium Ore

Primary: SKM-Ore-C1

Duplicate: SKM-Ore-C2

Manganese Ore

Primary: SKM-ORE-M1

Duplicate: SKM-ORE-M2

To assess the potential leachability of the ores under various environmental conditions, each of the ore samples was leached in:

- Seawater, collected from the northern end of PHPA No. 1 Wharf;
- Acetate Extract (pH 5); and
- Borate (pH of 9.2).

In addition, total metal concentrations in the seawater collected from the Port Hedland harbour were analysed (Refer to **Table 3)**. Notably, the concentration of chromium (VI) in the seawater was also analysed but was not detectable above the laboratory recording limit of 0.01 mg/L (Refer to **Appendix F**).

- **Table 3: Total Metal Concentrations in Seawater.**

Metals	Concentration (mg/L)
Aluminium	0.12
Arsenic	ND
Cadmium	ND
Chromium	0.001
Copper	0.007
Iron	0.15
Lead	ND
Manganese	0.006
Nickel	0.005
Zinc	0.006

ND: Concentrations of metals are not detectable above the limit of recording for the analysis.

For all ore samples leached in seawater, all chromium (III) concentrations recorded were below the detection limit. Ore samples SKM-Ore-C1 and SKM-Ore-C2, recorded manganese concentrations of 0.10 mg/L and 0.11 mg/L respectively (Refer to **Appendix F**). These manganese concentration levels are well below the NHMRC drinking water guideline for health of 0.5 mg/L and the ANZECC fresh water quality guideline of 2.5 mg/L (90 %) and 1.2 mg/L (99%).

With the exception of ore sample SKM-Ore-M1, for all ore samples leached in seawater chromium (VI) concentrations were not detected above the laboratory recording limit (of 0.01 mg/L). The concentration of chromium (VI) recorded in sample SKM-Ore M1 was 0.02 mg/L (Refer to

Appendix F). This level exceeds the ANZECC marine water quality guideline of 0.020 mg/L (90%) and 0.00014mg/L (99%) but is below the NHMRC drinking water guideline of 0.05 mg/L.

Chromium (III) concentrations for manganese ore samples leached in acetate were not detectable above the laboratory limit (0.1 mg/L). The chromium (III) concentrations recorded in both chromium ore samples leached in acetate was 0.1 mg/L. Manganese concentrations for ore samples, SKM-Ore-M1, SKM-Ore-C1 and SKM-Ore-C2, leached in acetate were 0.6, 1.2 and 2.5 mg/L. (For ore sample SKM-Ore-M2 manganese concentration was not detectable above the laboratory recording limit of 0.1 mg/L). Chromium (VI) was not detected above the laboratory recording limit (of 0.01 mg/L) in all ore samples to leached in acetate. (Refer to **Appendix F**)

Chromium (III) and manganese concentrations from all ore samples leached in borate were not detectable above the laboratory recording limit of 0.1 mg/L. Similarly, chromium (VI) concentration were not detectable above the recording limit (0.01 mg/L), with the exception of SKM-Ore-M1 which recorded a concentration of 0.01 mg/L.

Despite the limitations of the data, these results collectively show that there is potential for chromium (III), chromium (VI) and manganese to be leached from chromium and manganese ores. Consequently, there is a potential for these contaminants to be leached from stockpiles and interact with the environment.

However, the interaction of leachates with the underlying groundwater and/or marine water will be affected by a number of variables that will affect the end concentrations reaching these receptors including:

- quantities of leachate produced;
- surface area over which the run-off will be distributed;
- standing time or run-off speed from source to collection;
- permeability of surface material;
- depth to groundwater; and
- dilution in water applied to the site, during infiltration and/or actually in the receptive water bodies.

It is also expected the risk of these contaminants impacting on the environment will be substantially reduced by limiting the permeability of fill material used for the construction of the stockpile site (to 10^{-7} m/s or lower), by ensuring all surface water runoff is captured and treated within the stockpile area, and by ensuring appropriate management of sediments.

6.1.4 PAOC4: Truck Wash Facility

The operation of this facility at the Site is not considered as a risk to the environment on the proviso that such operations are appropriately managed. For instance, the use of surfactants at the truck wash could limit the effectiveness of any plate separation techniques used for waste management and should be considered in the environmental management plan for the site.

6.1.5 PAOC5: Ablutions including Water Storage and Treatment

The operation of this facility at the Site is not considered as a risk to the environment on the proviso that such operations are appropriately managed.

6.2 General Concerns - Construction and Related Activities

Any fill material brought to site should be appropriately validated prior to its use to mitigate any environmental impact from its emplacement. It is currently proposed that no excavation will occur on the site. All construction will occur into the imported fill.

6.3 Offsite Activities

Transport of dust, surface water and groundwater from the adjacent BHPBIO facility hold the potential to pollute the Site. From the desk study undertaken as part of this PSI no documentation pertaining to pollution of the environment from the operations at the BHPBIO facility were recorded.

The following table summarises the results of the preliminary conceptual site model.

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PAOC Number	PAOC Locality (Grid Location)	Activity (Primary Source)	Release Mechanism to Media	Secondary Source (Media)	Contaminant	Exposure Pathway	Receptor	Hazard
1	Northern portion	Water and fines within the settlement pond	Overflow, leak	Contaminated soils	MnO_2 and $FeCr_2O_4$	Dermal contact with Impacted Soils (Secondary Source), Dermal contact with water and sediments in ponds;	Human	Lethargy, Loss of appetite Neurological malfunction
1	Northern Portion	Settlement pond for ores fines	Overflow, leak	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Suspension in surface water run off	Groundwater	Degradation of water quality
1	Northern portion	Settlement pond for ores fines	Overflow, leak	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Surface water run off , groundwater discharge, aeolian transport	Marine environment	Degradation of water quality
1	Northern Portion	Settlement pond for ores fines	Overflow, leak	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Surface water run off , groundwater discharge, aeolian transport	Marine environment	Degradation of water quality impact on flora and fauna (smothering)
1	Northern portion	Settlement pond for ores fines	Overflow, leak	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Surface water run off , groundwater discharge, aeolian transport	Mangroves	Possible vegetative die back

PAOC Number	PAOC Locality (Grid Location)	Activity (Primary Source)	Release Mechanism to Media	Secondary Source (Media)	Contaminant	Exposure Pathway	Receptor	Hazard
2	Northern portion	Workshop and fuel storage	Leaks and spills	Contaminated sediments	Diesel Lubricants Hydraulic oils Grease Solvents	Volatilisation Inhalation	Human	Breathing difficulties Dizziness Nausea Possible carcinogens
2	Northern portion	Workshop and fuel storage	Leaks and spills	Contaminated sediments	Diesel Lubricants Hydraulic oils Grease Solvents	Dermal contact	Human	Breathing difficulties Dizziness Nausea Possible carcinogens
2	Northern portion	Workshop and fuel storage	Leaks and spills	Contaminated sediments	Diesel Lubricants Hydraulic oils Grease Solvents	Surface water run off , groundwater discharge,	Groundwater	Degradation of water quality
2	Northern portion	Workshop and fuel storage	Leaks and spills	Contaminated sediments	Diesel Lubricants Hydraulic oils Grease Solvents	Surface water run off , groundwater discharge, air transport	Marine environment	Degradation of water quality, impact on flora and fauna
2	Northern portion	Workshop and fuel storage	Leaks and spills	Contaminated sediments	Diesel Lubricants Hydraulic oils Grease Solvents	Surface water run off , groundwater discharge, air transport	Mangroves	Possible vegetative die back
3	Central portion of site	Ore stockpiling	Dust	Contaminated surface run off	MnO_2 and $FeCr_2O_4$	Dermal contact	Human	Lethargy, Loss of appetite Neurological malfunction

PAOC Number	PAOC Locality (Grid Location)	Activity (Primary Source)	Release Mechanism to Media	Secondary Source (Media)	Contaminant	Exposure Pathway	Receptor	Hazard
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Dermal contact	Human	Lethargy, Loss of appetite Neurological malfunction
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Inhalation	Human	Lethargy, Loss of appetite Neurological malfunction
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Suspension in surface run off	Groundwater	Degradation of water quality
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Leaching from solids/sediments	Groundwater	Degradation of water quality
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Suspension in surface run off	Marine environment	Degradation of water quality
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Suspension in surface run off	Marine environment	impact on flora and fauna
3	Central portion of site	Ore stockpiling	Dust	Contaminated sediment	MnO_2 and $FeCr_2O_4$	Aeolian input, Surface water and groundwater transport	Mangroves	Possible vegetative die back
3	Central portion of site	Ore stockpiling trucks	Leaks and spills	none	Diesel Fuel	Volatilisation; vapour transport through air	Human	Dizziness, nausea Potential carcinogen
3	Central portion of site	Ore stockpiling trucks	Leaks and spills	Contaminated sediment	Diesel Fuel	Surface water run off	Groundwater	Degradation of water quality

PAOC Number	PAOC Locality (Grid Location)	Activity (Primary Source)	Release Mechanism to Media	Secondary Source (Media)	Contaminant	Exposure Pathway	Receptor	Hazard
3	Central portion of site	Ore stockpiling trucks	Leaks and spills	Contaminated sediment	Diesel Fuel	Surface water run off Groundwater discharge	Marine environment	Degradation of water quality, impact on flora and fauna
3	Central portion of site	Ore stockpiling trucks	Leaks and spills	Contaminated sediment	Diesel Fuel	Surface water run off Groundwater discharge	Mangroves	Possible vegetative die back
4	Central portion of site	Truck wash facility	Runoff, spills and leaks	Contaminated sediment	Diesel Fuel lubricants hydraulic fluid MnO_2 and $FeCr_2O_4$ Surfactants	Dermal contact inhalation	Human	Dizziness Nausea Potential carcinogen
4	Central portion of site	Truck wash facility	Runoff, spills and leaks	Contaminated sediment	Diesel Fuel lubricants hydraulic fluid MnO_2 and $FeCr_2O_4$ Surfactants	Surface water run off Groundwater discharge	Groundwater	Degradation of water quality
4	Central portion of site A2	Truck wash facility	Runoff, spills and leaks	Contaminated sediment	Diesel Fuel lubricants hydraulic fluid MnO_2 and $FeCr_2O_4$ Surfactants	Surface water run off Groundwater discharge	Marine environment	Degradation of water quality, impact on flora and fauna

PAOC Number	PAOC Locality (Grid Location)	Activity (Primary Source)	Release Mechanism to Media	Secondary Source (Media)	Contaminant	Exposure Pathway	Receptor	Hazard
4	Central portion of site A2	Truck wash facility	Runoff, spills and leaks	Contaminated sediment	Diesel Fuel lubricants hydraulic fluid MnO_2 and $FeCr_2O_4$ Surfactants	Surface water run off Groundwater discharge	Mangroves	Possible vegetative die back
5	Central portion of site A2	Ablutions including water storage and treatment	Runoff, spills and leaks	Contaminated sediment	Chlorine Ammonia Chloramine Organic waste Pathogens i.e. E-coli	Dermal contact	Humans	Burns Nausea Breathing difficulties Potential carcinogen
5	Central portion of site A2	Ablutions including water storage and treatment	Overflows and leaks	Contaminated sediment	Chlorine Ammonia Chloramine Organic waste Pathogens i.e. E-coli	Leaching through sediments	Groundwater	Degradation of water quality,
5	Central portion of site A2	Ablutions including water storage and treatment	Overflows and leaks	Contaminated sediment	Chlorine Ammonia Chloramine Organic waste Pathogens i.e. E-coli	Surface water run off Groundwater discharge	Marine Environment	Degradation of water quality, impact on flora and fauna
5	Central portion of site A2	Ablutions including water storage and treatment	Overflows and leaks	Contaminated sediment	Chlorine Ammonia Chloramine Organic waste Pathogens i.e. E-coli	Surface water run off Groundwater discharge	Mangroves	Possible vegetative die back

7. Conclusions and Recommendations

SKM has performed a PSI of the property identified as Utah Point and Stanley Point, a 22 hectare (ha) portion of land located along the south-eastern portion of Finucane Island. Finucane Island is part of the port of Port Hedland, which is situated within the Pilbara region of WA. The PSI has been completed in general accordance with the DEC guideline entitled, *Reporting of Site Assessments* (December 2001). This PSI report has been prepared to document potential impacts from current and future operations conducted at the Site.

Based on the information derived as part of this PSI, the Site lies on Crown Land within the local government area of Port Hedland, and is vested with the Port Hedland Port Authority. The Site is currently undeveloped and a review of historical aerial photographs indicated that the Site was undeveloped in 1971 and remained in a similar condition up until the most recent photograph, shot in 2005. A review of the DEC Contaminated Sites database determined that the Site is not classed as a contaminated site.

During the site visit, conducted on 26 April 2007, it was observed that the Site consists of two regions; a calcarenite area, and a mangrove area. The calcarenite area is a hard substrate zone sparsely covered in shrubs. The mangrove area surrounds the calcarenite area to the east, south and west. Dense foliage and mud in the mangrove area reduced access to the waters edge during the Site visit. The only structures observed on Site were three beacon towers and remnants of a fence at the northern edge of the calcarenite area.

Given the information obtained as part of this PSI, SKM has identified five future PAOCs at the Site. These PAOCs are identified as follows:

- PAOC1: Settlement pond
- PAOC2: Workshop and fuel storage facility
- PAOC3: Ore stockpile
- PAOC4: Truck Wash facility
- PAOC5: Ablutions including water storage and treatment

In order to confirm that the quality of superficial and subsurface media at the Site has not been impacted by adjacent industrial activities and to provide baseline data, further site investigations are currently in progress. These investigations include sampling of superficial and subsurface soils, installation of groundwater bores and groundwater monitoring. Groundwater monitoring will be undertaken periodically to establish a baseline dataset and to monitor target analytes, such as manganese, chromium and other heavy metals. The findings of further investigations and groundwater monitoring will be reported separately.

The primary risk to the environment that has been identified as part of this PSI is the potential leaching of chromium and manganese from stockpiles and subsequently entering the underlying groundwater or adjacent marine environment.

The risk of these contaminants impacting on the environment will be substantially reduced by limiting the permeability of fill material used for the construction of the stockpile site by ensuring all surface water runoff is captured and treated within the stockpile area, through geotechnical barrier lining of potential risk areas, and by ensuring appropriate management of sediments. It is recommended that each of these design and management factors be taken into careful consideration during both construction and operations of the Utah Point Berth Project.

In the event that, during abnormal weather events or other emergency, sediment or stored water from the settlement pond enters the marine environment it is considered that the greatest risk exists from the turbidity generated by the introduction of sediments rather than the potential for leaching to take place of metals including manganese and chromium. It is therefore considered that the management systems to be included in the operations of the Site, which will manage the quantities of sediment or water stored at any given time particularly during seasons of extreme weather, will mitigate the potential for significant harm occurring to the environment.

Furthermore, as the levels of leaching potential are relatively low, and given that the background levels of metals in the seawater around the Site are low or below detection limits, the introduction of any dissolved metals will be significantly diluted by the receiving waters. As the results for hexavalent chromium are twice the level of reporting for sample SKM-Ore-M1, (based on a more conservative fresh water level), the dilution factor from the settling ponds to the adjacent waters, (inner harbour) is 2:1 mg/l. The total volume of the settling ponds is 3.542 mega litres, whilst the volume of the inner harbour is approximately 15-20 giga-litres at low tide; not including extreme cyclonic events which would significantly increase the flow, dispersion and volume size of the inner harbour. Therefore the dissolved hexavalent chromium will be sufficiently diluted to mitigate the influence of this metal on the marine environment and this is considered unlikely to increase metal concentrations to potentially hazardous levels.

The management of the facility should include for the regular maintenance of storage ponds and for the monitoring of receiving waters to maintain a watching brief on background environmental conditions.

8. References

ATSDR – see Agency for Toxic Substances and Disease Registry

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SKM – see Sinclair Knight Merz

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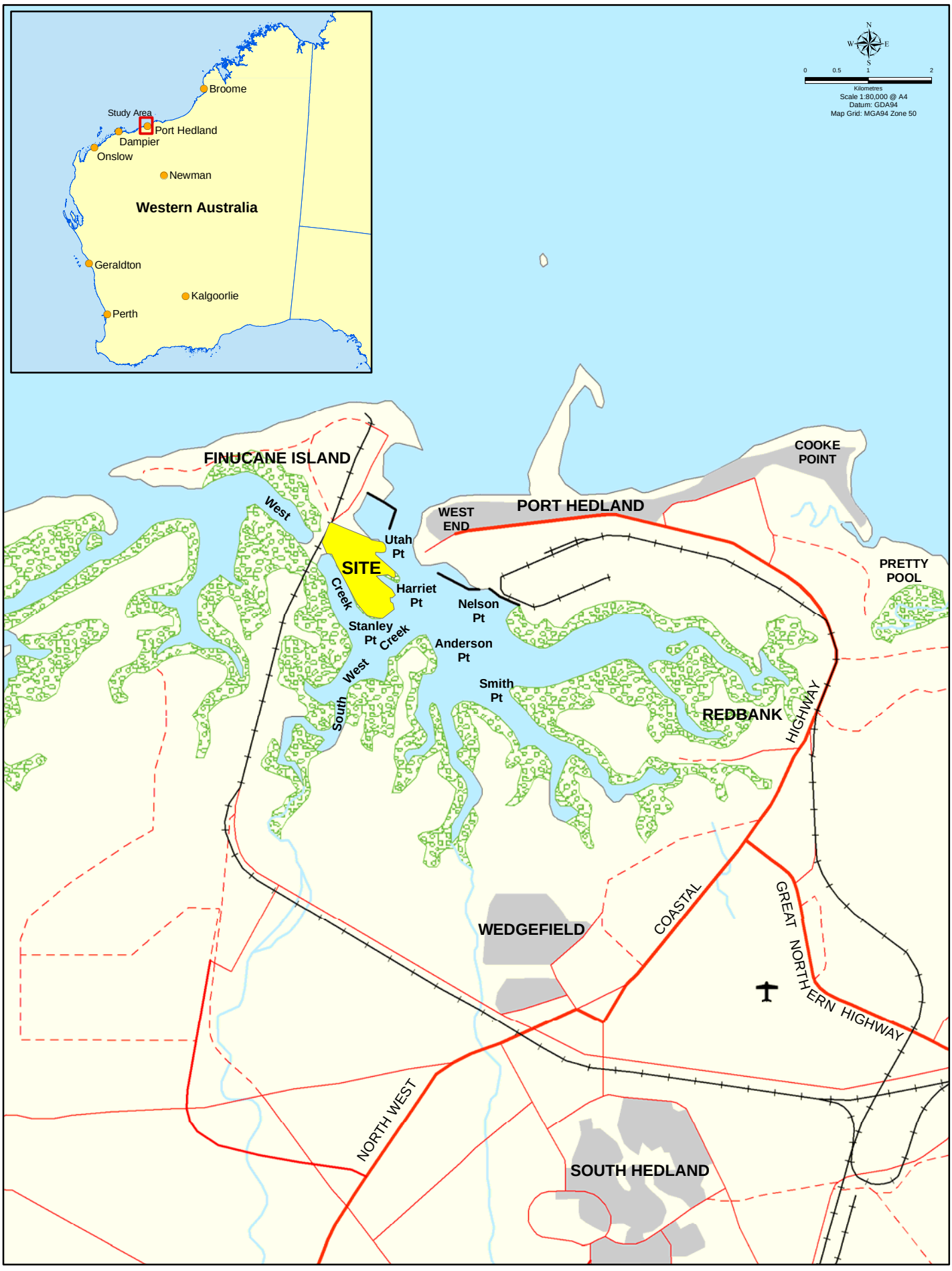
Appendix A Figures



SKM

Sinclair Knight Merz
263 Adelaide Terrace, Perth WA Australia 6001
Ph: 08 9268 4500 Fax: 08 92689 9625
www.skmconsulting.com

Client
Port Hedland Port Authority

Project
Utah Point Berth Project

Drawing Title
Locality Map

Drawing No.
Figure 1

Revision No. 0
Date: 24.05.07
Project WV03278

I:\WVES\Projects\WV03278\Technical\Disciplines\600 Dwgs and Images\610 GIS\ArcMap\Figure1_LocalityMap.mxd

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263 Adelaide Terrace, Perth WA Australia 6001
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Client
Port Hedland Port Authority

Project
Utah Point Berth Project
Preliminary Site Investigation

Drawing Title
Study Area

Drawing No.
Figure 2

Revision No. C
Date: 16.11.07
Project WV03278

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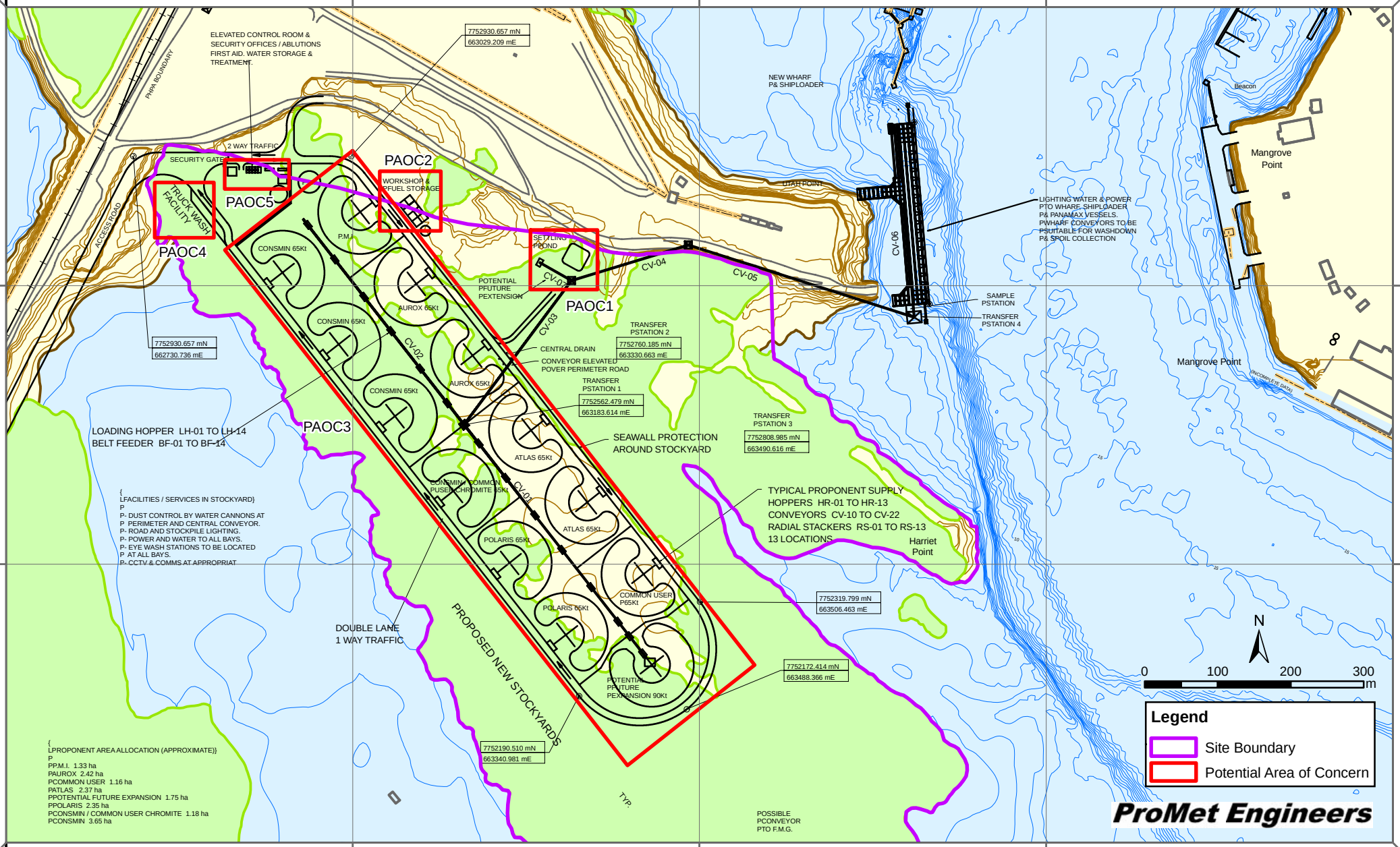

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Sinclair Knight Merz
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www.skmconsulting.com

Client
Port Hedland Port Authority

Project
Utah Point Panama Berth Project
Preliminary Site Investigation

Drawing Title
Development Plan and Future Potential Areas of Concern

Drawing No.
Figure 3

Revision No. B
Date: 24.05.07
Project WV03278

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Appendix B Photographic Documentation

APPENDIX B – PHOTOGRAPHIC DOCUMENTATION

Photograph 1: View of the access road on Site.

Photograph 2: View of the vegetated central calcarenite area of the Site.

APPENDIX B – PHOTOGRAPHIC DOCUMENTATION

Photograph 3: View of the base of one of the beacon towers on Site.

Photograph 4: View of blue metal observed in the central portion of the Site.

APPENDIX B – PHOTOGRAPHIC DOCUMENTATION

Photograph 5: View of mangroves on the Site.

Photograph 6: View of algal mat growth on Site.

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Appendix C Certificate of Title

REGISTER NUMBER	
370/DP35619	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

VOLUME LR3118 FOLIO 753

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 370 ON DEPOSITED PLAN 35619

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: VESTED UNDER STATUTE

PRIMARY INTEREST HOLDER: PORT HEDLAND PORT AUTHORITY OF POST OFFICE BOX 2, PORT HEDLAND
(XE I461275) REGISTERED 29 APRIL 2003

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. I461275 VESTED. VESTING PURSUANT TO SECTION 25 (2)(B) PORT AUTHORITIES ACT 1999. REGISTERED 29.4.2003.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP35619 [SHEET 1,2,3,4].
PREVIOUS TITLE: LR3060-706, LR3060-708, LR3059-579.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: TOWN OF PORT HEDLAND.

NOTE 1: I457759 CORRESPONDENCE FILE 03178-1969-01RO
NOTE 2: ALTERNATIVE PARCEL IDENTIFIER - FORREST LOCATION 370.

ED/VER	AMENDMENTS	BY	SIGNATURE/NOTES	DATE

TYPE **CROWN**

PURPOSE SUBDIVISION

PLAN OF

LOTS 370, 6251 AND 6252

EARLY ISSUE: NO

DISTRICT	FORREST	DOLA FILE	3178/1969
TOWNSITE	PORT HEDLAND		
LOCAL AUTHORITY	TOWN OF PORT HEDLAND		
LOCALITY	PORT HEDLAND & SURROUNDS		

ON INDEX: SEE TABLE
PUBLIC
FIELD BOOK: COMPILED

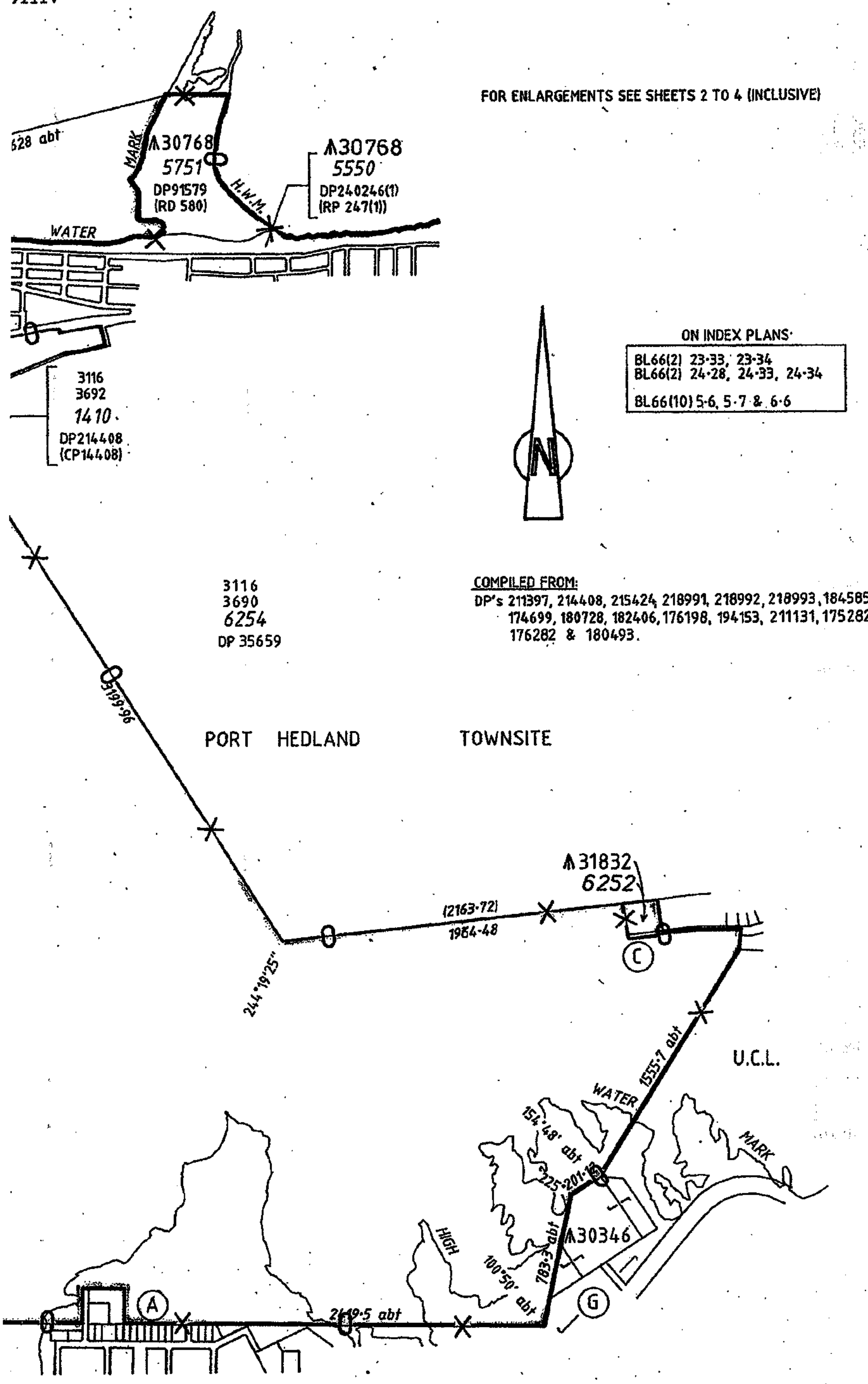
FORMER TENURE: SEE TABLE

SCALE 1:25000 — ALL DISTANCES ARE METRES (500 0 500 1000)

FOR ENLARGEMENTS SEE SHEETS 2 TO 4 (INCLUSIVE)

ON INDEX PLANS
BL66(2) 23·33, 23·34
BL66(2) 24·28, 24·33, 24·34
BL66(10) 5·6, 5·7 & 6·6

COMPILED FROM:
DP's 211397, 214408, 215424, 218991, 218992, 218993, 184585, 174699, 180728, 182406, 176198, 194153, 211131, 175282, 176282 & 180493.



SURVEYOR'S CERTIFICATE — Compiled
I, G. L. YORATH hereby certify that this compiled plan–
(a) is a correct and accurate representation of the survey(s) of the subject land, and
(b) is in accordance with the relevant law in relation to which it is lodged.
[signature] 22 Jan 2003
Licensed Surveyor — Date

MAKJaP
A.B.N. 66 009 123 331
MAKJaP PTY LTD
Consulting Engineers & Surveyors
15 Kingsmill Street
PO Box 384 Port Hedland WA 6721
Telephone: (08) 9173 1286
Facsimile: (08) 9173 2894
Email: porthedland

LODGED: DATE 28.1.03; FEE PAID $295; ASSESS No. 370141

TYPE OF VALIDATION: FULL AUDIT; LEGAL COMPONENT [signature]; DOCKET PLAN/DIAGRAM; CERTIFIED CORRECT [signature] 16.4.03; F.S.C.

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE
EXEMPT FROM SEC. 27(5) LAND ADMINISTRATION ACT 1995
DELEGATED UNDER SEC 20 WAPC ACT 1985
DATE

IN ORDER FOR DEALINGS
SUBJECT TO (1) ~~ROAD CLOSURE~~ REDESCRIPTION
(2) ~~CANCELLATION~~ OF Λ31832
(3) REDEFINITION OF THE 'PORT OF PORT HEDLAND' BOUNDARY.
(4) AMENDMENT TO 'PORT HEDLAND TOWNSITE' BOUNDARY.
[signature] 16.4.2003
FOR INSPECTOR OF PLANS & SURVEYS, AUTHORIZED LAND OFFICER — DATE

APPROVED – Reg 21(1) –
[signature] 24.4.03
INSPECTOR OF PLANS & SURVEYS — AUTHORIZED LAND OFFICER

DOLA
Department of LAND ADMINISTRATION

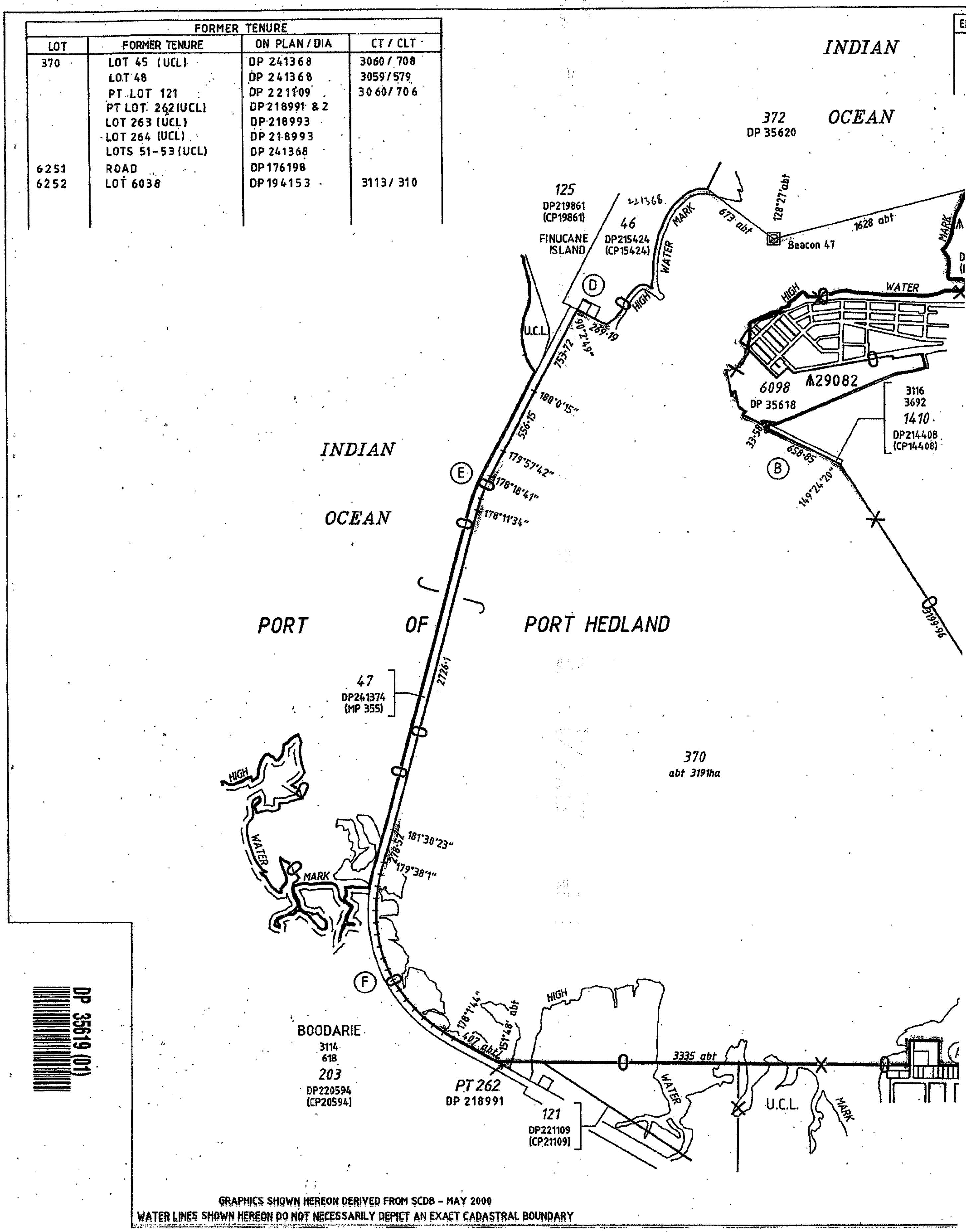
DEPOSITED PLAN

35619

204700020400.DWG (Sheet 1)

SHEET 1 OF 4 SHEETS
EDITION 1 VERSION 1

FORMER TENURE			
LOT	FORMER TENURE	ON PLAN / DIA	CT / CLT
370	LOT 45 (UCL)	DP 241368	3060 / 708
	LOT 48	DP 241368	3059 / 579
	PT LOT 121	DP 221109	3060 / 706
	PT LOT 262 (UCL)	DP 218991 & 2	
	LOT 263 (UCL)	DP 218993	
	LOT 264 (UCL)	DP 218993	
	LOTS 51-53 (UCL)	DP 241368	
6251	ROAD	DP 176198	
6252	LOT 6038	DP 194153	3113 / 310



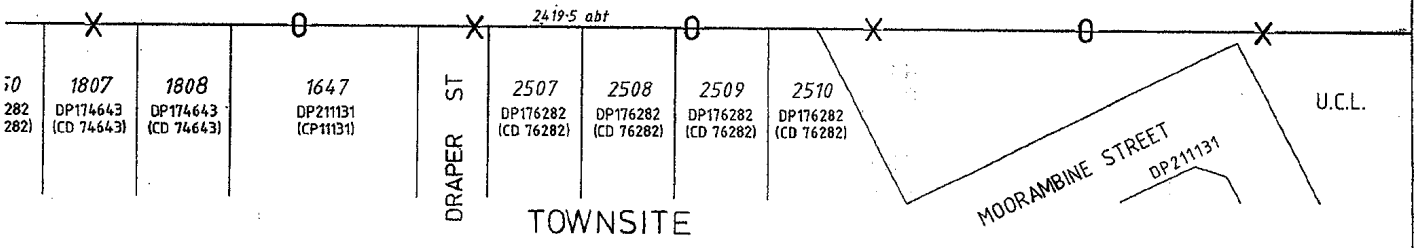
DP 35619 (01)

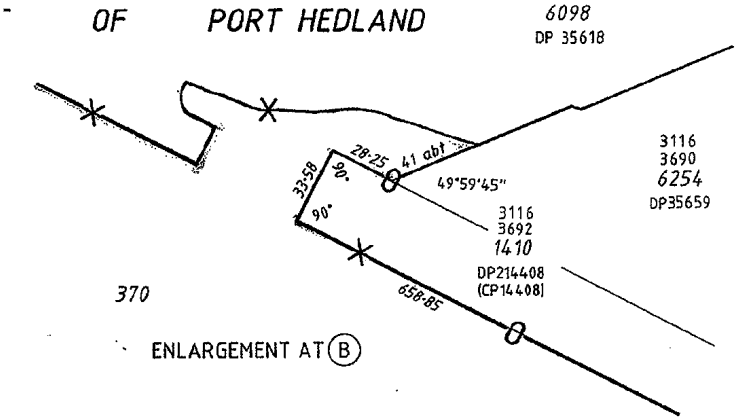
EET 1 FOR HEADING

DP 35619 (02)

OF PORT HEDLAND

370





GRAPHICS SHOWN HEREON DERIVED FROM SCDB - MAY 2000
WATER LINES SHOWN HEREON DO NOT NECESSARILY DEPICT AN EXACT CADASTRAL BOUNDARY

204700020400.DWG (Sheet 2)

SCALE 1:2000
ALL DISTANCES ARE METRES
20 0 20 40 60 80

22 Jan. 2003
Licensed Surveyor Date

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE

EXEMPT FROM SECTION 27(5)
LAND ADMINISTRATION ACT 1997

DELEGATED UNDER SECTION 20 WAPC ACT 1985
DATE

DOLA
Department of LAND ADMINISTRATION

DEPOSITED PLAN
35619

SHEET 2 OF 4 SHEETS
EDITION 1 VERSION 1

MAKJaP
A.B.N. 64 009 183 831
MAKJaP PTY LTD
Consulting Engineers & Surveyors
16 Kingsmill Street, Port Hedland
PO Box 384 Port Hedland WA 6721
Telephone: (08) 9173 1298
Facsimile: (08) 9173 2894
Email: porthedland@makjap.com.au

1649

WESTERN AUSTRALIA

REGISTER NUMBER	
121/DP221109	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME	FOLIO
LR3060	706

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 121 ON DEPOSITED PLAN 221109

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. I457759 PORTION COMPRISED IN LOT 370 ON DEPOSITED PLAN 35619 TO VOL. 3118 FOL. 753. REGISTERED 24.4.2003.
2. I513733 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP37227 TO VOL. 3131 FOL. 840. REGISTERED 12.6.2003.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: LR3060-706 (121/DP221109).
PREVIOUS TITLE: This Title.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.

NOTE 1: A000001A CORRESPONDENCE FILE 03994-1968-02RO.
NOTE 2: SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE
QUALIFIED

REGISTER NUMBER: 121/DP221109 VOLUME/FOLIO: LR3060-706 PAGE 2

NOTE 3: LAND PARCEL IDENTIFIER OF FORREST LOCATION 121 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 121 ON DEPOSITED PLAN 221109 ON 23-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 4: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.

NO DUPLICATE ISSUED

Application H511103
Corr. 03994-1968-02ro

WESTERN AUSTRALIA

REGISTER VOLUME 3060 FOLIO 706

QUALIFIED CERTIFICATE OF CROWN LAND TITLE

UNDER THE "TRANSFER OF LAND ACT 1893" AS AMENDED
AND THE "LAND ADMINISTRATION ACT 1997"

The undermentioned land is Crown land, in the name of the
STATE of WESTERN AUSTRALIA,
subject to the interests and status orders in the First Schedule which interests and status orders are subject to the interests, easements, encumbrances and notices shown in the Second Schedule hereto.

Page 1 of 2 Page(s)

Dated 26 July 2000

REGISTRAR OF TITLES

LAND REFERRED TO

Forrest Location 121 on Land Administration Miscellaneous Plan 21109 delineated on the sketch in the Third Schedule.

THIRD SCHEDULE

Graphic too large to fit at a suitable scale.
Refer to survey document quoted in the Land Description.

Subject to Survey
Not for Alienation Purposes

WARNING: (1) THE LAND AND INTERESTS ETC. SHOWN HEREON MAY BE AFFECTED BY INTERESTS ETC. THAT CAN BE, BUT ARE NOT, SHOWN ON THE REGISTER.
(2) THE INTERESTS ETC. SHOWN HEREON MAY HAVE A DIFFERENT PRIORITY THAN SHOWN.

QCLT - 28/10/5

QUALIFIED CERTIFICATE OF CROWN LAND TITLE VOL. 3060 FOL. 706

FIRST SCHEDULE NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT									
NATURE	NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL

SECOND SCHEDULE NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT									
NATURE	NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL

REGISTER NUMBER	
45/DP241368	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME LR3060 FOLIO 708

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

Cancelled

LAND DESCRIPTION:

LOT 45 ON DEPOSITED PLAN 241368

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. 1457759 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP35619 TO VOL. 3118 FOL. 753. REGISTERED 24.4.2003.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: LR3060-708 (45/DP241368).
PREVIOUS TITLE: This Title.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.

NOTE 1: A000001A CORRESPONDENCE FILE 755/1966.
NOTE 2: SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES
NOTE 3: LAND PARCEL IDENTIFIER OF FORREST LOCATION 45 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 45 ON DEPOSITED PLAN

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE
QUALIFIED

NOTE 4: 241368 ON 23-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE. THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.

NO DUPLICATE ISSUED

Application G774686
Corr. 755/1966

WESTERN AUSTRALIA

REGISTER VOLUME 3060 FOLIO 708

QUALIFIED CERTIFICATE OF CROWN LAND TITLE

UNDER THE "TRANSFER OF LAND ACT 1893" AS AMENDED
AND THE "LAND ADMINISTRATION ACT 1997"

The undermentioned land is Crown land, in the name of the
STATE of WESTERN AUSTRALIA,
subject to the interests and status orders in the First Schedule which interests and status orders are subject to the interests, easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 24 April, 1998

Page 1 of 2 page(s)

LAND REFERRED TO

Forrest Location 45 on Land Administration Miscellaneous Plan 349 (Sheet 2)

Graphic too large to fit at a suitable scale.
Refer to survey document quoted in the Land Description.

SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES

WARNING: (1) THE LAND AND INTERESTS ETC. SHOWN HEREON MAY BE AFFECTED BY INTERESTS ETC. THAT CAN BE, BUT ARE NOT, SHOWN ON THE REGISTER.
(2) THE INTERESTS ETC. SHOWN HEREON MAY HAVE A DIFFERENT PRIORITY THAN SHOWN.

QCLT - 17/04/9

QUALIFIED CERTIFICATE OF CROWN LAND TITLE VOL. 3060 FOL. 708

FIRST SCHEDULE NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL
		Lease 1683/1989 to **Goldsworthy Mining Ltd.** Of 8th Floor ANZ House 84 Saint George's Terrace, Perth.							
Extension	E181997	of lease 1683/1989	11.6.96	10:22		Removal of Lease	H498021	5.7.00	
		As to Lease 1683/1989 only :							
Transfer	G748914	To **BHP Minerals Pty Ltd.** of 600 Bourke Street, Melbourne of 85 undivided 100th shares, **CI Minerals Australia Pty Ltd.** of 8 undivided 100th shares and **Mitsui Iron Ore Corporation Pty Ltd.** of 7 undivided 100th shares both of 221 Saint George's Terrace, Perth **as tenants in common.**	27.3.98	8:18		Removal of Lease	H498021	5.7.00	

SECOND SCHEDULE NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL

1653

WESTERN AUSTRALIA

REGISTER NUMBER	
48/DP241368	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME LR3059 FOLIO 579

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 48 ON DEPOSITED PLAN 241368

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. I457759 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP35619 TO VOL. 3118 FOL. 753. REGISTERED 24.4.2003.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: LR3059-579 (48/DP241368).
PREVIOUS TITLE: This Title.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.

NOTE 1: A000001A CORRESPONDENCE FILE 938/1966.
NOTE 2: SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES
NOTE 3: LAND PARCEL IDENTIFIER OF FORREST LOCATION 48 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 48 ON DEPOSITED PLAN

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE
QUALIFIED

NOTE 4: 241368 ON 01-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE. THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.

NO DUPLICATE ISSUED

Application G774957
Cert. 938/1966

WESTERN AUSTRALIA

REGISTER VOLUME	FOLIO
3059	579

QUALIFIED CERTIFICATE OF CROWN LAND TITLE

UNDER THE "TRANSFER OF LAND ACT 1893" AS AMENDED
AND THE "LAND ADMINISTRATION ACT 1997"

The undermentioned land is Crown land, in the name of the
STATE of WESTERN AUSTRALIA,
subject to the interests and status orders in the First Schedule which interests and status orders are subject to the interests, easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 24 April, 1998

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND REFERRED TO

Forrest Location 48 on Land Administration Miscellaneous Plan 349 (Sheet 2)

Graphic too large to fit at a suitable scale.
Refer to survey document quoted in the Land Description.

SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES

WARNING: (1) THE LAND AND INTERESTS ETC. SHOWN HEREON MAY BE AFFECTED BY INTERESTS ETC. THAT CAN BE, BUT ARE NOT, SHOWN ON THE REGISTER.
(2) THE INTERESTS ETC. SHOWN HEREON MAY HAVE A DIFFERENT PRIORITY THAN SHOWN.

QUALIFIED CERTIFICATE OF CROWN LAND TITLE — VOL. 3059 FOL. 579

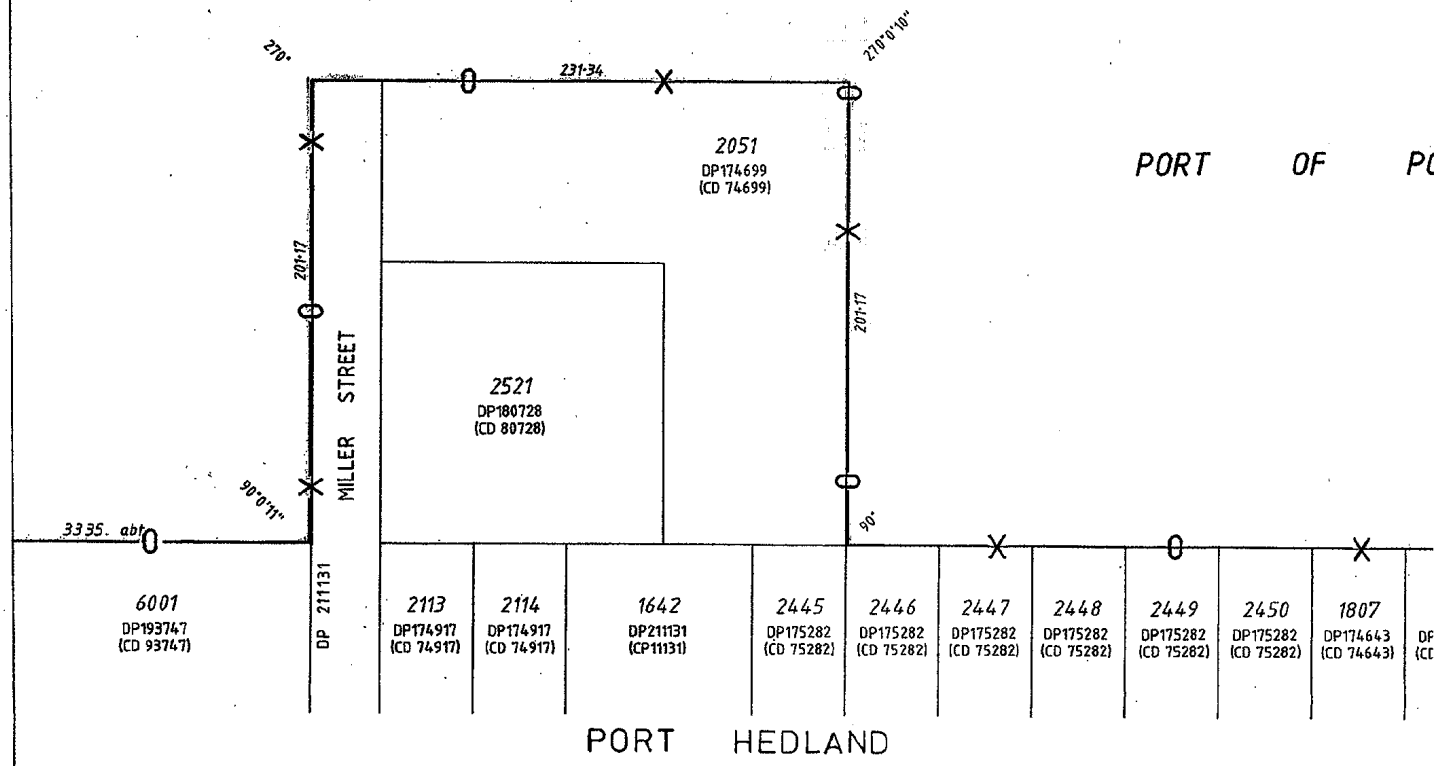
FIRST SCHEDULE — NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL
		Lease 178/1978 to **Goldsworthy Mining Ltd.** Of ANZ House 84 Saint George's Terrace, Perth.	30.6.78						
Extension	E699526	of lease 178/1978 As to Lease 178/1978 only :	11.9.91	10:48					
Transfer	G748914	To **BHP Minerals Pty Ltd.** of 600 Bourke Street, Melbourne of 85 undivided 100th shares, **CI Minerals Australia Pty Ltd.** of 8 undivided 100th shares and **Mitsui Iron Ore Corporation Pty Ltd.** of 7 undivided 100th shares both of 221 Saint George's Terrace, Perth **as tenants in common.**	27.3.98	8:18					
~~Extension~~	~~H195539~~	~~As to Lease 178/1978 only: of Lease 3116/6169.~~ Barrallier Assist. Registrar of Titles	~~13.8.99~~	~~15.11~~					
Sundry	H346306	The above endorsement is deleted by Commissioners Instruction pursuant to Section 188(ii) of the Transfer of Land Act 1893.	8.12.00	15.10					

SECOND SCHEDULE — NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL

SEE SHEET 1 FOR HEA



ENLARGEMENT AT (A)

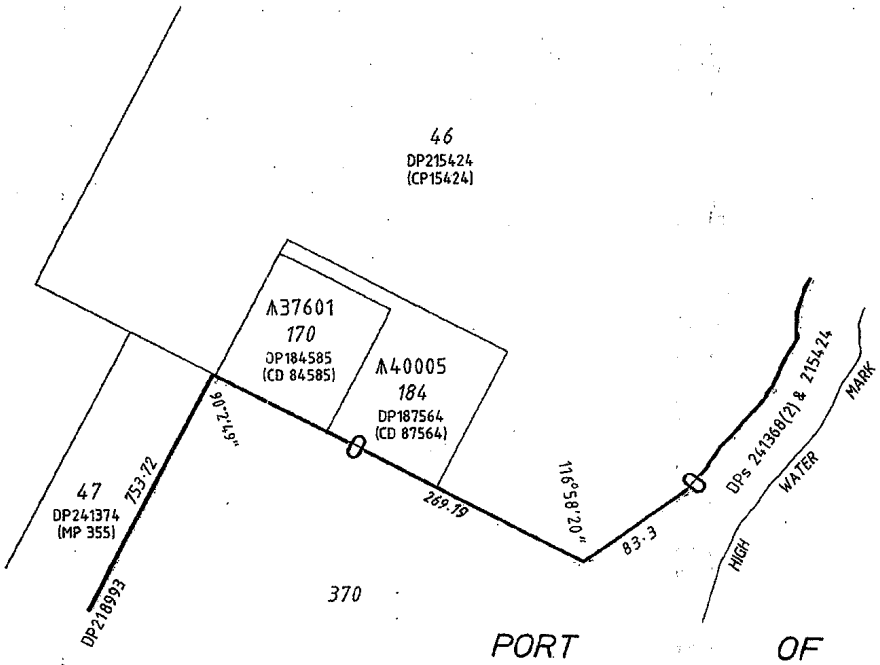
PORT OF

370

E

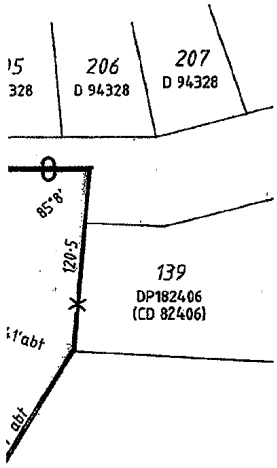
ET 1 FOR HEADING

DP 35619 (03)



ENLARGEMENT AT (D)

OWNSITE



GRAPHICS SHOWN HEREON DERIVED FROM SCDB - MAY 2000
WATER LINES SHOWN HEREON DO NOT NECESSARILY DEPICT AN EXACT CADASTRAL BOUNDARY

204700020400.DWG (Sheet 3)

SCALE 1:3000
ALL DISTANCES ARE METRES
50 0 50 100

Licensed Surveyor 22 Jan 2003
Date

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE

EXEMPT FROM SECTION 27(6)
LAND ADMINISTRATION ACT 1997

DELEGATED UNDER SECTION 20 WAPC ACT 1985
DATE

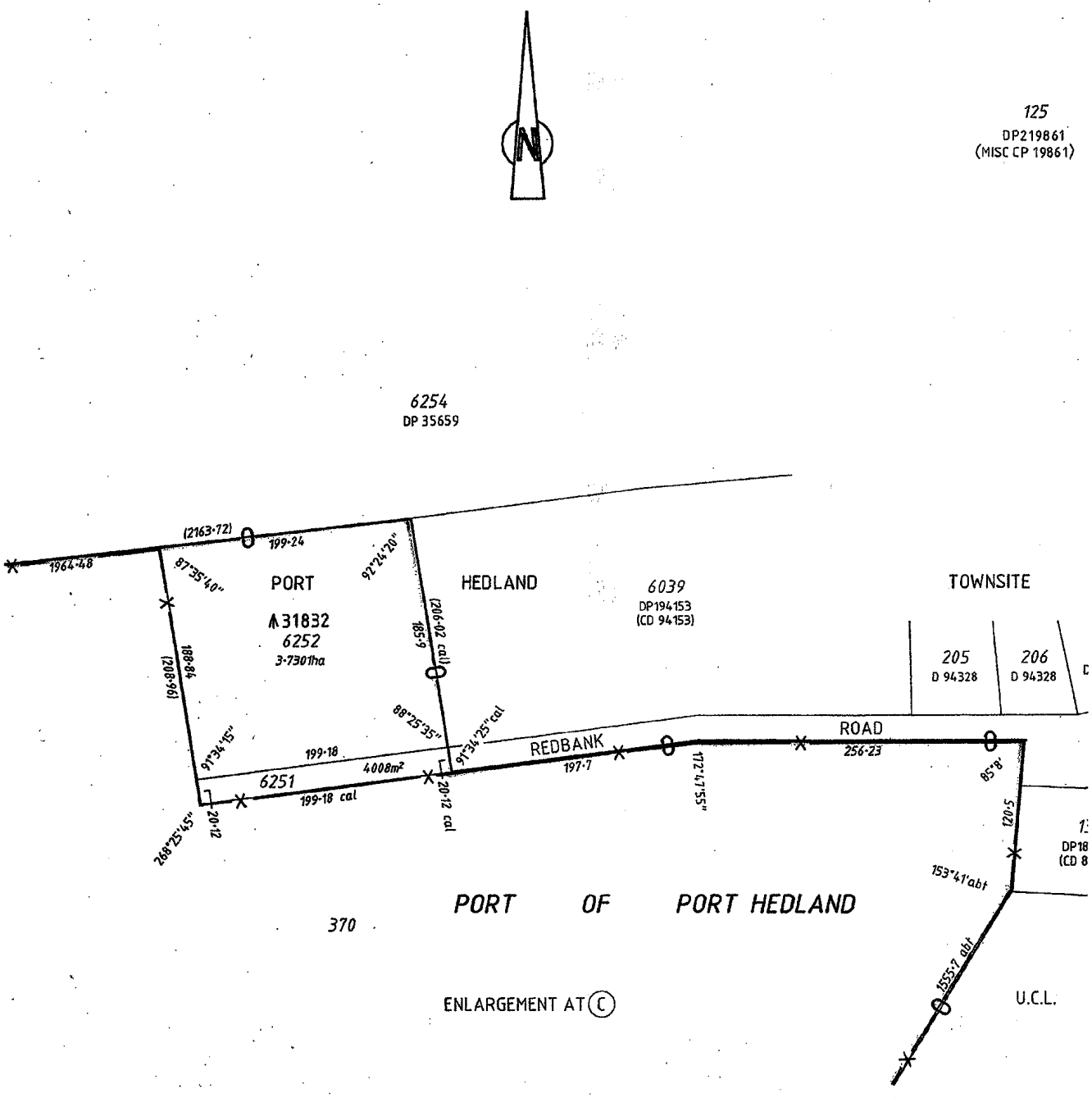
DOLA
Department of LAND ADMINISTRATION

DEPOSITED PLAN
35619

SHEET 3 OF 4 SHEETS
EDITION 1 VERSION 1

MAKJaP
A.B.N. 68 009 183 831
MAKJaP PTY LTD
Consulting Engineers & Surveyors
15 Kingsmill Street, Port Hedland
PO Box 384 Port Hedland WA 6721
Telephone: (08) 9173 1298
Facsimile: (08) 9173 2894
Email: porthedland@makjap.com.au

SEE SHEET 1 FOR HEAI

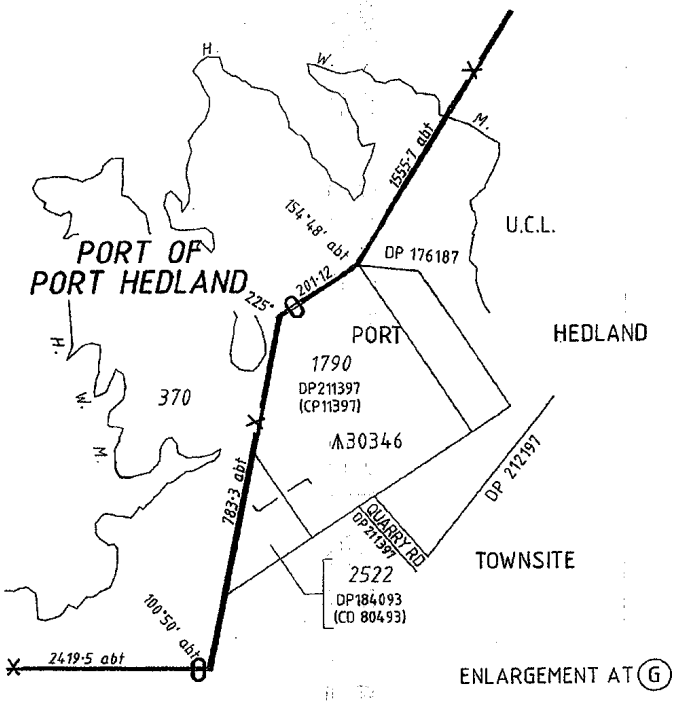


ET 1 FOR HEADING

DP 35619 (04)

42"

PORT OF
PORT HEDLAND



GRAPHICS SHOWN HEREON DERIVED FROM SCDB - MAY 2000
WATER LINES SHOWN HEREON DO NOT NECESSARILY DEPICT AN EXACT CADASTRAL BOUNDARY

204700020400.DWG (Sheet 4)

SCALE 1:10000
ALL DISTANCES ARE METRES
100 0 100 200 300 400

22 Dec 2003
Licensed Surveyor Date

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE

EXEMPT FROM SECTION 27(5)
LAND ADMINISTRATION ACT 1997

DELEGATED UNDER SECTION 20 WAPC ACT 1985
DATE

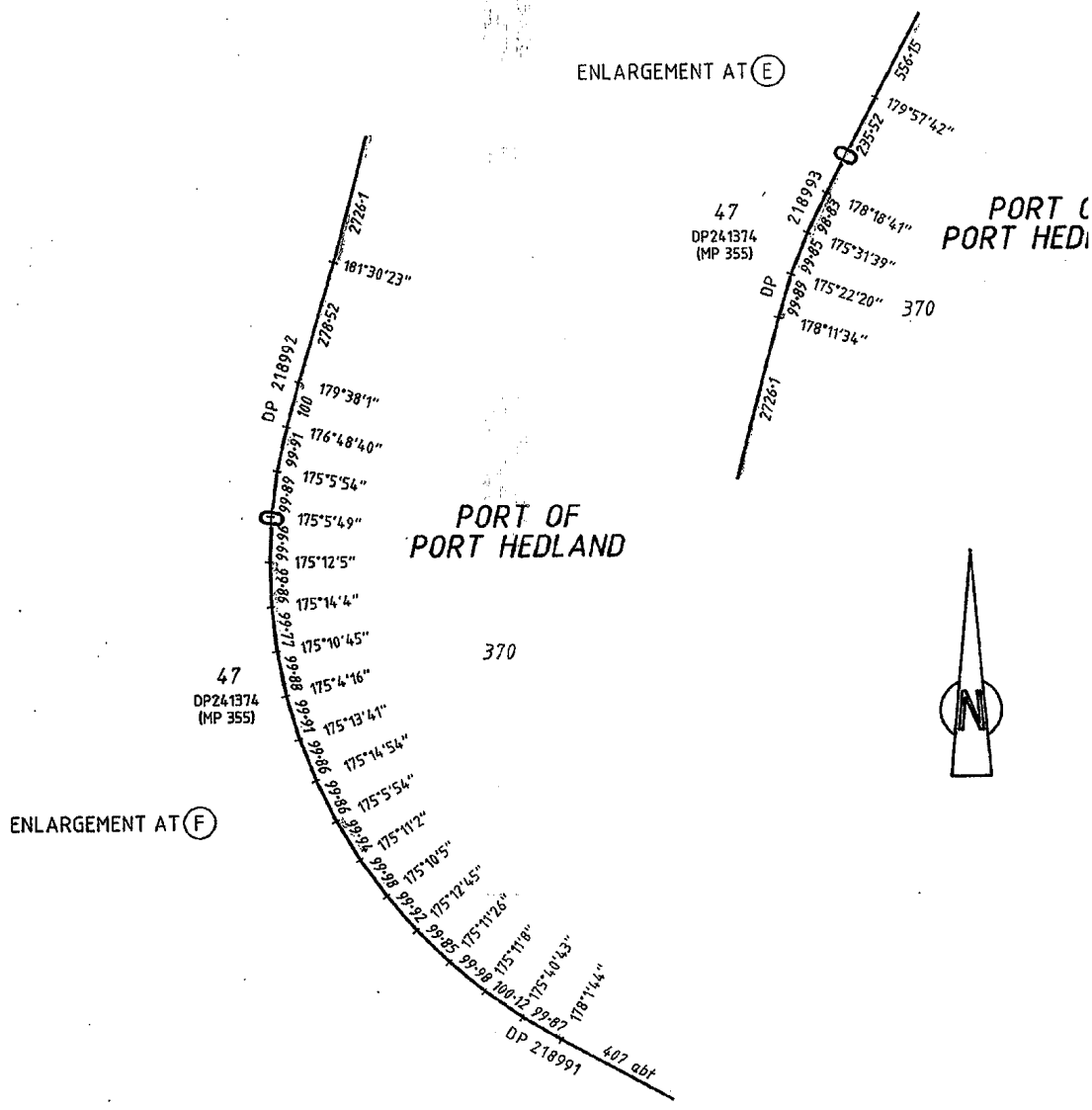
DOLA
Department of LAND ADMINISTRATION

DEPOSITED PLAN
35619

SHEET 4 OF 4 SHEETS
EDITION 1 VERSION 1

MAKJaP
A.B.N. 65 009 183 631
MAKJaP PTY LTD
Consulting Licensed Surveyors
15 Kingsmill Street, Port Hedland
PO Box 384 Port Hedland WA 6721
Telephone: (08) 9173 1298
Facsimile: (08) 9173 2894
Email: porthedland@makjap.com.au

SEE SHEET 1 FOR HEA



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Appendix D Aerial Photographs

APPENDIX D – AERIAL PHOTOGRAPHS

1971 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

1976 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

1977 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

1979 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

1985 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

1993 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

2004 Photograph

APPENDIX D – AERIAL PHOTOGRAPHS

2005 Photograph

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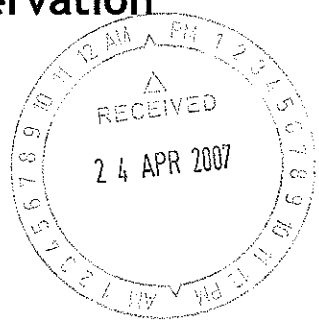
Appendix E Regulatory Information

Department of
Environment and Conservation

Your ref:
Our ref:
Enquiries:
Phone: 1302/04
Fax: Registrar
Email: 1300 762982



Ariaan Purich
SKM
PO Box H615
Perth WA 6001

Dear Sir/Madam

DETAILED SUMMARY OF RECORDS REQUEST
PURSUANT TO REGULATION 10 OF THE *CONTAMINATED SITES REGULATIONS 2006*

Thank you for your Detailed Summary of Records ("DSR") request for the site consisting of the following parcel(s) of land:

- FORREST LOCATION Lot 370 on Plan 35619 as shown on certificate of title LR3118/753 known as Finucane Island, Wedgefield WA 6721 ("the Site"),

which Department of Environment and Conservation ("DEC") received on 05/04/2007

A search of DEC records of known and suspected contaminated sites was undertaken however, although we hold information relating to this site, as of 17/04/2007 this site has not yet been classified under the *Contaminated Sites Act 2003*.

As the information we currently hold on the Site is insufficient for us to classify it, DEC is unable to provide a Summary of Records for this Site. A refund of $270.00 will be processed shortly (a search fee of $30.00 applies for processing the Summary of Records request). Other areas within DEC appear to have information relating to the Site, therefore you may want to consider a Freedom of Information (FOI) request to access these files.

General information on a Summary of Records and associated request forms is available from DEC's website on www.dec.wa.gov.au/contaminatedsites or by contacting the Registrar on 1300 762982.

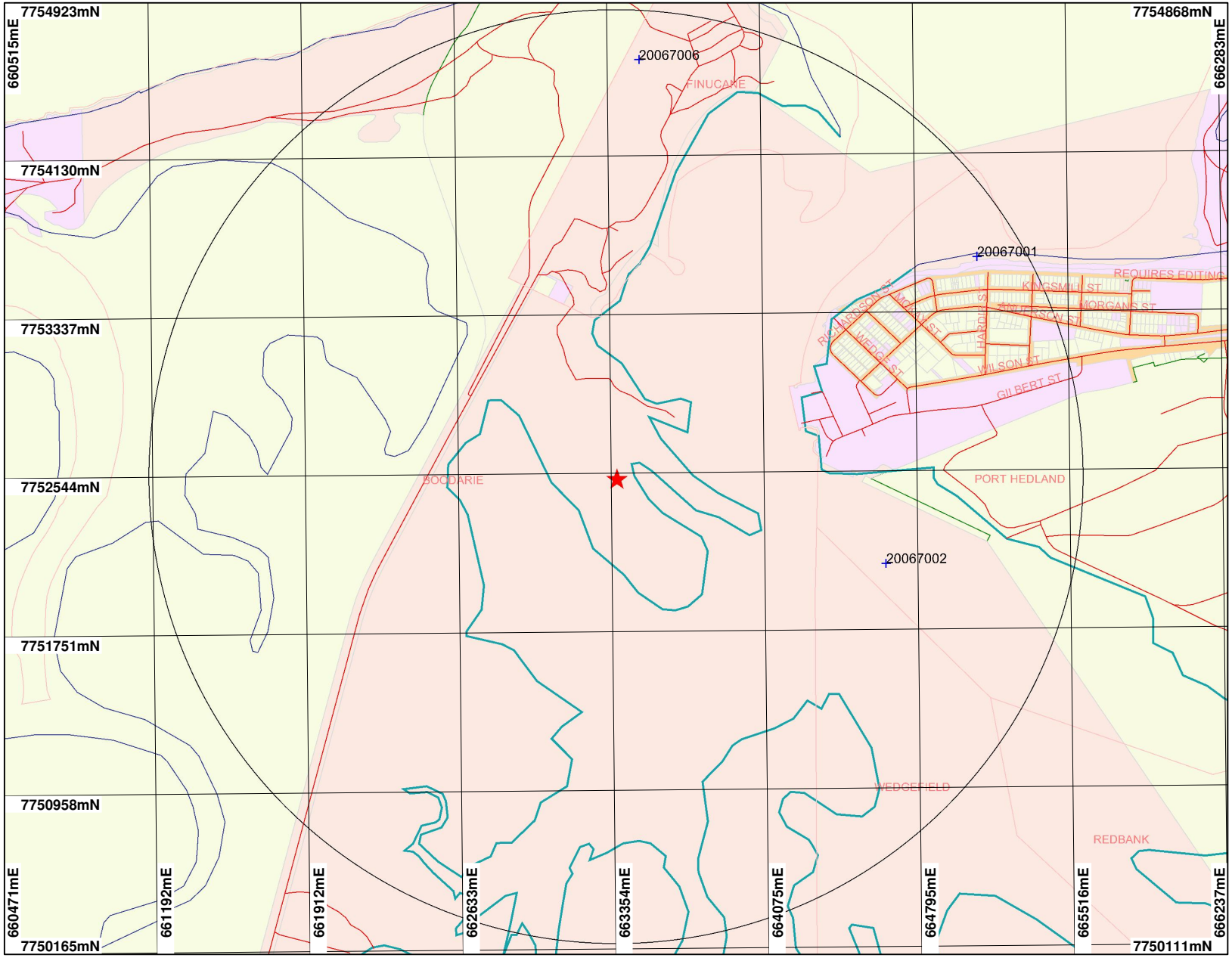
Yours sincerely

.....

Janet Macmillan, A/SECTION MANAGER
LAND AND WATER QUALITY BRANCH
Delegated Officer under section 91
of the *Contaminated Sites Act 2003*

17/04/2007
Enc. Receipt Number 027030

Bores - radius 2.2km of Zone 50: 663381E 7752512N - Finucane Island



LEGEND

Cadastre - DLI

- Freehold
- Crown Reserve
- State Forest / Timber Reserve
- Marine Park
- Crown Lease
- Lease / Reserve
- Lease on State Forest / Timber Reserve
- Public Roads
- Unallocated Crown Land
- Water

Hydrography, linear (hierarchy) - DOW

- Coastal Waterline
- Estuarine
- Infrastructure
- Insignificant Trib
- Inundation Area
- Mainstream
- Major River
- Major Trib
- Minor River
- Minor Trib
- Paleo-Drainage Line
- Significant Stream

- Road Centrelines - DLI 1/5/04
- Localities - DLI
- WIN Groundwater Sites, Monitoring - non DEWCP (Current)
- WIN Groundwater Sites, Monitoring - DEWCP (Current)
- WIN Groundwater Sites, Other - non DEWCP (Current)
- WIN Groundwater Sites, Other - DEWCP

N

0 ~750 m

Scale 1:27583
(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

Prepared by: SandilP
Prepared for: Ariaan Purich
Date: 5/04/2007 4:30:09 PM

DR18791

Information derived from this map should be confirmed with the data custodian acknowleged by the agency acronym in the legend.

Department of Water
Government of Western Australia

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Appendix F Laboratory Results

Please direct enquiries to:
Tye Pope
Tel: 61 8 9326 0106
Email: tye_pope@urscorp.com

Ref: 42906159 - 1892
R1230 / DK:M&C2630/PER

22 December 2006

Port Hedland Port Authority
Post Office Box 2
PORT HEDLAND WA 6721

Attention: Craig Wilson
Environmental Engineer

Dear Sir

PORT HEDLAND PORT AUTHORITY ORE SAMPLES: MANGANESE AND CHROMITE TOXICITY ASSESSMENT

1. INTRODUCTION

During the 2005-06 financial year, Port Hedland Port Authority (PHPA) was responsible for the export of 1,058,844 tonnes of manganese ore and 259,458 tonnes of chromite ore from PHPA No. 1 Wharf (Port Hedland Port Authority 2006). Minor spillages and dust fallout during loading results in an unkown quantity of each ore entering the marine environment.

During 2006, URS was engaged by PHPA to undertake a toxicity assessment of the manganese and chromite ore being exported through the port. The objective of the study was to ascertain the potential toxicity to the marine environment of chromite and manganese to develop site-specific criteria against which the results from future surveillance monitoring programmes may be compared.

2. SCOPE OF WORK

The initial scope of work consisted of elutriate testing of chromite and manganese ore to determine whether the constituents of these ores are bioavailable in the marine environment. If so, microtoxicity testing of the ores was to be conducted to determine the toxicity level to marine micro-organisms.

3. MATERIALS AND METHODS

Nine raw ore samples were provided by PHPA for URS to submit for elutriate analysis. These consisted of chromite (lump 1 – 3), manganese (fines 1 – 3) and manganese (lump 1 – 3). The analysing laboratory was Geotechnical Services Pty Ltd.

An elutriate was obtained for each sample by combining one part of each sample with four parts of deionised water in a clean jar, shaken vigorously for one hour and allowed to settle overnight. The overlying water (elutriate) was decanted off and analysed using ICP-MS.

URS Australia Pty Ltd (ABN 46 000 691 690)
Level 3, 20 Terrace Road
East Perth WA 6004 Australia
Phone: 61 8 9326 0100
Fax: 61 8 9326 0296

4. RESULTS AND DISCUSSION

Elutriate analysis of both ore types produced evidence of release of bioavailable manganese and chromium from each. However, converse to the fine samples, manganese lump did not release detectable levels of bioavailable chromium (see Table 3).

Table 1 – Manganese and Chromium Concentrations within Chromite Ore Lump Sample Elutriates

	PQL	Trigger Level[a]	Chromium Lump #1	Chromium Lump #2	Chromium Lump #3	Mean
Analyte	**mg/L**					
Manganese	0.001	n/a	0.004	0.005	0.002	**0.004**
Chromium	0.001	0.0486	0.004	0.005	0.005	**0.005**

a - Concentrations below which toxic effects are not expected (ANZECC & ARMCANZ 2000) at a level of 90% protection of species
n/a - Not applicable

Table 2 - Manganese and Chromium Concentrations within Manganese Ore Fines

	PQL	Trigger Level[a]	Manganese Fines #1	Manganese Fines #2	Manganese Fines #3	Mean (fines)
Analyte	**mg/L**					
Manganese	0.001	n/a	0.032	0.046	0.048	**0.042**
Chromium	0.001	0.0486	0.003	0.004	0.004	**0.004**

a - Concentrations below which toxic effects are not expected (ANZECC & ARMCANZ 2000) at a level of 90% protection of species
n/a - Not applicable

Table 3 - Manganese and Chromium Concentrations within Manganese Ore Lumps

	PQL	Trigger Level[a]	Manganese Lumps #1	Manganese Lumps #2	Manganese Lumps #3	Mean (lumps)
Analyte	**mg/L**					
Manganese	0.001	n/a	0.11	0.043	0.042	**0.065**
Chromium	0.001	0.0486	<0.001	<0.001	<0.001	**<0.001**

a - Concentrations below which toxic effects are not expected (ANZECC & ARMCANZ 2000) at a level of 90% protection of species
n/a - Not applicable

Concentration of bioavailable manganese was highest within the elutriate produced from manganese lump where the average was 0.065 mg/L. Elutriate samples created from processing lumps of manganese ore exhibited a higher mean manganese concentration (0.065 gm/L) than the manganese fines (0.042 mg/L). This is unexpected due to the lower surface area that the lump would present to the water used for the elutriate analysis compared to that of the fines. A low reliability guideline of 0.08 mg/L exists in the ANZECC and ARMCANZ guidelines but recent research suggests a level of 0.14 mg/L would provide a more reliable trigger level (Stauber 2006). All analysed elutriate samples recorded manganese concentrations below this level.

Concentration of bioavailable chromium was highest within elutriate produced from chromite lump where the average was 0.005 mg/L. Concentration of chromium was comparable within elutriate produced from chromite ore lump and manganese ore fine. This demonstrates that each ore potentially contains contaminants. However, concentration of chromium in elutriate from both ore types were in the order of 1/10 of the ANZECC & ARMCANZ trigger levels for 90% protection of species (see Table 1, 2 and 3).

5. REFERENCES

ANZECC & ARMCANZ 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1: The Guidelines. Australian and New Zealand Environment & Conservation Council and Agriculture & Resource Management Council of Australia & New Zealand, October 2000.

Port Hedland Port Authority 2006, *2005/2006 Cargo Statistics and Port Information.*

Stauber JL, 2006. *Determination of a Manganese Trigger Value for Port Curtis, Queensland.* Report prepared for URS Australia Pty Ltd by CSIRO Land and Water Science. Report 45/06, October 2006.

Yours faithfully
URS AUSTRALIA PTY LTD

Tye Pope
Marine Environmental Scientist

Peter Collins
Ecological Consultant

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Perth	Page	: 1 of 6
Contact	: MR DOMINIC NORTH	Contact	: Michael Sharp	Work Order	: EP0703536
Address	: P O BOX H615 PERTH WA AUSTRALIA 6001	Address	: 10 Hod Way Malaga WA Australia 6090		
E-mail	: dnorth@skm.com.au	E-mail	: Michael.Sharp@alsenviro.com		
Telephone	: 9268 9678	Telephone	: +61-8-9209 7655		
Facsimile	: 9268 4598	Facsimile	: +61-8-9209 7600		
Project	: WV03278	Quote number	: EN-003-07 BQ	Date received	: 23 Aug 2007
Order number	: - Not provided -			Date issued	: 30 Aug 2007
C-O-C number	: - Not provided -			No. of samples	- Received : 9
Site	: Leachability Study				Analysed : 9

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Position	Department
Alan Foley	Senior Chemist - Inorganics	Perth Inorganics - NATA 825 (15847 - Perth)
Celine Conceicao	Spectroscopist	Inorganics - NATA 825 (10911 - Sydney)
Scott James	Metals Team Leader	Perth Inorganics - NATA 825 (15847 - Perth)

Comments

This report for the ALSE reference EP0703536 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental 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 herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **EP0703536**

Positive method blank results due to sea water matrix
LOR for Sea Water Leach samples raised, due to the high amount of Sodium present.
EG005W Sea Water Leach: NATA accreditation does not cover performance of this service.

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: SKM-Ore-M1	SKM-Ore-M2	SKM-Ore-C2	SKM-Ore-C1	SKM-sw-1
Sample Matrix Type / Description:				SEAWATER	SEAWATER	SEAWATER	SEAWATER	SEAWATER
Sample Date / Time:				28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00	10 Aug 2007 15:00
Laboratory Sample ID:				EP0703536-001	EP0703536-002	EP0703536-003	EP0703536-004	EP0703536-005
EG005W: Water Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.10	mg/L	<0.10	<0.10	<0.10	<0.10	----
Arsenic	7440-38-2	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
Cadmium	7440-43-9	0.005	mg/L	<0.050	<0.050	<0.050	<0.050	----
Chromium	7440-47-3	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
Copper	7440-50-8	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
Iron	7439-89-6	0.05	mg/L	<0.10	<0.10	<0.10	<0.10	----
Lead	7439-92-1	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
Manganese	7439-96-5	0.01	mg/L	<0.10	<0.10	0.11	0.10	----
Nickel	7440-02-0	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
Zinc	7440-66-6	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	----	----	----	----	0.12
Arsenic	7440-38-2	0.001	mg/L	----	----	----	----	<0.001
Cadmium	7440-43-9	0.0001	mg/L	----	----	----	----	<0.0001
Chromium	7440-47-3	0.001	mg/L	----	----	----	----	0.001
Copper	7440-50-8	0.001	mg/L	----	----	----	----	0.007
Lead	7439-92-1	0.001	mg/L	----	----	----	----	<0.001
Manganese	7439-96-5	0.001	mg/L	----	----	----	----	0.006
Nickel	7440-02-0	0.001	mg/L	----	----	----	----	0.005
Zinc	7440-66-6	0.005	mg/L	----	----	----	----	0.006
Iron	7439-89-6	0.05	mg/L	----	----	----	----	0.15
EG035T: Total Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	----	----	<0.0001
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050F: Hexavalent Chromium - Filtered								
Hexavalent Chromium	18540-29-9	0.010	mg/L	----	----	----	----	<0.010
EG050G-W: Hexavalent Chromium - Water Leachable								
Hexavalent Chromium	18540-29-9	0.01	mg/L	0.02	<0.01	<0.01	<0.01	----
EN60: Bottle Leaching Procedure								
Final pH		0.1	pH Unit	7.9	7.9	8.1	8.1	----

ALS Environmental

Analytical Results

Analyte	CAS number	LOR	Units	Client Sample ID: SKM-Ore-M1	SKM-Ore-M2	SKM-Ore-C2	SKM-Ore-C1	SKM-Ore-M1 Borate Solution
Sample Matrix Type / Description:				TCLP LEACHATE	TCLP LEACHATE	TCLP LEACHATE	TCLP LEACHATE	TCLP LEACHATE
Sample Date / Time:				28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00
Laboratory Sample ID:				EP0703536-001	EP0703536-002	EP0703536-003	EP0703536-004	EP0703536-006
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	0.2	0.3	0.2
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.1	0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/L	0.6	<0.1	2.5	1.2	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.1	<0.1	<0.1
Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EG050G: Hexvalent Chromium by Discrete Analyser								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.01
EN33: TCLP Leach								
Final pH		0.1	pH Unit	4.9	5.0	5.2	5.0	9.3

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Analytical Results

				Client Sample ID :	SKM-Ore-M2 Borate Solution	SKM-Ore-C2 Borate Solution	SKM-Ore-C1 Borate Solution		
				Sample Matrix Type / Description :	TCLP LEACHATE	TCLP LEACHATE	TCLP LEACHATE		
				Sample Date / Time :	28 Aug 2007 12:00	28 Aug 2007 12:00	28 Aug 2007 12:00		
				Laboratory Sample ID :					
Analyte	*CAS number*	*LOR*	*Units*		EP0703536-007	EP0703536-008	EP0703536-009		
EG005C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		0.1	0.2	0.3		
Arsenic	7440-38-2	0.1	mg/L		<0.1	<0.1	<0.1		
Cadmium	7440-43-9	0.05	mg/L		<0.05	<0.05	<0.05		
Chromium	7440-47-3	0.1	mg/L		<0.1	<0.1	<0.1		
Copper	7440-50-8	0.1	mg/L		<0.1	<0.1	<0.1		
Iron	7439-89-6	0.1	mg/L		<0.1	<0.1	<0.1		
Lead	7439-92-1	0.1	mg/L		<0.1	<0.1	<0.1		
Manganese	7439-96-5	0.1	mg/L		<0.1	<0.1	<0.1		
Nickel	7440-02-0	0.1	mg/L		<0.1	<0.1	<0.1		
Zinc	7440-66-6	0.1	mg/L		<0.1	<0.1	<0.1		
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	<0.0010	<0.0010		
EG050G: Hexvalent Chromium by Discrete Analyser									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	<0.01	<0.01		
EN33: TCLP Leach									
Final pH		0.1	pH Unit		9.3	9.3	9.3		

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Surrogate Control Limits

- **No surrogates present on this report.**

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QUALITY CONTROL REPORT

Client	:	**SINCLAIR KNIGHT MERZ**	**Laboratory**	: Environmental Division Perth	**Page**	:	**1 of 11**
Contact	:	MR DOMINIC NORTH	**Contact**	: Michael Sharp			
Address	:	P O BOX H615 PERTH WA AUSTRALIA 6001	**Address**	: 10 Hod Way Malaga WA Australia 6090	**Work order**	:	**EP0703536**
					Amendment No.	:	
Project	:	WV03278	**Quote number**	: EN-003-07 BQ	**Date received**	:	**23 Aug 2007**
Order number	:	- Not provided -			**Date issued**	:	**30 Aug 2007**
C-O-C number	:	- Not provided -					
Site	:	Leachability Study					
E-mail	:	dnorth@skm.com.au	**E-mail**	: Michael.Sharp@alsenviro.com	**No. of samples**		
Telephone	:	9268 9678	**Telephone**	: +61-8-9209 7655	**Received**	:	9
Facsimile	:	9268 4598	**Facsimile**	: +61-8-9209 7600	**Analysed**	:	9

This final report for the ALSE work order reference EP0703536 supersedes any previous reports with this reference.
Results apply to the samples as submitted. All pages of this report have been checked and approved for release.
This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

Work order specific comments
LOR for Sea Water Leach samples raised, due to the high amount of Sodium present.
EG005W Sea Water Leach: NATA accreditation does not cover performance of this service.
Positive method blank results due to sea water matrix

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory - 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Department
Alan Foley	Perth Inorganics - NATA 825 (15847 - Perth)
Celine Conceicao	Inorganics - NATA 825 (10911 - Sydney)
Scott James	Perth Inorganics - NATA 825 (15847 - Perth)

Quality Control Report - Laboratory Duplicates (DUP)

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** = *Limit of Reporting,* ***RPD*** = *Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

Matrix Type: WATER ***Laboratory Duplicates (DUP) Report***

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EG005C: Leachable Metals by ICPAES						
EG005C: Leachable Metals by ICPAES - (QC Lot: 480787)				**mg/L**	**mg/L**	**%**
EP0703536-001	SKM-Ore-M1	Aluminium	0.1 mg/L	<0.1	<0.1	0.0
		Arsenic	0.1 mg/L	<0.1	<0.1	0.0
		Cadmium	0.05 mg/L	<0.05	<0.05	0.0
		Chromium	0.1 mg/L	<0.1	<0.1	0.0
		Copper	0.1 mg/L	<0.1	<0.1	0.0
		Iron	0.1 mg/L	<0.1	<0.1	0.0
		Lead	0.1 mg/L	<0.1	<0.1	0.0
		Manganese	0.1 mg/L	0.6	0.6	0.0
		Nickel	0.1 mg/L	<0.1	<0.1	0.0
		Zinc	0.1 mg/L	<0.1	<0.1	0.0
EG005C: Leachable Metals by ICPAES - (QC Lot: 480824)				**mg/L**	**mg/L**	**%**
EP0703536-006	SKM-Ore-M1 - Borate Solution	Aluminium	0.1 mg/L	0.2	0.2	0.0
		Arsenic	0.1 mg/L	<0.1	<0.1	0.0
		Cadmium	0.05 mg/L	<0.05	<0.05	0.0
		Chromium	0.1 mg/L	<0.1	<0.1	0.0
		Copper	0.1 mg/L	<0.1	<0.1	0.0
		Iron	0.1 mg/L	<0.1	<0.1	0.0
		Lead	0.1 mg/L	<0.1	<0.1	0.0
		Manganese	0.1 mg/L	<0.1	<0.1	0.0
		Nickel	0.1 mg/L	<0.1	<0.1	0.0
		Zinc	0.1 mg/L	<0.1	<0.1	0.0
EG005W: Water Leachable Metals by ICPAES						
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788)				**mg/L**	**mg/L**	**%**
EP0703536-001	SKM-Ore-M1	Aluminium	0.10 mg/L	<0.10	<0.10	0.0
		Arsenic	0.01 mg/L	<0.10	<0.10	0.0

Matrix Type: WATER

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	Client Sample ID	Analyte name	LOR	Original Result	Duplicate Result	RPD
EG005W: Water Leachable Metals by ICPAES - continued						
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788) - continued				mg/L	mg/L	%
EP0703536-001	SKM-Ore-M1	Cadmium	0.005 mg/L	<0.050	<0.050	0.0
		Chromium	0.01 mg/L	<0.10	<0.10	0.0
		Copper	0.01 mg/L	<0.10	<0.10	0.0
		Iron	0.05 mg/L	<0.10	<0.10	0.0
		Lead	0.01 mg/L	<0.10	<0.10	0.0
		Manganese	0.01 mg/L	<0.10	<0.10	0.0
		Nickel	0.01 mg/L	<0.10	<0.10	0.0
		Zinc	0.01 mg/L	<0.10	<0.10	0.0
EG020T: Total Metals by ICP-MS						
EG020T: Total Metals by ICP-MS - (QC Lot: 481017)				mg/L	mg/L	%
EP0703536-005	SKM-sw-1	Aluminium	0.01 mg/L	0.12	0.12	0.0
		Arsenic	0.001 mg/L	<0.001	0.005	133
		Cadmium	0.0001 mg/L	<0.0001	<0.0001	0.0
		Chromium	0.001 mg/L	0.001	0.002	66.7
		Copper	0.001 mg/L	0.007	0.007	0.0
		Lead	0.001 mg/L	<0.001	<0.001	0.0
		Manganese	0.001 mg/L	0.006	0.006	0.0
		Nickel	0.001 mg/L	0.005	0.005	0.0
		Zinc	0.005 mg/L	0.006	0.010	50.0
		Iron	0.05 mg/L	0.15	0.26	52.2
EG035C: Leachable Mercury by FIMS						
EG035C: Leachable Mercury by FIMS - (QC Lot: 480789)				mg/L	mg/L	%
EP0703536-001	SKM-Ore-M1	Mercury	0.0010 mg/L	<0.0010	<0.0010	0.0
EG035T: Total Mercury by FIMS						
EG035T: Total Mercury by FIMS - (QC Lot: 481029)				mg/L	mg/L	%
EP0703536-005	SKM-sw-1	Mercury	0.0001 mg/L	<0.0001	<0.0001	0.0
ES0711845-002	Anonymous	Mercury	0.0001 mg/L	<0.0001	<0.0001	0.0
EG035W: Water Leachable Mercury by FIMS						
EG035W: Water Leachable Mercury by FIMS - (QC Lot: 480790)				mg/L	mg/L	%

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Matrix Type: WATER

Laboratory Duplicates (DUP) Report

Laboratory Sample ID	*Client Sample ID*	*Analyte name*	*LOR*	*Original Result*	*Duplicate Result*	*RPD*
EG035W: Water Leachable Mercury by FIMS - continued						
EG035W: Water Leachable Mercury by FIMS - (QC Lot: 480790) - continued				**mg/L**	**mg/L**	**%**
EP0703536-001	SKM-Ore-M1	Mercury	0.0001 mg/L	<0.0001	<0.0001	0.0
EG050F: Hexavalent Chromium - Filtered						
EG050F: Hexavalent Chromium - Filtered - (QC Lot: 479877)				**mg/L**	**mg/L**	**%**
EP0703536-005	SKM-sw-1	Hexavalent Chromium	0.010 mg/L	<0.010	<0.010	0.0
EG050G: Hexvalent Chromium by Discrete Analyser						
EG050G: Hexvalent Chromium by Discrete Analyser - (QC Lot: 480845)				**mg/L**	**mg/L**	**%**
EP0703536-001	SKM-Ore-M1	Hexavalent Chromium	0.01 mg/L	<0.01	<0.01	0.0
EG050G-W: Hexavalent Chromium - Water Leachable						
EG050G-W: Hexavalent Chromium - Water Leachable - (QC Lot: 480846)				**mg/L**	**mg/L**	**%**
EP0703536-001	SKM-Ore-M1	Hexavalent Chromium	0.01 mg/L	0.02	0.02	0.0

Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

Matrix Type: WATER

Method Blank (MB) and Laboratory Control Samples (LCS) Report

		Method blank result	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
Analyte name	*LOR*			*LCS*	*Low*	*High*
EG005C: Leachable Metals by ICPAES						
EG005C: Leachable Metals by ICPAES - (QC Lot: 480787)		mg/L	mg/L	%	%	%
Aluminium	0.1 mg/L	<0.1	----	----	----	----
	0.1 mg/L	----	1.0	101	81.6	120
Arsenic	0.1 mg/L	----	1.0	103	88.2	118
	0.1 mg/L	<0.1	----	----	----	----
Cadmium	0.05 mg/L	----	1.00	101	93.9	110
	0.05 mg/L	<0.05	----	----	----	----
Chromium	0.1 mg/L	----	1.0	97.6	94.7	109
	0.1 mg/L	<0.1	----	----	----	----
Copper	0.1 mg/L	<0.1	----	----	----	----
	0.1 mg/L	----	1.0	98.4	89.9	114
Iron	0.1 mg/L	----	1.0	107	80.7	125
	0.1 mg/L	<0.1	----	----	----	----
Lead	0.1 mg/L	----	1.0	99.6	95.8	108
	0.1 mg/L	<0.1	----	----	----	----
Manganese	0.1 mg/L	<0.1	----	----	----	----
	0.1 mg/L	----	1.0	106	81.4	127
Nickel	0.1 mg/L	----	1.0	97.6	91.6	112
	0.1 mg/L	<0.1	----	----	----	----
Zinc	0.1 mg/L	----	1.0	103	91.3	113
	0.1 mg/L	<0.1	----	----	----	----
EG005C: Leachable Metals by ICPAES - (QC Lot: 480824)		mg/L	mg/L	%	%	%
Aluminium	0.1 mg/L	<0.1	----	----	----	----
	0.1 mg/L	----	1.0	103	81.6	120
Arsenic	0.1 mg/L	----	1.0	106	88.2	118
	0.1 mg/L	<0.1	----	----	----	----

Matrix Type: WATER

Method Blank (MB) and Laboratory Control Samples (LCS) Report

Analyte name	*LOR*	*Method blank result*	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
				LCS	*Low*	*High*
EG005C: Leachable Metals by ICPAES - continued						
EG005C: Leachable Metals by ICPAES - (QC Lot: 480824) - continued		mg/L	mg/L	%	%	%
Cadmium	0.05 mg/L	<0.05	----	----	----	----
	0.05 mg/L	----	1.00	101	93.9	110
Chromium	0.1 mg/L	<0.1	----	----	----	----
	0.1 mg/L	----	1.0	97.5	94.7	109
Copper	0.1 mg/L	----	1.0	100	89.9	114
	0.1 mg/L	<0.1	----	----	----	----
Iron	0.1 mg/L	----	1.0	112	80.7	125
	0.1 mg/L	<0.1	----	----	----	----
Lead	0.1 mg/L	----	1.0	98.3	95.8	108
	0.1 mg/L	<0.1	----	----	----	----
Manganese	0.1 mg/L	----	1.0	110	81.4	127
	0.1 mg/L	<0.1	----	----	----	----
Nickel	0.1 mg/L	----	1.0	97.4	91.6	112
	0.1 mg/L	<0.1	----	----	----	----
Zinc	0.1 mg/L	----	1.0	106	91.3	113
	0.1 mg/L	<0.1	----	----	----	----
EG005W: Water Leachable Metals by ICPAES						
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788)		mg/L	mg/L	%	%	%
Aluminium	0.10 mg/L	<0.10	----	----	----	----
	0.1 mg/L	----	1.0	103	86.6	113
Arsenic	0.01 mg/L	----	1.0	103	88.7	115
	0.01 mg/L	<0.10	----	----	----	----
Cadmium	0.005 mg/L	----	1.00	95.5	89.7	114
	0.005 mg/L	<0.050	----	----	----	----
Chromium	0.01 mg/L	----	1.0	94.1	92.1	110
	0.01 mg/L	<0.10	----	----	----	----
Copper	0.01 mg/L	----	1.0	97.8	89.1	113
	0.01 mg/L	<0.10	----	----	----	----
Iron	0.05 mg/L	----	1.0	108	77.8	124
	0.05 mg/L	<0.10	----	----	----	----

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Matrix Type: WATER

Method Blank (MB) and Laboratory Control Samples (LCS) Report

Analyte name	LOR	Method blank result	Actual Results: Spike concentration	Actual Results: Spike Recovery LCS	Recovery Limits: Dynamic Recovery Limits Low	Recovery Limits: Dynamic Recovery Limits High
EG005W: Water Leachable Metals by ICPAES - continued						
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788) - continued		mg/L	mg/L	%	%	%
Lead	0.01 mg/L	<0.10	----	----	----	----
	0.01 mg/L	----	1.0	94.6	90.8	113
Manganese	0.01 mg/L	----	1.0	106	78.4	128
	0.01 mg/L	<0.10	----	----	----	----
Nickel	0.01 mg/L	<0.10	----	----	----	----
	0.01 mg/L	----	1.0	88.9	86	118
Zinc	0.01 mg/L	<0.10	----	----	----	----
	0.01 mg/L	----	1.0	105	87.4	117
EG020T: Total Metals by ICP-MS						
EG020T: Total Metals by ICP-MS - (QC Lot: 481017)		mg/L	mg/L	%	%	%
Aluminium	0.01 mg/L	----	0.5	108	84.4	118
	0.01 mg/L	<0.01	----	----	----	----
Arsenic	0.001 mg/L	<0.001	----	----	----	----
	0.001 mg/L	----	0.1	90.0	78.7	111
Cadmium	0.0001 mg/L	<0.0001	----	----	----	----
	0.0001 mg/L	----	0.1	98.0	79.3	111
Chromium	0.001 mg/L	<0.001	----	----	----	----
	0.001 mg/L	----	0.1	101	83.4	114
Copper	0.001 mg/L	----	0.1	93.0	80.1	118
	0.001 mg/L	<0.001	----	----	----	----
Iron	0.05 mg/L	----	0.5	106	80.9	119
	0.05 mg/L	<0.05	----	----	----	----
Lead	0.001 mg/L	----	0.1	98.0	83.2	116
	0.001 mg/L	<0.001	----	----	----	----
Manganese	0.001 mg/L	----	0.1	97.0	80.1	114
	0.001 mg/L	<0.001	----	----	----	----
Nickel	0.001 mg/L	----	0.1	93.0	84.3	115
	0.001 mg/L	<0.001	----	----	----	----
Zinc	0.005 mg/L	<0.005	----	----	----	----
	0.005 mg/L	----	0.1	90.0	77.2	109

Matrix Type: WATER

Method Blank (MB) and Laboratory Control Samples (LCS) Report

Analyte name	*LOR*	*Method blank result*	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
				LCS	*Low*	*High*
EG035C: Leachable Mercury by FIMS						
EG035C: Leachable Mercury by FIMS - (QC Lot: 480789)		mg/L	mg/L	%	%	%
Mercury	0.0010 mg/L	<0.0010	----	----	----	----
	0.001 mg/L	----	0.0100	102	70	130
EG035T: Total Mercury by FIMS						
EG035T: Total Mercury by FIMS - (QC Lot: 481029)		mg/L	mg/L	%	%	%
Mercury	0.0001 mg/L	<0.0001	----	----	----	----
	0.0001 mg/L	----	0.010	101	78.6	118
EG035W: Water Leachable Mercury by FIMS						
EG035W: Water Leachable Mercury by FIMS - (QC Lot: 480790)		mg/L	mg/L	%	%	%
Mercury	0.0001 mg/L	<0.0001	----	----	----	----
	0.0001 mg/L	----	0.0100	99.3	70	130
EG050F: Hexavalent Chromium - Filtered						
EG050F: Hexavalent Chromium - Filtered - (QC Lot: 479877)		mg/L	mg/L	%	%	%
Hexavalent Chromium	0.010 mg/L	<0.010	----	----	----	----
	0.01 mg/L	----	0.5	104	70	130
EG050G: Hexvalent Chromium by Discrete Analyser						
EG050G: Hexvalent Chromium by Discrete Analyser - (QC Lot: 480845)		mg/L	mg/L	%	%	%
Hexavalent Chromium	0.01 mg/L	----	0.50	99.9	70	130
	0.01 mg/L	<0.01	----	----	----	----
EG050G-W: Hexavalent Chromium - Water Leachable						
EG050G-W: Hexavalent Chromium - Water Leachable - (QC Lot: 480846)		mg/L	mg/L	%	%	%
Hexavalent Chromium	0.01 mg/L	----	0.50	100	70	130
	0.01 mg/L	<0.01	----	----	----	----

Quality Control Report - Matrix Spikes (MS)

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC

Matrix Type: WATER

Matrix Spike (MS) Report

					Actual Results		Recovery Limits	
					Sample Result	Spike Recovery	Static Limits	
Analyte name	*Laboratory Sample ID*	*Client Sample ID*	*LOR*	*Spike Concentration*		*MS*	*Low*	*High*
EG005C: Leachable Metals by ICPAES								
EG005C: Leachable Metals by ICPAES - (QC Lot: 480787)				mg/L	mg/L	%	%	%
Aluminium	EP0703536-002	SKM-Ore-M2	0.1 mg/L	1.0	<0.1	124	70	130
Arsenic			0.1 mg/L	1.0	<0.1	104	70	130
Cadmium			0.05 mg/L	1.00	<0.05	101	70	130
Chromium			0.1 mg/L	1.0	<0.1	98.0	70	130
Copper			0.1 mg/L	1.0	<0.1	97.7	70	130
Iron			0.1 mg/L	1.0	<0.1	107	70	130
Lead			0.1 mg/L	1.0	<0.1	99.9	70	130
Manganese			0.1 mg/L	1.0	<0.1	110	70	130
Nickel			0.1 mg/L	1.0	<0.1	97.1	70	130
Zinc			0.1 mg/L	1.0	<0.1	103	70	130
EG005C: Leachable Metals by ICPAES - (QC Lot: 480824)				mg/L	mg/L	%	%	%
Aluminium	EP0703536-007	SKM-Ore-M2 - Borate Solution	0.1 mg/L	1.0	0.1	110	70	130
Arsenic			0.1 mg/L	1.0	<0.1	119	70	130
Cadmium			0.05 mg/L	1.00	<0.05	110	70	130
Chromium			0.1 mg/L	1.0	<0.1	106	70	130
Copper			0.1 mg/L	1.0	<0.1	109	70	130
Iron			0.1 mg/L	1.0	<0.1	120	70	130
Lead			0.1 mg/L	1.0	<0.1	106	70	130
Manganese			0.1 mg/L	1.0	<0.1	119	70	130
Nickel			0.1 mg/L	1.0	<0.1	106	70	130
Zinc			0.1 mg/L	1.0	<0.1	115	70	130
EG005W: Water Leachable Metals by ICPAES								
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788)				mg/L	mg/L	%	%	%
Aluminium	EP0703536-002	SKM-Ore-M2	0.1 mg/L	1.0	<0.10	96.6	70	130
Arsenic			0.01 mg/L	1.0	<0.10	106	70	130

ALS Environmental

Matrix Type: WATER

Matrix Spike (MS) Report

					Actual Results		Recovery Limits	
					Sample Result	Spike Recovery	Static Limits	
Analyte name	*Laboratory Sample ID*	*Client Sample ID*	*LOR*	*Spike Concentration*		*MS*	*Low*	*High*
EG005W: Water Leachable Metals by ICPAES - continued								
EG005W: Water Leachable Metals by ICPAES - (QC Lot: 480788) - continued				mg/L	mg/L	%	%	%
Cadmium	EP0703536-002	SKM-Ore-M2	0.005 mg/L	1.00	<0.050	95.5	70	130
Chromium			0.01 mg/L	1.0	<0.10	94.5	70	130
Copper			0.01 mg/L	1.0	<0.10	94.5	70	130
Iron			0.05 mg/L	1.0	<0.10	106	70	130
Lead			0.01 mg/L	1.0	<0.10	97.0	70	130
Manganese			0.01 mg/L	1.0	<0.10	108	70	130
Nickel			0.01 mg/L	1.0	<0.10	90.8	70	130
Zinc			0.01 mg/L	1.0	<0.10	107	70	130
EG020T: Total Metals by ICP-MS								
EG020T: Total Metals by ICP-MS - (QC Lot: 481017)				mg/L	mg/L	%	%	%
Arsenic	ES0711789-001	Anonymous	0.001 mg/L	1	0.004	84.6	70	130
Cadmium			0.0001 mg/L	0.25	<0.0001	92.0	70	130
Chromium			0.001 mg/L	1	0.005	106	70	130
Copper			0.001 mg/L	1	0.004	103	70	130
Lead			0.001 mg/L	1	0.002	89.8	70	130
Manganese			0.001 mg/L	1	0.077	103	70	130
Nickel			0.001 mg/L	1	0.002	99.8	70	130
Zinc			0.005 mg/L	1	0.015	88.5	70	130
EG035C: Leachable Mercury by FIMS								
EG035C: Leachable Mercury by FIMS - (QC Lot: 480789)				mg/L	mg/L	%	%	%
Mercury	EP0703536-002	SKM-Ore-M2	0.001 mg/L	0.0100	<0.0010	103	70	130
EG035T: Total Mercury by FIMS								
EG035T: Total Mercury by FIMS - (QC Lot: 481029)				mg/L	mg/L	%	%	%
Mercury	EP0703536-005	SKM-sw-1	0.0001 mg/L	0.010	<0.0001	88.2	70	130
EG035W: Water Leachable Mercury by FIMS								
EG035W: Water Leachable Mercury by FIMS - (QC Lot: 480790)				mg/L	mg/L	%	%	%
Mercury	EP0703536-002	SKM-Ore-M2	0.0001 mg/L	0.0100	<0.0001	97.3	70	130
EG050G: Hexvalent Chromium by Discrete Analyser								

ALS Environmental

Matrix Type: WATER

Matrix Spike (MS) Report

					Actual Results		Recovery Limits	
					Sample Result	Spike Recovery	Static Limits	
Analyte name	***Laboratory Sample ID***	***Client Sample ID***	***LOR***	***Spike Concentration***		***MS***	***Low***	***High***
EG050G: Hexvalent Chromium by Discrete Analyser - continued								
EG050G: Hexvalent Chromium by Discrete Analyser - (QC Lot: 480845)				mg/L	mg/L	%	%	%
Hexavalent Chromium	EP0703536-002	SKM-Ore-M2	0.01 mg/L	0.50	<0.01	95.1	70	130
EG050G-W: Hexavalent Chromium - Water Leachable								
EG050G-W: Hexavalent Chromium - Water Leachable - (QC Lot: 480846)				mg/L	mg/L	%	%	%
Hexavalent Chromium	EP0703536-002	SKM-Ore-M2	0.01 mg/L	0.50	<0.01	98.0	70	130

ALS Environmental

INTERPRETIVE QUALITY CONTROL REPORT

Client	:	**SINCLAIR KNIGHT MERZ**	**Laboratory**	:	Environmental Division Perth	**Page**	: **1 of 7**
Contact	:	MR DOMINIC NORTH	**Contact**	:	Michael Sharp		
Address	:	P O BOX H615 PERTH WA AUSTRALIA 6001	**Address**	:	10 Hod Way Malaga WA Australia 6090	**Work order**	: **EP0703536**
						Amendment No.	:
Project	:	WV03278	**Quote number**	:	EN-003-07 BQ	**Date received**	: 23 Aug 2007
Order number	:	- Not provided -				**Date issued**	: 30 Aug 2007
C-O-C number	:	- Not provided -					
Site	:	Leachability Study					
E-mail	:	dnorth@skm.com.au	**E-mail**	:	Michael.Sharp@alsenviro.com	**No. of samples**	
Telephone	:	9268 9678	**Telephone**	:	+61-8-9209 7655	**Received**	: 9
Facsimile	:	9268 4598	**Facsimile**	:	+61-8-9209 7600	**Analysed**	: 9

This Interpretive Quality Control Report was issued on 30 Aug 2007 for the ALS work order reference EP0703536 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

Interpretive Quality Control Report - Analysis Holding Time

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

Matrix Type: WATER ***Analysis Holding Time and Preservation***

Method / **Container /** Client Sample ID(s)	**Date Sampled**	**Extraction / Preparation**			**Analysis**		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EG020A-T: Total Metals by ICP-MS - Suite A							
Clear Plastic Bottle - Unfiltered; Lab-acidified							
SKM-sw-1	**10 Aug 2007**	**29 Aug 2007**	6 Feb 2008	Pass	**29 Aug 2007**	6 Feb 2008	Pass
EG035T: Total Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified							
SKM-sw-1	**10 Aug 2007**	----	----	----	**30 Aug 2007**	7 Sep 2007	Pass
EG050G-F: Hexavalent Chromium by Discrete Analyser - Filtered							
Miscellaneous Plastic bottle -unpreserved							
SKM-sw-1	**10 Aug 2007**	----	----	----	**27 Aug 2007**	11 Aug 2007	**Fail by 16 days**

Matrix Type: SOIL ***Analysis Holding Time and Preservation***

Method / **Container /** Client Sample ID(s)		**Date Sampled**	**Extraction / Preparation**			**Analysis**		
			Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EG005C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered								
SKM-Ore-M1,	SKM-Ore-M2,	**28 Aug 2007**	**28 Aug 2007**	24 Feb 2008	Pass	**28 Aug 2007**	24 Feb 2008	Pass
SKM-Ore-C2,	SKM-Ore-C1,							
SKM-Ore-M1 - Borate Solution,	SKM-Ore-M2 - Borate Solution,							
SKM-Ore-C2 - Borate Solution,	SKM-Ore-C1 - Borate Solution							
EG005W: Water Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered								
SKM-Ore-M1,	SKM-Ore-M2,	**28 Aug 2007**	**28 Aug 2007**	24 Feb 2008	Pass	**28 Aug 2007**	24 Feb 2008	Pass
SKM-Ore-C2,	SKM-Ore-C1							
EG035C: Leachable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered								
SKM-Ore-M1,	SKM-Ore-M2,	**28 Aug 2007**	----	----	----	**28 Aug 2007**	25 Sep 2007	Pass
SKM-Ore-C2,	SKM-Ore-C1,							
SKM-Ore-M1 - Borate Solution,	SKM-Ore-M2 - Borate Solution,							
SKM-Ore-C2 - Borate Solution,	SKM-Ore-C1 - Borate Solution							
EG035W: Water Leachable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered								
SKM-Ore-M1,	SKM-Ore-M2,	**28 Aug 2007**	----	----	----	**28 Aug 2007**	25 Sep 2007	Pass
SKM-Ore-C2,	SKM-Ore-C1							
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable								

Matrix Type: SOIL

Analysis Holding Time and Preservation

Method / **Container /** Client Sample ID(s)	**Date Sampled**	**Extraction / Preparation**			**Analysis**		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable **- continued**							
Clear Plastic Bottle - Natural							
SKM-Ore-M1, SKM-Ore-M2, SKM-Ore-C2, SKM-Ore-C1, SKM-Ore-M1 - Borate Solution, SKM-Ore-M2 - Borate Solution, SKM-Ore-C2 - Borate Solution, SKM-Ore-C1 - Borate Solution	**28 Aug 2007**	----	----	----	**28 Aug 2007**	29 Aug 2007	Pass
EG050G-W: Hexavalent Chromium by Discrete Analyser - Water Leachable							
Clear Plastic Bottle - Natural							
SKM-Ore-M1, SKM-Ore-M2, SKM-Ore-C2, SKM-Ore-C1	**28 Aug 2007**	----	----	----	**28 Aug 2007**	29 Aug 2007	Pass

ALS Environmental

Interpretive Quality Control Report - Frequency of Quality Control Samples

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

Matrix Type: WATER ***Frequency of Quality Control Samples***

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
EG005C: Leachable Metals by ICPAES	2	8	**25.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG005W: Water Leachable Metals by ICPAES	1	4	**25.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG020A-T: Total Metals by ICP-MS - Suite A	1	3	**33.3**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035C: Leachable Mercury by FIMS	1	8	**12.5**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035T: Total Mercury by FIMS	2	20	**10.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035W: Water Leachable Mercury by FIMS	1	4	**25.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable	1	8	**12.5**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-F: Hexavalent Chromium by Discrete Analyser - Filtered	1	1	**100.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-W: Hexavalent Chromium by Discrete Analyser - Water Leachable	1	4	**25.0**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Laboratory Control Samples (LCS)					
EG005C: Leachable Metals by ICPAES	2	8	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG005W: Water Leachable Metals by ICPAES	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG020A-T: Total Metals by ICP-MS - Suite A	1	3	**33.3**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035C: Leachable Mercury by FIMS	1	8	**12.5**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035T: Total Mercury by FIMS	1	20	**5.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035W: Water Leachable Mercury by FIMS	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable	1	8	**12.5**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-F: Hexavalent Chromium by Discrete Analyser - Filtered	1	1	**100.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-W: Hexavalent Chromium by Discrete Analyser - Water Leachable	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Method Blanks (MB)					
EG005C: Leachable Metals by ICPAES	2	8	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG005W: Water Leachable Metals by ICPAES	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG020A-T: Total Metals by ICP-MS - Suite A	1	3	**33.3**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035C: Leachable Mercury by FIMS	1	8	**12.5**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035T: Total Mercury by FIMS	1	20	**5.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035W: Water Leachable Mercury by FIMS	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable	1	8	**12.5**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-F: Hexavalent Chromium by Discrete Analyser - Filtered	1	1	**100.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-W: Hexavalent Chromium by Discrete Analyser - Water Leachable	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Matrix Spikes (MS)					
EG005C: Leachable Metals by ICPAES	2	8	**25.0**	**5.0**	ALS QCS3 requirement
EG005W: Water Leachable Metals by ICPAES	1	4	**25.0**	**5.0**	ALS QCS3 requirement
EG020A-T: Total Metals by ICP-MS - Suite A	1	3	**33.3**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035C: Leachable Mercury by FIMS	1	8	**12.5**	**5.0**	ALS QCS3 requirement
EG035T: Total Mercury by FIMS	1	20	**5.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG035W: Water Leachable Mercury by FIMS	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
EG050G-C: Hexavalent Chromium by Discrete Analyser - Leachable	1	8	**12.5**	**5.0**	ALS QCS3 requirement
EG050G-W: Hexavalent Chromium by Discrete Analyser - Water Leachable	1	4	**25.0**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement

Interpretive Quality Control Report - Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

Non-surrogates

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

Surrogates

- **For all matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

Method / **Container /** Client Sample ID(s)	**Date Sampled**	**Extraction / Preparation**			**Analysis**		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EG050G-F: Hexavalent Chromium by Discrete Analyser - Filtered							
Miscellaneous Plastic bottle -unpreserved							
SKM-sw-1	**10 Aug 2007**	----	----	----	**27 Aug 2007**	11 Aug 2007	**Fail by 16 days**

Outliers : Frequency of Quality Control Samples

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure 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 herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Matrix Type: SEAWATER ***Method Reference Summary***

Preparation Methods

EN25 : Digestion for Total Recoverable Metals - 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 (1999) Schedule B(3) (Appdx. 2)

EN25W : Digestion for Total Recoverable Metals - 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 (1999) Schedule B(3) (Appdx. 2)

Analytical Methods

EG005W : Water Leachable Metals by ICPAES - APHA 21st ed., 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 (1999) Schedule B(3) (Appdx. 2)

EG020A-T : Total Metals by ICP-MS - Suite A - (APHA 21st ed., 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.

EG035T : Total Mercury by FIMS - AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The 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 (1999) Schedule B(3) (Appdx. 2)

EG035W : Water Leachable Mercury by FIMS - AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The 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 (1999) Schedule B(3) (Appdx. 2)

EG050G-F : Hexavalent Chromium by Discrete Analyser - Filtered - APHA 21st ed., 3500 Cr-A & B. Hexavalent chromium is determined directly on water sample by Seal 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 (1999) Schedule B(3) (Appdx. 2)

EG050G-W : Hexavalent Chromium by Discrete Analyser - Water Leachable - APHA 21st ed., 3500 Cr-A & B. Hexavalent chromium is determined directly on leachate samples by Seal 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 (1999) Schedule B(3) (Appdx. 2)

EN60 : Bottle leaching Procedure - AS4439.3 Preparation of Leachates. This procedure outlines the preparation of leachates designed to determine the mobility of both organic and inorganic analytes present in liquid, solid and multiphasic wastes.

Matrix Type: TCLP LEACHATE ***Method Reference Summary***

Preparation Methods

EN25C : Digestion for Total Recoverable Metals - 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 (1999) Schedule B(3) (Appdx. 2)

Analytical Methods

Matrix Type: TCLP LEACHATE

Method Reference Summary

Analytical Methods

EG005C : Leachable Metals by ICPAES - APHA 21st ed., 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 (1999) Schedule B(3) (Appdx. 2)

EG035C : Leachable Mercury by FIMS - AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The 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 (1999) Schedule B(3) (Appdx. 2)

EG050G-C : Hexavalent Chromium by Discrete Analyser - Leachable - APHA 21st ed., 3500 Cr-A & B. Hexavalent chromium is determined directly on leachate samples by Seal 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 (1999) Schedule B(3) (Appdx. 2)

EN33 : TCLP for Non and Semivolatile Analytes - (USEPA SW846-1311, ALS QWI-EN/33) The TCLP procedure is designed to determine the mobility of both organic and inorganic analytes present in wastes. The standard TCLP leach is for non-volatile and Semivolatile test parameters. Extraction Fluid #1 pH 4.88 - 4.98. Extraction Fluid #2 pH 2.83 - 2.93.

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