APPLICATION ON NOTIFICATION – CROWN DEVELOPMENT

Applicant:	Origin Energy Power Limited
Development Number:	010/V008/18
Nature of Development:	'Project LISA – LPG into South Australia'. Floating gas storage and berthing platform and upgrade to existing gas turbine
Type of development:	Public Infrastructure
Zone / Policy Area:	Public Purposes (Quarantine Station)
Subject Land:	Quarantine Power Station - Grand Trunkway, Torrens Island and Port River
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Start Date:	Wednesday 21 February 2018
Close Date:	Thursday 15 March 2018

During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders Street, Adelaide during normal business hours. Application documentation may also be viewed during normal business hours at the local Council office (Port Adelaide Enfield Council).

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, faxed or emailed to the State Commission Assessment Panel (SCAP). A representation form is provided as part of this pdf document.

Any representations received after the close date will not be considered.

Postal Address:
The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:
Development Division
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street
ADELAIDE

Email Address: scapadmin@sa.gov.au
Fax Number: (08) 8303 0753

Government of South Australia

Department of Planning, Transport and Infrastructure

DEVELOPMENT ACT 1993

NOTICE OF APPLICATION FOR CONSENT TO DEVELOPMENT

SECTION 49 – PUBLIC INFRASTRUCTURE

Notice is hereby given that an application has been made by **Origin Energy Power Limited** for **'Project LISA - LPG Into South Australia'** (Development Application Number: **010/V008/18**). The proposal comprises the installation of a floating gas storage and berthing platform that would be moored in the Port River, opposite the Quarantine Power Station, and be periodically refilled by a gas carrier replenishment ship. The application also includes the upgrade of an existing gas turbine (i.e. to use LPG) within the Quarantine Power Station and a pipeline connecting the two facilities. Approximately 30,000 square metres of the Port River would be dredged to enable vessel access to the platform. Approximately 70,000 cubic metres of dredged material would be disposed of at existing EPA licensed ponds, nearby on Le Fevre Peninsula.

The land is situated at the **Quarantine Power Station – Grand Trunkway, Torrens Island and the adjacent Port River** and applies to the land parcels - Allotment 305 in Deposited Plan 90964 (CT 6132/766) and Allotment 112 in Deposited Plan 59977 (CT 5907/399).

The subject land is located within the Public Purposes (Quarantine Station) Zone of the Land Not Within a Council Area (Metropolitan) Development Plan (consolidated 5 May 2016).

The application may be examined during normal office hours at the office of the State Commission Assessment Panel, Level 5, 50 Flinders Street and at the office of Port Adelaide Enfield Council, 163 St Vincent Street, Port Adelaide. Application documentation may also be viewed on the SCAP website at: http://www.saplanningcommission.sa.gov.au/scap/public_notices.

Any person or body who desires to do so may make representations concerning the application by notice in writing delivered to the Secretary, State Commission Assessment Panel (GPO Box 1815, Adelaide SA 5001), not later than **15 March 2018.**

Each person or body making a representation should state the reason for the representation and whether that person or body wishes to be given the opportunity to appear before the Panel to further explain the representation.

Representations may be made available for public inspection. Please indicate in writing if you object to your representations being made available in this way.

Should you wish to discuss the application and the public notification procedure please contact **Lee Webb** on **(08) 7109 7066** or lee.webb@sa.gov.au

Alison Gill
SECRETARY
STATE COMMISSION ASSESSMENT PANEL
www.saplanningcommission.sa.gov.au/scap

PN2495

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Portside Messenger
Wed 21 February 2018

DEVELOPMENT ACT, 1993
S49/S49A – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Origin Energy Power Limited
Development Number:	010/V008/18
Nature of Development:	Installation of a floating gas storage and berthing platform (including dredging in the Port River), opposite the Quarantine Power Station, to be periodically refilled by a gas carrier replenishment ship. The upgrade of an existing gas turbine within the Power Station and a pipeline connecting the two facilities.
Zone / Policy Area:	Public Purposes (Quarantine Station)
Subject Land:	Quarantine Station - Grand Trunkway, Torrens Island and Port River
Contact Officer:	Lee Webb
Phone Number:	(08) 7109 7066
Close Date:	Thursday 15 March 2018

My name:____

My phone number: ____

PRIMARY METHOD(s) OF CONTACT: Email address: ______________________________

Postal address:______________________________

______________________________Postcode____________

<u>You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.</u>

My interests are:
[ ] owner of local property
[ ] occupier of local property
[ ] a representative of a company/other organisation affected by the proposal
[ ] a private citizen

The address of the property affected is ....Postcode....................................

The specific aspects of the application to which I make comment on are: ....

....

....

....

....

....

....

I [ ] wish to be heard in support of my submission
[ ] do not wish to be heard in support of my submission
(Please tick one)

by [ ] appearing personally
[ ] being represented by the following person : ....
(Cross out whichever does not apply)

Date: .... Signature: ....

Return Address: The Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 or scapadmin@sa.gov.au

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: Land Not Within a Council Area

APPLICANT: Origin Energy Power Limited

ADDRESS: 339 Coronation Drive, Milton, QLD, 4064

CROWN AGENCY: Department of the Premier and Cabinet

FOR OFFICE USE

DEVELOPMENT No: ____________

PREVIOUS DEVELOPMENT No: ____________

DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: Peter Anderberg

Telephone: 0448 675 290 [work] 08 8200 9610 [Ah]

Fax: ____________ [work] ____________ [Ah]

Email: ____________

☐ Complying ☐ Merit ☐ Public Notification ☐ Referrals	Decision: ____________ Type: ____________ Finalised: / /

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over $4 million (excl. fit-out) will be subject to an advertising fee. (2) Three copies of the application should also be provided.

	Decision required	Fees	Receipt No	Date
Planning:				
Land Division:				
Additional:				
Minister's Approval				

EXISTING USE: Quarantine Power Station and shipping / Port-related activities

DESCRIPTION OF PROPOSED DEVELOPMENT: The proposal is named 'Project "LISA"' – LPG into South Australia and constitutes a moored Storage Barge in Port River that is replenished by a transient Small Gas Carrier (Replenishment Ship), an upgrade of an existing gas turbine (QPS Unit 5), and a pipeline connecting the two facilities.

LOCATION OF PROPOSED DEVELOPMENT: ____________

House No: ______ Lot No: ______ Street: ____________ Town/Suburb: Torrens Island

Section No [full/part] ______ Hundred: ______ Volume: 6132 Folio: 766

Section No [full/part] ______ Hundred: ______ Volume: ______ Folio: ______

LAND DIVISION:

Site Area [m^2] ______ Reserve Area [m^2] ______ No of existing allotments ______

Number of additional allotments [excluding road and reserve]: ______ Lease: **YES** ☐ **NO** ☐

DEVELOPMENT COST [do not include any fit-out costs]: $ 14,000,000

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from sa.gov.au.

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993* and meet the requirements for lodgement under s.49 of the Development Act 1993.

SIGNATURE: ____________ Dated: 24 / 01 / 18

24 January 2017

EXECUTIVE SUMMARY

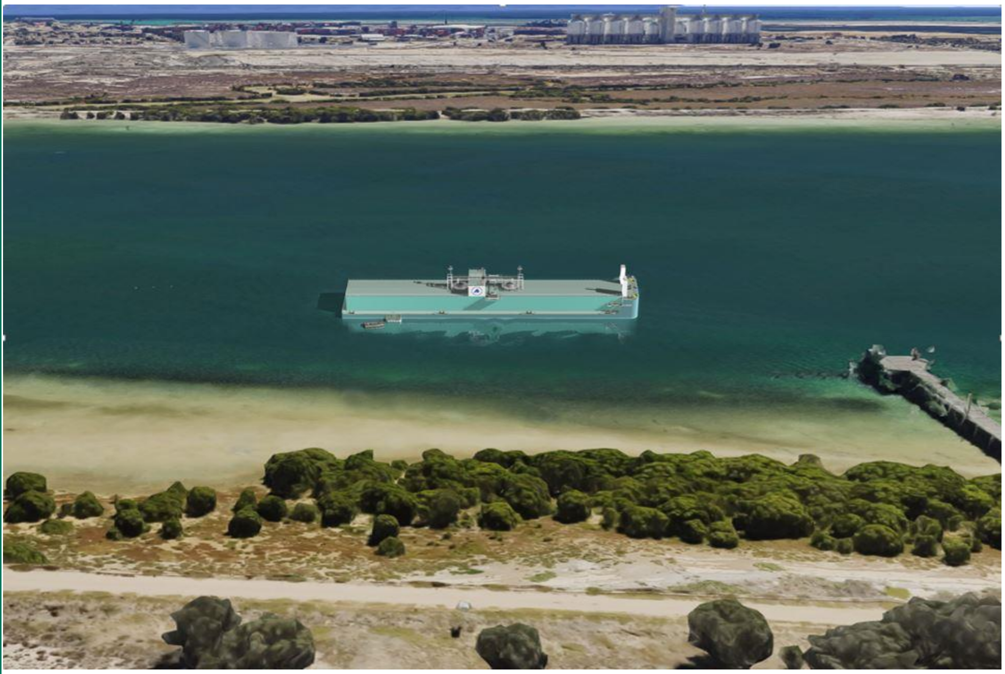
ORIGIN ENERGY POWER LIMITED

LPG Into South Australia Executive Summary

VOLUME 1: EXECUTIVE SUMMARY

Submitted to:
Zoe Delmenico
Department of Planning, Transport and Infrastructure

On behalf of:
Origin Energy Power Limited



Report Number. 1783241-002-R-Rev0

Distribution:

1 E-copy- Origin Energy Power Limited
1 E-copy- Golder Associates

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Preface

It should be noted this Development Application Report has been prepared by Golder Associates (Golder) on behalf of Origin Energy Power Limited (Origin) and is supported by specialist reports from independent consultants.

This Development Application for the Project LISA has been prepared with all reasonable care, and whilst every effort has been made to ensure the accuracy of the material published in the associated documents, Origin is not liable for any inaccuracies and deficiencies.

Registered office:

Origin Energy Power Limited

339 Coronation Drive, Milton QLD 4064

1.0 PROJECT LISA

1.1 Introduction

Origin Energy Power Limited (Origin) is proposing to upgrade a portion of the Quarantine Power Station (QPS) on Torrens Island, South Australia to include dual fuel capabilities (LPG and natural gas). This will ensure reliable and affordable electricity supply to Origin's customers and add significantly to improved security of the SA electricity network.

The proposal is named 'Project "LISA"' – LPG into South Australia and constitutes a moored Storage Barge in Port River that is replenished by a transient Small Gas Carrier (Replenishment Ship), an upgrade of an existing gas turbine (QPS Unit 5), and a pipeline connecting the two facilities. LPG is expected to be sourced from Port Bonython.

Construction will include localised backhoe excavation and cutter suction dredging to enable the Storage Barge and Replenishment Ship to be safety moored in position. Disposal of the spoil will be to existing licensed dredge disposal ponds or, if suitable, will be used to improve breeding habitat for the South Australian endangered Fairy Tern. Horizontal directional drilling will be used for the placement of the pipeline, a technique that will avoid disturbance to mangroves and the seawall on Torrens Island. On Torrens Island, the pipeline will be placed in a covered culvert. Equipment will be fabricated by others and delivered to site for installation.

There are no works in the adjacent Torrens Island Quarantine Station.

1.2 The proponent

Origin is one of Australia's leading integrated energy companies. Origin explores, produces, transports and sells energy to power millions of Australian homes and businesses every day and plays an integral role in shaping Australia's energy future.

Origin has been an incorporated company for 17 years, having demerged from Boral Limited in 2000. Origin has been involved in South Australia through its history, having control of the largest peaking power station in South Australia (QPS) as well as constructing and commissioning the SEA Gas Pipeline that links Victoria and South Australia.

Origin is the main ship carrier of LPG on the Australian coast. With a fleet of three Small Gas Carriers (SGC) and one Very Large Gas Carrier (VLGC) imported every two months, Origin ships load approximately 200,000 tonnes from floating storage operations at Moreton Bay and delivers the LPG to Australian and international sea terminals.

1.3 Approval pathway

This Development Application Report (DAR) has been prepared for submission to the State Commission Assessment Panel (SCAP) and relevant referral bodies, pursuant to Section 49(1)(a) of the Development Act 1999 (Development Act). In accordance with the Development Act, the Project, considered to be Public Infrastructure, has been granted Crown Sponsorship through the Department of Premier and Cabinet (DPC).

The Project location is within the Land Not Within a Council Area (Metropolitan) Development Plan.

1.4 Project description

Origin proposes to upgrade QPS Unit 5 (hereafter referred to as Unit 5) to have dual fuel capabilities (LPG and natural gas) with associated fuel storage on a barge in Port River.

Project LISA will supply LPG from a Replenishment Ship to a Storage Barge, moored in Port River to the west of QPS. Figure 1 shows the site with existing and proposed infrastructure.

To allow the Replenishment Ship access to the Storage Barge, a small area of the Port River needs to be deepened. Origin will use a backhoe and cutter suction dredge (CSD) to remove approximately 70,000 m^3 of material, which will be placed on a barge, transported and offloaded at the disposal site. In January 2018, EPA identified that the dredge material has the potential to improve breeding habitat for an endangered bird on 'Bird Island', a small sand spit opposite the Pelican Point dredge disposal ponds in Outer Harbor. Origin will continue to work with agencies to determine the suitability of Bird Island as a disposal site, and if not suitable, will use two existing licensed dredge disposal ponds on Le Fevre Peninsula, owned and operated by Flinders Ports.

The Storage Barge has been designed to provide for 4.5 days of continuous operation of the 128 MW gas turbine (equivalent to 13,000 MWh of fuel storage). LPG will be transferred via secure ship-to-barge and then Barge-to-Unit pipes and hoses, as used on existing LPG ships owned by Origin. A visual representation of the Storage Barge, "L.I.S.A", in position is included as Figure 2. The visualisation is representative of the proposed barge, and has used a publicly accessible image to render the appropriate features.

After some equipment upgrades and installation of new vaporisers, Unit 5 can use the stored LPG to generate electricity in response to peaking power needs. Response times are rapid (i.e. within 24 minutes) and constrained only by Unit 5 start-up times.

Project LISA infrastructure and activities can be summarised as having Port River, Torrens Island and Le Fevre Peninsula elements. The Replenishment Ship is a transitory feature of the project, expected to berth alongside the Storage Barge 10 -12 times a year for up to a day.

Table 1 summarises the current land use and planning zones of the Port River, Torrens Island and Le Fevre Peninsula, as well as the proposed infrastructure and activities.

Table 1: Project LISA broad infrastructure and activity elements

Location	Existing land use	Infrastructure and activities
Port River	■ South Australia's primary maritime gateway and includes 19 berths of varying capacity. The river and shipping channel is periodically dredged for capital and maintenance purposes ■ The area below low water mark is not zoned under any Development Plan and constitutes Crown Land (Figure 5).	■ Deepening the river via backhoe and Cutter Suction Dredge (subject to detailed design) to enable safe Replenishment Ship access to the Storage Barge ■ Mooring dolphin for safe and secure positioning ■ Storage Barge "L.I.S.A" ■ 6 inch pipeline from Storage Barge to Unit 5 (expected to be directionally drilled, subject to detailed design).
Torrens Island	■ Two existing power stations (QPS and Torrens Island Power Station (TIPS)) and the Torrens Island Quarantine Station (TIQS) surrounded by conservation areas ■ Torrens Island is 'Land Not Within a Council Area' (LNWCA). The QPS is within the 'Public Purpose (Quarantine Station) zone.	■ 6 inch pipeline from Storage Barge to Unit 5 (continued; expected to be directionally drilled, and then installed in a shallow covered culvert) ■ Installation of 2 new vaporisers ■ Unit 5 turbine upgrade.
Le Fevre Peninsula	■ Highly industrialised peninsula with existing facilities to accommodate the dredged material ■ Much of the land adjacent Port River is zoned 'Industrial' under the Port Adelaide Enfield Development Plan.	■ No new infrastructure required ■ Dredge material (approximately 70,000 m^3) to be disposed at licensed Flinders Ports dredge disposal facilities

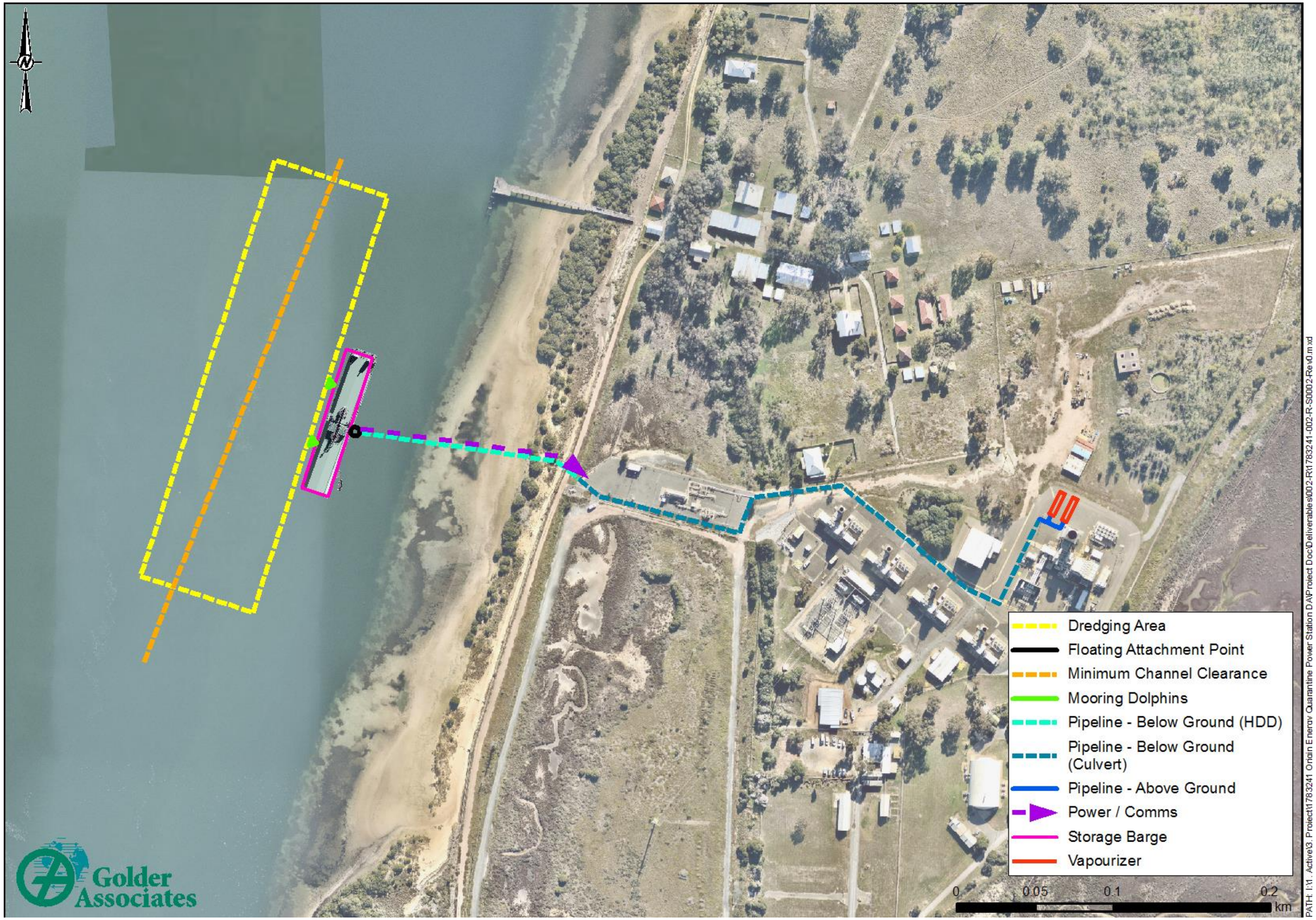

Figure 1: Project LISA existing and proposed infrastructure

Figure 2: Visualisation of L.I.S.A moored in Port River

1.5 Project objectives

Origin's QPS and AGL's Torrens Island Power Station (TIPS) currently use natural gas. When natural gas supply is constrained or expensive, Origin is proposing to introduce an alternative fuel source, LPG, to Unit 5. The provision of LPG into South Australia will fulfil the following objectives:

- Increases the stability and inertia of the South Australian energy market by providing approximately 13,000 MWh of power storage
- Provides security of fuel supply for power generation
- Reduces the impact of potential single point equipment failures of the Moomba to Adelaide Pipeline (MAP, owned by Epic Energy) and/or the Port Campbell to Adelaide Pipeline (owned by SEA Gas)
- Opens new growth markets for the LPG industry.

The Project also aligns with State and Commonwealth policies for increasing energy security.

1.6 Consultation

Preparation of this Development Application (DA) has been undertaken in consultation with:

- Department of State Development (DSD)
- Department of Environment, Water and Natural Resources (DEWNR)
- Department of Planning Transport and Infrastructure (DPTI)
- Environment Protection Authority (EPA)
- Biosecurity SA
- City of Port Adelaide Enfield (PAE)
- Safework SA
- Australian Maritime Security Authority (AMSA)
- Flinders Ports
- Easement holders (Epic Energy and SEA Gas).

2.0 SURROUNDING ENVIRONMENT AND POTENTIAL IMPACTS

2.1.1 Geology and soils

The quaternary coastal marine and continental facies of the region between Le Fevre Peninsula and Mount Lofty Ranges is shown in Figure 3. Sedimentary deposits in the Port Adelaide region include a sequence of coastal lagoons and intertidal facies comprised of the St Kilda Formation, overlying the Glanville Formation, with areas of the non-marine Pooraka Formation (Belperio, 2012).

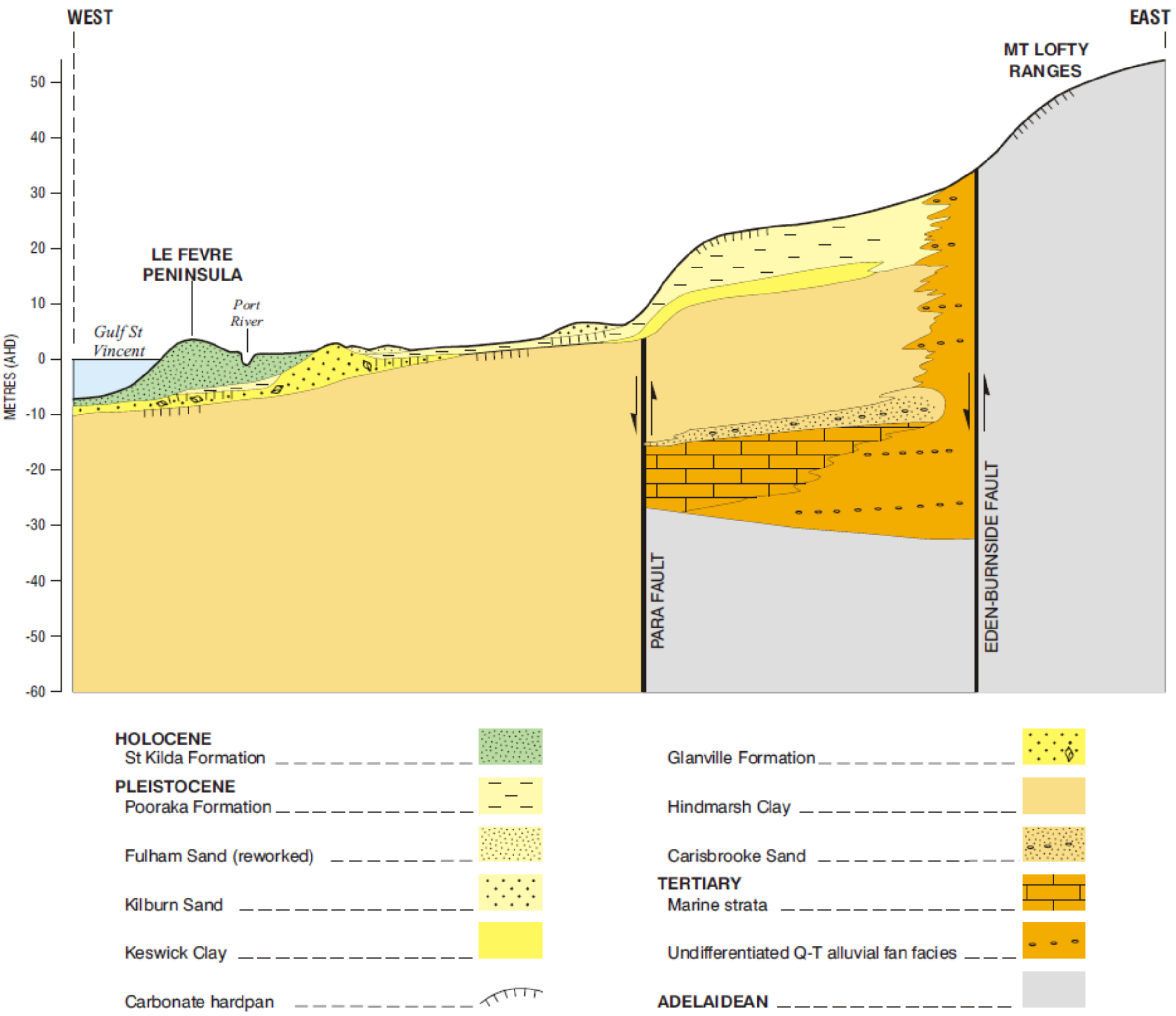

Figure 3: Schematic cross-section from Le Fevre Peninsula to the Mount Lofty Ranges- not to scale (Belperio, 2010)

Onshore - QPS

Installation of the pipeline from the Storage Barge to Unit 5 is expected to be installed by a combination of Horizontal Directional Drilling (HDD) at maximum depth of 6 m bgl and by excavating and installing a pre-fabricated shallow culvert. The method of trench installation selected minimises disturbance at the surface and the surplus soil generated and requiring disposal and/or management.

Fill (up to 0.65 m bgl) and semaphore sand (up to 1.9 mbgl) are expected to be encountered during excavations.

Surplus soils generated will be managed in accordance with SA EPA guidelines, including appropriate soil contamination investigation for disposal or offsite reuse.

Port River

The shallow sediments of the Port River river bed include sediments of the St Kilda Formation comprising varying thickness soft sandy shelly mud, overlying the Glanville Formation comprising cemented calcarenite/calcrete at the top and stiff calcareous clay (Seas Offshore, 2017).

Deepening the river bed between 5.2 and 8 m is expected to encounter St Kilda Formation and Glanville Formation. Approximately 70,000 m^3 of sediment, surplus to Project requirements, will be generated as a result of the dredging activities and will require disposal.

An *in situ* contamination assessment of the shallow sediment was undertaken to inform the preliminary designs and the most appropriate and pragmatic disposal options for the surplus sediment. The results indicated that the sediment proposed for excavation is suitable for disposal to the proposed licensed disposal ponds without having an adverse impact on the receiving environment.

Management

Soil management measures during construction will be detailed in a Construction Environmental Management Plan (CEMP) and a Dynamic Dredge Management Plan.

Further geophysical/geotechnical investigations may be required to assess the Glanville Formation sediments in the detailed mooring designs.

2.1.2 Groundwater

The depth to groundwater in the Port Adelaide region is generally between 2 and 5 mbgl (SARIG) and during geotechnical investigations undertaken at the QPS (Coffey, 2012), shallow groundwater was encountered at depths of between 1.15 and 1.5 m.

Groundwater may be encountered during installation of the pipeline from the Storage Barge to Unit 5, dependent on detailed design and final construction methodology.

There will be no further impact to groundwater following shallow excavations associated with pipeline installation.

Where groundwater is encountered, temporary dewatering may be required to facilitate installation of the pipeline, depending on the construction methodology. The extracted water will be appropriately disposed of in accordance with the SA EP Act, including permits for discharging to sewer, if required.

Requirements for dewatering will be considered and documented in a Dewatering Management Plan (if required) by the Contractor.

Requirements and options for management/disposal of extracted water will be further investigated during detailed design.

2.1.3 Water quality

Water quality monitoring

In 2017, water quality within Port River adjacent to Site 1 and Site 4 was analysed, south of the QPS, as identified in Figure 4. The water quality results are shown in Table 2.

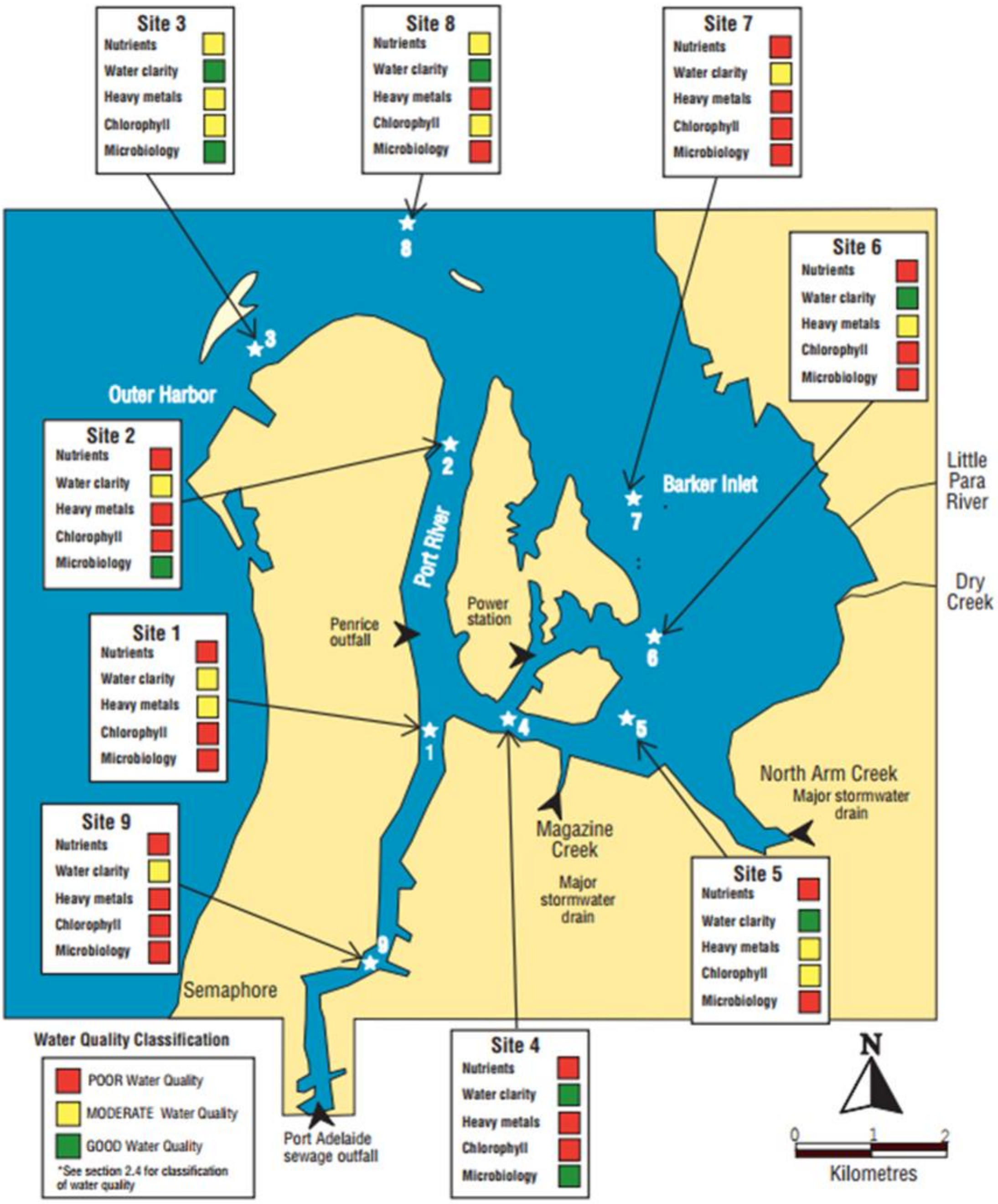

Figure 4: Port River ambient water quality monitoring sites and water quality classification from September 1995 to August 2000 (SA EPA, 2002)

Table 2: Summary of surface water field parameters

Site	Temp (°C)	Redox (mV)	EC (µS/cm)	pH (pH units)	DO (mg/L)
Site 1	16.5	72.2	42.58	7.87	8.72
Site 4	16.1	78.4	41.94	7.82	8.70

Units: °C – degrees Celsius, mV – millivolts, µS/cm – mircosiemens per centimetre, mg/L – milligrams per litre.

Concentrations of all analytes assessed (metals, nutrients, phenols, polycyclic aromatic hydrocarbons, polychlorinated biphenyls and BTEX (benzene, toluene, ethylbenzene and xylene)) were below the Recreation and Aesthetics criteria in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2010).

Concentrations of the analytes were also compared to the Australian and New Zealand Environment and Conservation Council guidelines for protection of 95% of marine systems (protection level based on the site being considered slightly-to-moderately disturbed). When compared to these results lead, nickel and zinc exceeded the criteria at Site 4, and copper exceeded the criteria at both locations. Water quality within Port River was demonstrated to have improved over the last decade.

Turbidity

The marine environment of Outer Harbor is exposed to periods of high levels of turbidity, primarily as a result of the shipping activity in the Port (KBR, 2004). Based on information collected prior to the Outer Harbor Capital Dredging Project in 2004, turbidity in the Port can be expected to increase up to 35 NTU above background levels during shipping movements. (KBR, 2004)

Background turbidity within Port River near the Torrens Island Quarantine Station jetty is shown in Table 3. These data show that while turbidity levels within the river remain low during winter and spring, there is significant fluctuation in the summer and autumn months.

Table 3: Seasonal turbidity near the Torrens Island Quarantine Station jetty (data recorded 1995-2008)

	Mean ± SD[1]	Maximum	Minimum
Summer	5.35 ±5.53	21.33	1.07
Autumn	3.84 ±2.79	10.71	1.10
Winter	2.43 ±1.33	5.73	1.30
Spring	2.80 ±1.30	4.80	0.50

1 Standard deviation

The use of Origin's proposed backhoe dredging inherently limits turbidity and sedimentation. Backhoe dredges remove spoil with a closed bucket and load dredged material onto a barge at near *in situ* water content and does not require overflow barges. Therefore, the resulting turbidity is drastically reduced when compared to hydraulic dredge methods (i.e. THSD and CSD).

The CSD will only be used where required to break through hard sediment. As a hydraulic method, CSD dredging is expected to produce a thin slurry of approximately 20% solids to 80% water. The barge overflow will remove excess water and be transported when the dredge mixture is approximately 80% solids and 20% water. There is little turbidity created at the cutter head, however, turbidity is caused by the overflowing water.

Dredging methods have been selected to limit turbidity and sediment dispersion, however, potential impacts to water quality from dredging remain and are discussed below.

- Increase in turbidity from deployment of dredging spuds
  - The installation of the anchoring spuds associated with the backhoe dredger and CSD will cause some disturbance of the river bed and suspension of fine sediments. However, this process is only expected to occur approximately once each day and would only occur over a short period of time (i.e. less than 5 minutes per spud). Any suspended plume is expected to disperse quickly via tidal currents following the spud installation.

- Increase in turbidity from dredging operations
  - Turbidity plumes are expected to be limited to the immediate vicinity of the sediment excavation and are considered to be minor and temporary. Backhoe dredging for the berthing facility upgrade at Kurnell generated little sediment – approximately 5 mg/L above background levels (URS 2013)
  - Turbidity increases as a result of the use of a CSD for channel deepening are expected to be greater than those resulting from the backhoe dredge as a result of the overflow barge. The turbidity impacts are expected to be minor and temporary, in the context of the use of Port River as a busy shipping channel. Use of the CSD will be limited to breaking through hard sediment only, and will be avoided wherever possible
  - With respect to sedimentation and turbidity impacting environmental values, the benthic environment surrounding the dredging activities are generally highly disturbed and dominated by noxious species *Caulerpa cylindracea* and *C. taxifolia.* A small community of seagrasses in poor condition was observed in shallow waters inshore and upstream of the proposed dredge footprint. Origin proposes to protect inshore seagrasses throughout the deepening works
  - Annual shipping movements during operation are expected to be approximately 10-12 annual shipments. This frequency is expected to have a negligible impact on the overall turbidity conditions of the Port River in the vicinity of the site, particularly considering the site is adjacent the shipping channel.

- Reduced water quality from mobilised sediment contaminants
  - The sediment proposed for excavation is suitable for disposal to the proposed licensed disposal facilities without having an adverse impact on the receiving environment
  - Mobilised sediment contaminants during construction are expected to have a negligible impact on water quality.

- Contamination from spills and discharges
  - Maintaining the water quality of the Port River has been central to the Project design. The Storage Barge has been specifically designed with tanks and pumps submerged below deck and all piping fully welded (except battery limits) to eliminate potential leak points and ensure the risk of impact to the Port River water quality during installation of the Storage Barge and operation are negligible.

Origin is committed to protecting sensitive environmental values and has selected a dredging technique to minimise impacts to water quality. Further, land-based disposal of dredge material provides additional protection to water quality.

Origin and the dredging contractor will work with the EPA to establish appropriate turbidity criteria as a part of the dredging licence.

Additional management measures that relate to seagrass protection, spill prevention/control, emergency procedures and other management measures to mitigate risks and minimise potential impacts will be implemented through the CEMP. The Storage Barge also includes spill detection systems.

2.1.4 Coastal ecology

Torrens Island is bound by the Port River to the west, the Barker Inlet to the south and east and the Section Bank mudflats to the north. These areas support tide dominated estuaries, with low tide saline mudflats, mangrove (approximately 60% of the Island) and salt marshes comprising a significant part of the area (EAC Ecological Evaluation (EAC) 2013). The island is part of an 822 ha ecosystem-unit which includes the Adelaide Dolphin Sanctuary and the Barker Inlet/St Kilda Aquatic Reserve, which is listed as a wetland of National Importance.

A flora and fauna field survey was undertaken as part of the Torrens Island Biodiversity Action Plan (The Action Plan) (EAC Ecological Evaluation Pty Ltd 2013). Torrens Island vegetation was characterised into four broad categories (Figure 5):

1) Coastal dunes – these are mainly found on the northern end and north western coast of Torrens Island, north of the TIQS and QPS.

2) Samphire shrublands – these are found on the northern end of the Island and southern area, east of the Torrens Island Power Station.

3) Mangroves – found on intertidal mudflats of tidal estuaries and muddy seashores and extending inland along the tidal channels merging into samphire shrublands at the landward limit of the intertidal zone.

4) Introduced grassland/herbland – to the east of the Torrens Island Quarantine Station and in degraded land adjacent salt marshes.

The ecosystem of Torrens Island is threatened by introduced weed species including a number of environmental weeds, and declared plants including Bridal creeper, Skeleton weed, False caper and African boxthorn.

Torrens Island provides a safe haven for local and migratory birds, including sea birds. Many bird species, including some with conservation significance, rely on the conservation area and surrounding samphire shrublands for foraging and breeding. Native reptiles are also expected to be present on Torrens Island (EAC 2013).

The QPS facility has been generally characterised as a cleared area with exotic grasses and herbs and amenity plantings (Jacobs 2017).

The intertidal area to the west of QPS consists of a regenerating Mangrove forest varying from 5 -15 m in width. There is a sparse coverage of samphire beneath the mangroves, increasing in density moving east towards the QPS. Above the seawall / levee bank and high tide mark the project area consists of degraded chenopod shrubland dominated by exotic grasses and low shrubs (Coastal Galenia), with sparse coverage of Saltbush, Nitre-bush and Round leaf pigface.

The Project infrastructure and construction method has been designed to ensure there is a negligible impact on the vegetation present at QPS. All of the QPS upgrade infrastructure and majority of the LPG pipeline will be within the existing hardstand area (Figure 6).

For the 6 inch pipeline to cross the intertidal areas containing Mangrove and chenopod shrubland, Origin has proposed HDD below the mangrove root zones. This eliminates the need for surface excavation and as such, no vegetation losses in the intertidal zone are anticipated.

With no loss of habitat anticipated, there are no impact pathways to avian fauna. Operational impacts to vegetation will also be negligible.

A self-assessment of the project in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) determined that there were no significant impact pathways that would require referral to the Department of the Environment and Energy (DotEE).

Management measures, such as enforcing exclusion zones, will be implemented during construction through the CEMP to ensure potential impacts to existing vegetation and fauna are minimised.

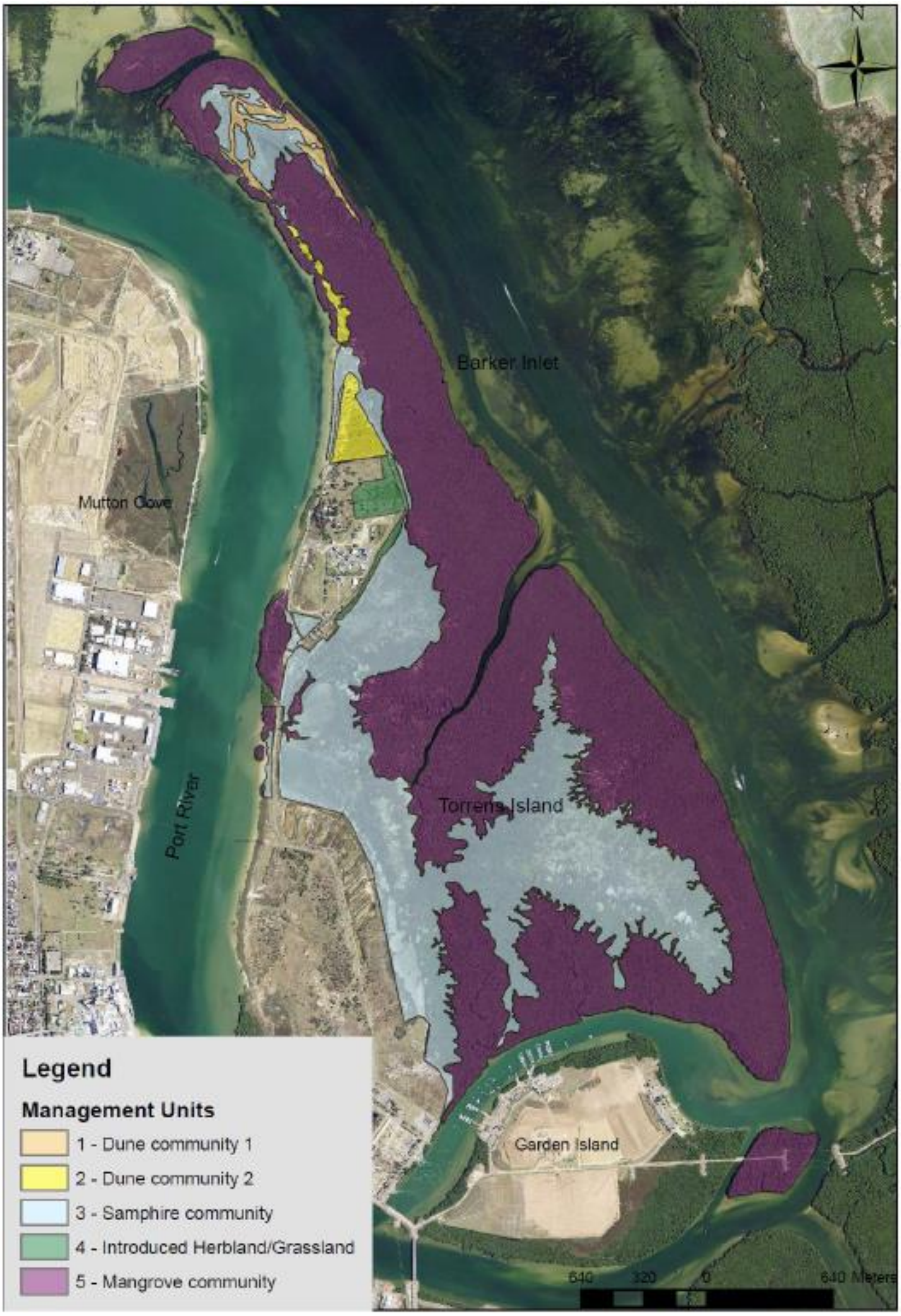

Figure 5: Torrens Island broad vegetation communities (EAC 2013)

Figure 6: Onshore infrastructure location (a) shallow culvert and (b) vaporisers

2.1.5 Marine ecology

An aquatic habitat assessment of the Project area within the Port River was undertaken at 20 monitoring locations within the proposed dredge footprint to characterise the vegetation and fauna, including a five meter buffer radius. Video transects were also used to gain a broad understanding of the distribution of habitats within the proposed dredge area and its surroundings.

A self-assessment of the project in accordance with the EPBC Act determined that there were no significant impact pathways that would require referral to the DotEE.

Storage Barge and Replenishment Ship berthing pocket

A dive and video transect survey through the area showed the Storage Barge and Replenishment Ship berthing pocket footprint was primarily covered by dense mats of invasive green algae (*Caulerpa cylindracea* and *C. taxifolia)*, introduced European fan worms (*Sabella spallanzanii)* and razor clams (*Pinna bicolor).* Densities of Caulerpa were typically greatest towards the shore side of the footprint and reduced in density towards the shipping channel. The dominant marine habitats are shown in Figure 7.

There were no seagrasses identified in the dredge area and accordingly, no direct losses are anticipated from Project LISA.

Benthic invertebrates such as blue swimmer crabs and razor clams were observed within the proposed dredge area, as well as numerous sediment burrows indicating the presence of infauna communities. Sessile fauna and low mobility species will be directly impacted by the dredging activities, although those impacts will be confined to the dredge area. Mobile species such as crabs are not expected to be significantly impacted given the small extent of dredging proposed.

Surrounding areas

There are sparse seagrasses inshore of the dredging area, as well as seagrass meadows in the shallow waters upstream although these were in poor condition with high epiphyte growth on the seagrass blades. In the deeper waters towards the shipping channel, the habitat was dominated by dense mats of Caulerpa.

Indirect impacts to these seagrasses are expected to be negligible based on the timing of dredging and limited turbidity generated from backhoe dredging. Seagrasses will be protected (where appropriate) from turbidity and sedimentation using silt curtains.

Minimising the general impacts of dredging will be considered in the CEMP.

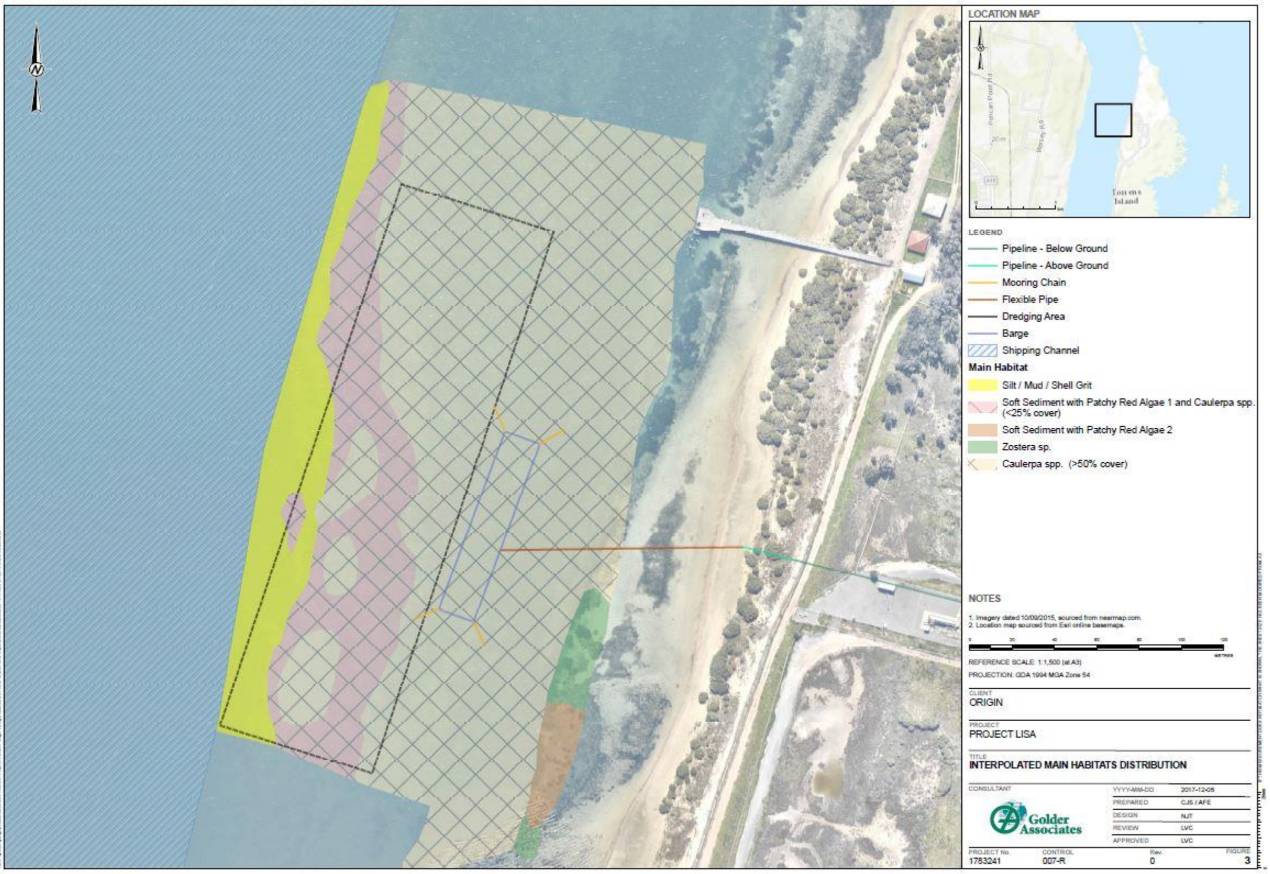

Figure 7: Benthic marine habitat and assemblages in the Project area

Marine megafauna

The Port River/Barker Inlet comprises the Adelaide Dolphin Sanctuary which was established in 2005 to protect the resident population of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*). The sanctuary covers 118 km^2 including Inner Port, Outer Harbor, North Haven Marina and stretches north to Port Gawler. Other marine megafauna (e.g. whales) may occur in the Port River, although their occurrence is not common.

It is recognised that dolphins are attracted to dredging activities due to the disturbance of sediments causing fish to aggregate. Backhoe operations or movement of the CSD and its dredge head may pose a strike risk, however this is minimised through the dredging technique requiring the barge to be fixed by spuds.

Within the project area, existing underwater noise sources include those associated with shipping movements. Dredging activities will contribute to underwater noise, however acoustic assessments within the Port River for the OHCW Project (which requires approximately 94% more dredging activity than Project LISA) indicated that dredging noise will have negligible impacts on sensitive marine fauna that are approximately 100-200 m from the dredging activity. Hearing damage is only expected if animals remain in the immediate vicinity of the dredge (i.e. 10 m from the vessel) for prolonged periods and this is considered unlikely (Arup 2017).

Risk mitigation measures for potential impacts on dolphins will be in accordance with the National Parks and Wildlife (Protected Animals - Marine Mammals) Regulations 2010, including adopting the appropriate work exclusion zone for marine mammals.

These requirements as well as other measures to mitigate risks and minimise potential impact on marine fauna will be included in the CEMP.

Pest species

The purpose-built Storage Barge is being constructed internationally. Ballast water and fouling of hulls have the potential to carry marine pest species. Pest species in ballast can quickly become established in new marine environments and outcompete local species, causing disruption to the ecosystem. Ballast water can also spread new diseases to local species. By adhering to Ballast Water Management Guidelines and National Biofouling Management Guidelines, the risk of introducing new species is considered low.

Ballast water exchanges are regulated by port rules and national regulations which limit the potential for ballast water impacts from Project LISA. These include the National Biofouling Management Guidance for Non-trading Vessels, and the Australian Ballast Water Management Requirements.

Origin has further managed the risk of introducing new pests by requiring:

- The barge to be built on land in China and limiting the time spent in international port waters prior to travel to Port Adelaide
- The barge to be inspected prior to departure at the international port and on arrival at Port Adelaide (and cleaned as required).

The dredging contractor will adopt the recommended Primary Industries and Regions SA guidelines for managing Caulerpa. This will include thorough inspection of any construction-based vessel and equipment (e.g. ropes, anchors etc.) before it is used and at the completion of works. The dredge disposal ponds have outfall screens to prevent Caulerpa fragments from returning back to the Port River.

Appropriate permits will be sought to remove Caulerpa from Port River, in accordance with the Fisheries Management Act.

The management of pest species will be addressed in the CEMP. Management of pest colonisation on Project LISA infrastructure at the time of decommissioning will be detailed in a Decommissioning Management Plan.

2.1.6 Aboriginal heritage

Prior to European settlement marine and estuarine areas were used extensively by the local Kaurna people. During sand mining on Torrens Island in the 1980s, a stone hand axe and an Aboriginal midden were discovered immediately to the west of the QPS site. The midden contained artefacts shaped from glass and broken clay tobacco pipes, indicating that occupation of the site continued after European colonisation. After the discovery of the midden, a thorough survey of the island was undertaken, but no other artefacts or middens were found.

The remains of almost 70 Kaurna people from the Port area were reburied on Torrens Island in December 2010, to a site north of the heritage-listed Quarantine Station. As part of this relocation, a search of DSD-AAR sites was undertaken. The search indicated there are eight recorded archaeological sites on Torrens Island, as shown on Figure 8.

The risk of impacting an Aboriginal site through construction and operation is considered negligible, considering the following:

- There are no sites registered within the QPS site
- Additional infrastructure to be installed will be predominately within previously disturbed areas
- The LPG pipeline is likely to be installed using HDD at depth, or will be above ground with minimal ground disturbance
- There will be no further ground disturbance following construction.

Measures to minimise any potential impact on Aboriginal heritage will be included in the CEMP.

Figure 8: Results of the DSD-AAR search for Torrens Island (EAC, 2013)

2.1.7 Built heritage

Torrens Island Quarantine Station was established by the South Australian Government in 1879 to prevent passengers from bringing diseases into the State. Following the declaration by the World Health Organisation of the eradication of smallpox in 1979, Torrens Island closed as a human quarantine station. It has been used for animal quarantine since the early 1850s.

The TIQS complex (Figure 9) was designated a State Heritage Place in the South Australian Heritage register in 1993 (State heritage ID 13931; Heritage Number 17297). The complex includes multiple buildings and a jetty which has since been damaged by fire.

Three historic shipwrecks may exist within 500 m of the river bed deepening activities (Figure 9). Two of these shipwrecks are located adjacent the Port River shipping channel, and one within a conservation area.

The closest proclaimed shipwreck is greater than 60 km from the Project area.

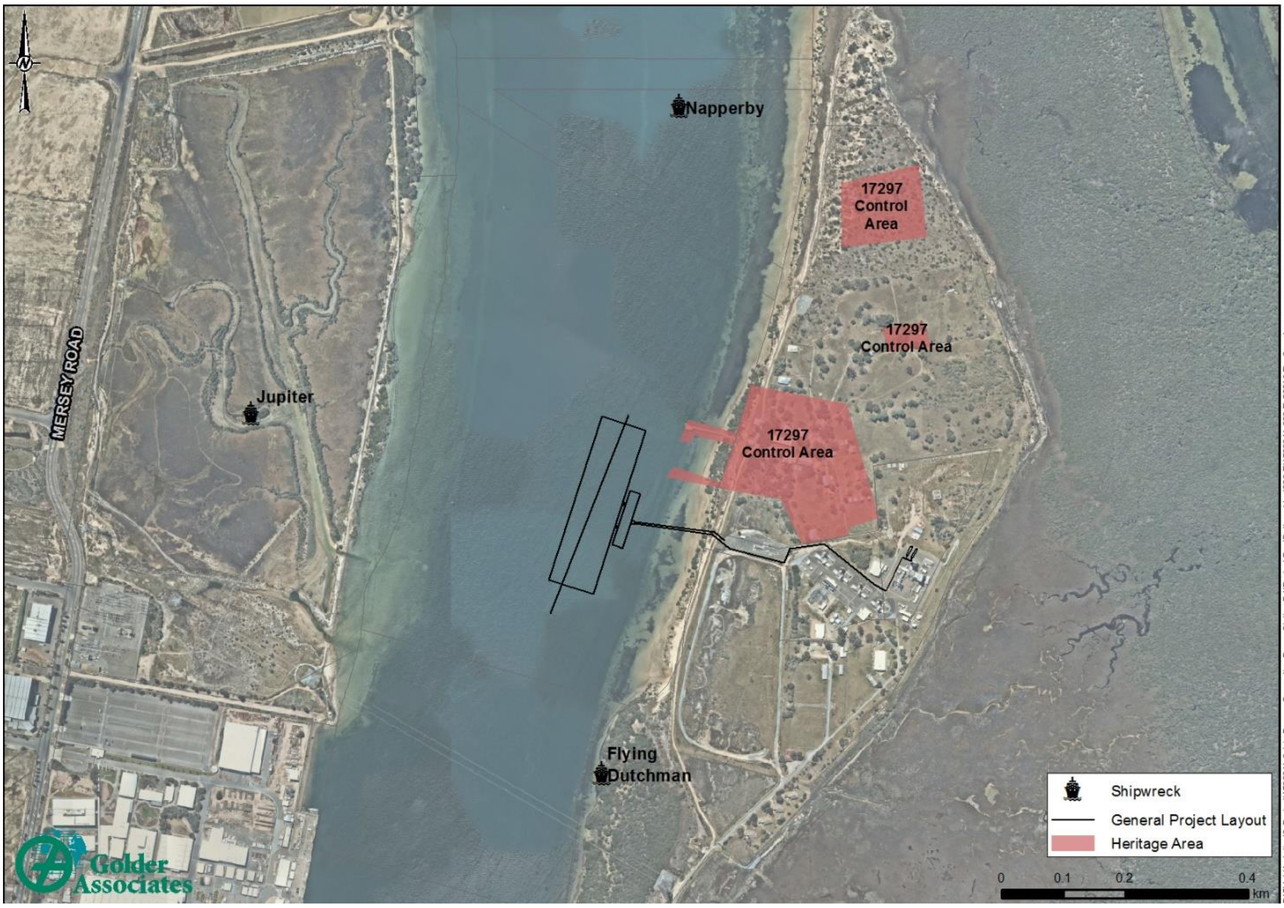

Figure 9: State heritage listed places

No impacts to the Torrens Island Quarantine Station during construction and operation are expected given the footprint of the QPS will not change.

Impacts to the historic shipwrecks potentially within 500 m of the river bed deepening activities are expected to be negligible.

The Torrens Island Quarantine Station complex (including the jetty), will be identified to site personnel during inductions to ensure it is protected during construction. Construction risks will be effectively mitigated, and potential impacts managed, through implementation of a CEMP.

2.1.8 Air quality

The EPA currently monitors air quality at Le Fevre Peninsula (Station name Le Fevre 2) which is historically rated ‘very good’, the highest category based on a comparison between pollutant concentrations and the relevant NEPM standards.

An air quality assessment was prepared in accordance with the EPA’s document: *Ambient air quality assessment* (SA EPA, 2016), regulatory requirements (Section 4) and best practice approaches. The proposed methodology was developed with agreement from EPA personnel prior to the assessment being conducted.

The assessment focused on nitrogen dioxide (NO_2) as the key pollutant emitted to the atmosphere from gas turbines. Other pollutants that may be emitted were not explicitly assessed, as they are typically emitted in trace amounts. NO_2 was considered a suitable indicator of the overall risk to air quality posed by Project LISA.

The air quality assessment showed that Project LISA has no impact on 1 hour average NO_2 or the annual average NO_2 emissions.

Construction activities will be effectively managed through implementation of the CEMP.

2.1.9 Visual

New infrastructure installed within the QPS will not be visible from any public vantage point.

The barge-to-Unit pipeline will be installed underground through the intertidal area and will not be visible from the shoreline.

The Storage Barge and mooring dolphins will result in a noticeable change to Port River. As shown in Figure 2, the additional features will present as relatively low, ship-like structure, similar to those regularly using the adjacent shipping channel.

The Replenishment Ship is a transitory feature of the project and is representative of general shipping channel activities.

The visual on-shore impact will be negligible.

Port River is an operational shipping channel; therefore, the appearance of the Storage Barge and Replenishment Ship will be in keeping with the existing environment and expected visual features.

There are no publicly visible features from Unit 5 upgrades.

3.0 CONCLUSION

Project LISA is an innovative way to provide a dual fuel source for power generation into South Australia. Project development has considered the impact pathways that construction and infrastructure placement may present to the environmental and social values of the Port River and its surrounds. Impact pathways and appropriate mitigation and/or management was considered in consultation with the relevant State agencies and regulators.

The proposed development is consistent with the current use of QPS and the Port River shipping channel, and does not conflict with the relevant 'Land Not Within a Council Area' Development Plan. Project LISA is also strategically aligned with the goals and objectives for state infrastructure and energy, and meets the requirements of local and State Government.

The Project has been designed to ensure the potential impact pathways from construction and infrastructure placement are limited, and where potential impact pathways exist, they can be effectively managed. The resulting project characteristics ensure the environmental and social values of the Port River and its surrounds are conserved.

Through the development of a Construction Environmental Management Plan and Dynamic Dredge Management Plan by the Contractors, the Project will incorporate appropriate measures to manage the construction phase in an environmentally sensitive manner and ensure the ongoing operations are similarly managed to avoid degradation of the landscape and promote a high level of environmental integrity.

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DEVELOPMENT APPLICATION

24 January 2018

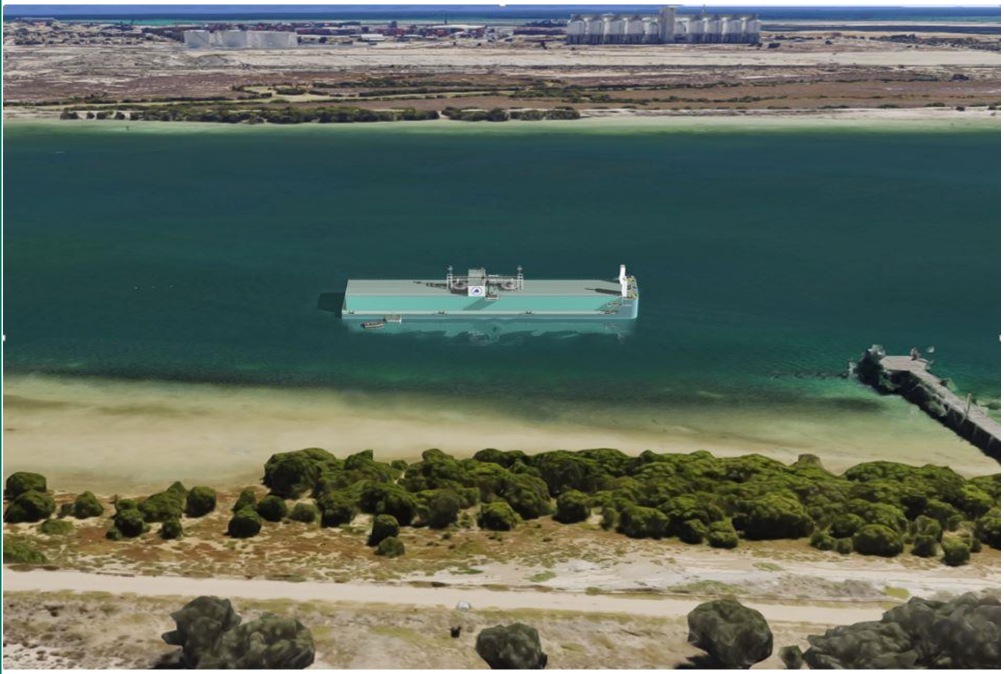
ORIGIN ENERGY POWER LIMITED

LPG Into South Australia Development Application Report

VOLUME 2: DEVELOPMENT REPORT

Submitted to:
Zoe Delmenico
Department of Planning, Transport and Infrastructure

On behalf of:
Origin Energy Power Limited



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Preface

It should be noted this Development Application Report has been prepared by Golder Associates (Golder) on behalf of Origin Energy Power Limited (Origin) and is supported by specialist reports from independent consultants.

This Development Application for the Project LISA has been prepared with all reasonable care, and whilst every effort has been made to ensure the accuracy of the material published in the associated documents, Origin is not liable for any inaccuracies and deficiencies.

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ACRONYMS AND DEFINITIONS

Acronym	Meaning
AAR	Aboriginal Affairs and Reconciliation
ALARP	As low as reasonably practicable
AMLR	Adelaide Mount Lofty Ranges
AMSA	Australian Maritime Security Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
COD	Commercial Operation Date
CPB	Coast Protection Board
CSD	Cutter Suction Dredge
DA	Development Application
DAR	Development Application Report
DEWNR	Department of Environment, Water and Natural Resources (SA)
DotEE	Department of the Environment and Energy (Commonwealth)
DPC	Department of the Premier and Cabinet
DPTI	Department of Planning Transport and Infrastructure (SA)
DSD	Department of State Development
DSD-AAR	Department of State Development-Aboriginal Affairs and Reconciliation
EMP	Environmental Management Plan
EPA	Environment Protection Authority (SA)
EPBC	Environment Protection and Biodiversity Conservation
ESD	Emergency shutdown
HDD	Horizontal Directional Drill
kV	Kilovolt
LISA	LPG into South Australia
LNWCA	Lands Not Within a Council Area
LPG	Liquid petroleum gas
MAP	Moomba to Adelaide Pipeline
MHF	Major Hazard Facility
MW	Megawatts
MWh	Megawatt hours
NAGD	National Assessment Guidelines for Dredging
NPW	National Parks & Wildlife
NRM	Natural Resources Management
NTU	Nephelometric turbidity unit
OHCD	Outer Harbor Channel Deepening
OHCW	Outer Harbor Channel Widening
OTR	Office of the Technical Regulator (SA)
PAE	Port Adelaide Enfield
PIRSA	Primary Industries and Resources SA
QPS	Quarantine Power Station
SARDI	South Australian Research and Development Institute

Acronym	Meaning
SASP	South Australia's Strategic Plan
SCAP	State Commission Assessment Panel
SD	Standard Deviation
SGC	Small Gas Carrier
SIPSA	State Infrastructure Plan South Australia.
SMS	Safety Management System
SOP	Standard Operating Procedure
THSD	Trailer Hopper Suction Dredge
TIPS	Torrens Island Power Station
TIQS	Torrens Island Quarantine Station
TJ	Terajoule
TIQS	Torrens Island Quarantine Station
VLGC	Very Large Gas Carrier

1.0 GENERAL INFORMATION

The purpose of this Development Application Report (DAR) is to provide necessary supporting information for a Development Application (DA) to be submitted to the South Australian Government under the Public Infrastructure provisions of Section 49 of the *Development Act 1993* (Development Act).

This DAR describes the potential environmental and social impacts associated with Origin Energy Power Limited's (Origin) proposal to upgrade a portion of the Quarantine Power Station (QPS) on Torrens Island, South Australia to include dual fuel capabilities (Liquid Petroleum Gas (LPG) and natural gas). This will ensure reliable and affordable electricity supply to Origin's customers and add significantly to improved security of the SA electricity network.

The proposal is named 'Project "LISA"' – LPG into South Australia.

1.1 The proponent

Origin is one of Australia's leading integrated energy companies. Origin explores, produces, transports and sells energy to power millions of Australian homes and businesses every day and plays an integral role in shaping Australia's energy future.

Origin has been an incorporated company for 17 years, having demerged from Boral Limited in 2000. Origin has been involved in South Australia through its history, having control of QPS (the largest peaking power station in South Australia) as well as constructing and commissioning the SEA Gas Pipeline that links Victoria and South Australia.

Origin is the main ship carrier of LPG on the Australian coast. With a fleet of three Small Gas Carriers (SGC) and one Very Large Gas Carrier (VLGC) imported every two months, Origin ships load approximately 200,000 tonnes from floating storage operations at Moreton Bay and delivers the LPG to Australian and international sea terminals (Figure 1).

Figure 1: An example of Origin's floating storage and gas transfer operation at Moreton Bay, off Brisbane Port.

1.2 Project LISA overview

Project LISA is an Origin initiative designed to enhance energy security in South Australia by providing an alternative fuel source – propane (hereafter referred to as LPG) to QPS. LPG is anticipated to be used when the existing natural gas pipelines supplying QPS are constrained, or when market conditions allow.

Project LISA is a customised solution to increase the fuel supply to one of the largest gas turbine generators in South Australia and de-constrain a network that reaches capacity using natural gas.

The existing QPS has a generation capacity of 224 MW consisting of:

- QPS Units 1- 4 (96 MW total) commissioned in 2002
- QPS Unit 5 (128 MW) commissioned in 2009.

Origin proposes to upgrade QPS Unit 5 (hereafter referred to as Unit 5) to have dual fuel capabilities (LPG and natural gas) with associated fuel storage on a barge moored in Port River. By providing an alternative fuel source to Unit 5, Project LISA fulfils the following objectives:

- Increases the stability and inertia of the South Australian energy market by providing approximately 13,000 MWh of power storage
- Provides security of fuel supply for power generation
- Reduces the impact of potential single point equipment failures of the Moomba to Adelaide Pipeline (MAP, owned by Epic Energy) and/or the Port Campbell to Adelaide Pipeline (owned by SEA Gas)
- Opens new growth markets for the LPG industry.

The Project will supply LPG from a SGC ('Replenishment Ship') to a Storage Barge that is moored in Port River.

To allow the Replenishment Ship access to the Storage Barge, a small area (approximately 30,000 m^2) of the Port River needs to be deepened. Origin will use a backhoe and Cutter Suction Dredge (CSD) to remove approximately 70,000 m^3 of river bed material, which will be placed on a barge, transported and offloaded at existing licensed dredge disposal ponds on Le Fevre Peninsula, owned and operated by Flinders Ports. The South Australian Environment Protection Authority (EPA) has identified an additional potential site for environmental reuse of the dredge material. Origin will continue to work with the EPA and other agencies to determine the suitability of this additional site.

The Storage Barge has been designed to provide for 4.5 days of continuous operation of Unit 5 (equivalent to 13,000 MWh of fuel storage). LPG will be transferred from a Replenishment Ship to the Storage Barge via secure ship-to-barge hoses, as used on existing LPG ships owned by Origin, and then from Barge-to-Unit via pipes and hoses.

Following minor equipment upgrades and installation of new vaporisers, Unit 5 will be able to use the stored LPG to generate electricity in response to peaking power needs. Response times are rapid (i.e. within 24 minutes) and constrained only by Unit 5 start-up times. Dual fuel is required because start-up and shut-down of the turbine in Unit 5 will still require natural gas.

Figure 2 shows the site with existing and proposed infrastructure. A visual representation of the Storage Barge, "L.I.S.A", in position has been provided (Figure 3). The Storage Barge will be infrequently accessed via small boats (i.e. tenders) using an access platform (Figure 4). The visualisation is representative of the proposed barge, and has used a publicly accessible image to render the appropriate features.

Project LISA infrastructure and activities can be summarised as having Port River, Torrens Island and Le Fevre Peninsula elements. The Replenishment Ship is a transitory feature of the project, expected to berth alongside the Storage Barge 10 -12 times a year for up to a day each time.

Table 1 summarises the current land use and planning zones of the Port River, Torrens Island and Le Fevre Peninsula, as well as the proposed infrastructure and activities. Land use zones are shown on Figure 5.

Table 1: Project LISA broad infrastructure and activity elements

Location	Current land use and planning	Infrastructure and activities
Port River	■ South Australia’s primary maritime gateway and includes 19 berths of varying capacity. The river and shipping channel is periodically dredged for capital and maintenance purposes ■ The area below low water mark is not zoned under any Development Plan and constitutes Crown Land (Figure 5).	■ Deepening the river via backhoe and CSD (subject to detailed design) to enable safe Replenishment Ship access to the Storage Barge ■ Mooring dolphin for safe and secure positioning ■ Storage Barge “L.I.S.A” ■ 6 inch pipeline from Storage Barge to Unit 5 (expected to be directionally drilled, subject to detailed design).
Torrens Island	■ Two existing power stations (QPS and Torrens Island Power Station (TIPS)) and the Torrens Island Quarantine Station (TIQS) surrounded by conservation areas ■ Torrens Island is ‘Land Not Within a Council Area’ (LNWCA). The QPS is within the ‘Public Purpose’ (Quarantine Station) zone (Figure 5).	■ 6 inch pipeline from Storage Barge to Unit 5 (continued; expected to be directionally drilled, and then installed in a shallow covered culvert) ■ Installation of 2 new vaporisers ■ Unit 5 turbine upgrade.
Le Fevre Peninsula	■ Highly industrialised peninsula with existing facilities to accommodate the dredged material ■ Much of the land adjacent Port River is zoned ‘Industrial’ under the Port Adelaide Enfield Development Plan (Figure 5).	■ Dredge material (70,000 m^3) to be disposed at licensed Flinders Ports dredge disposal facilities

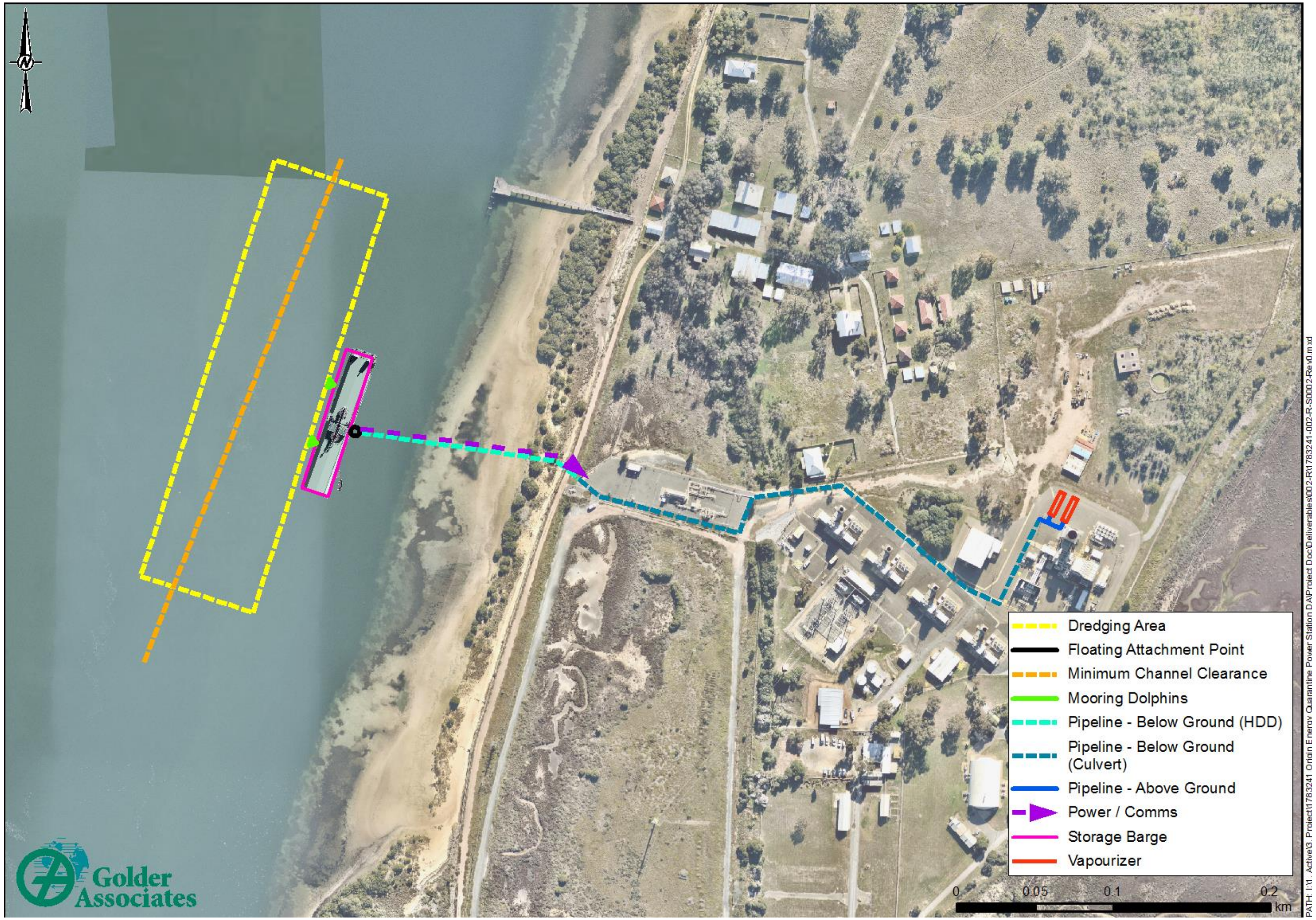

Figure 2: Project LISA existing and proposed infrastructure

Figure 3: Visualisation of L.I.S.A moored in Port River

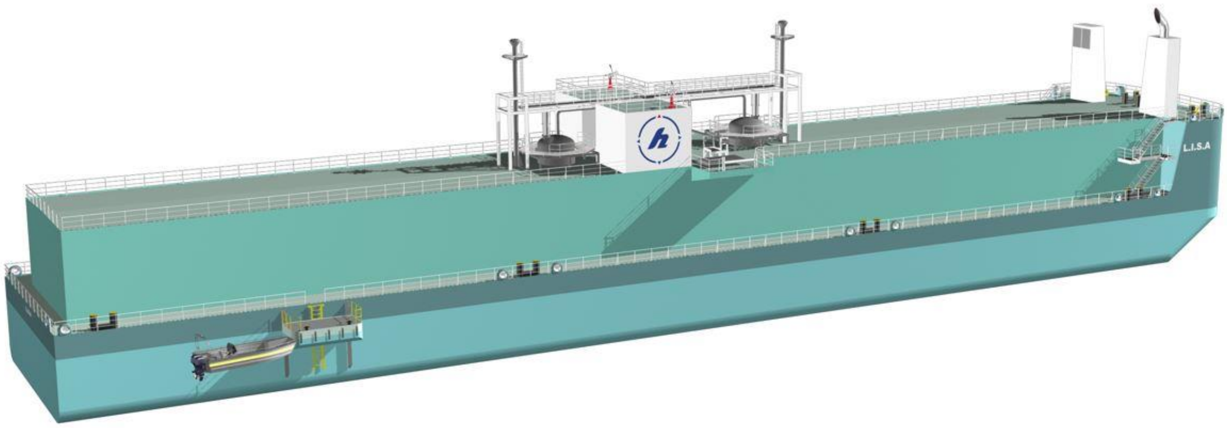

Figure 4: L.I.S.A showing access platform

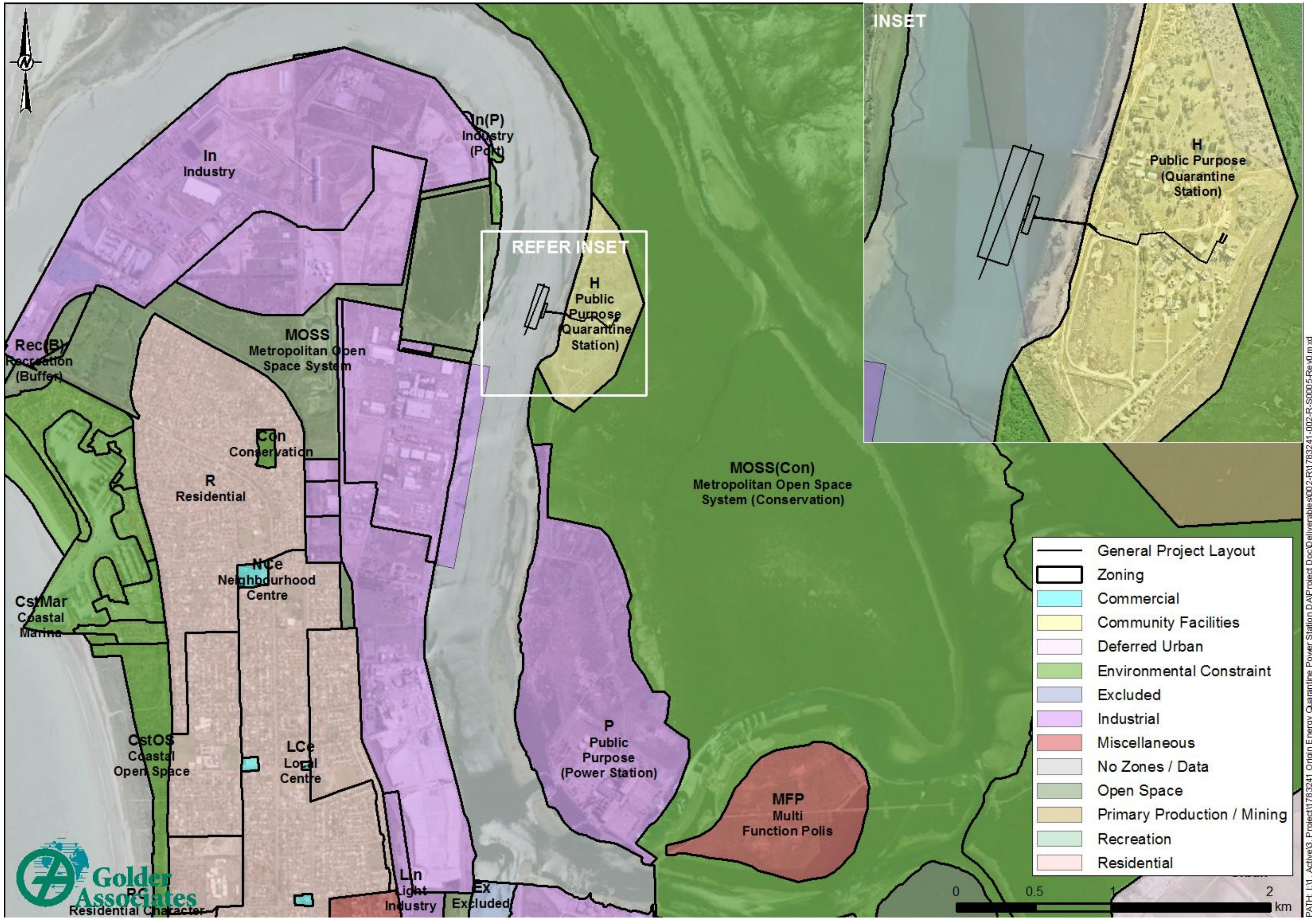

Figure 5: Project LISA and the surrounding land use zones

1.3 Approval pathway

Pursuant to Section 49(1)(a) of the Development Act, the Project is classified as Public Infrastructure, in that it is infrastructure, equipment, structures, works and other facilities used in or in connection with the supply of electricity. Section 7(d) applies to works that exceed $4 M.

The Project was granted Crown Sponsorship under Section 49 of the Development Act through the Department of the Premier and Cabinet (DPC) on 18 September 2017 (Attachment A).

This DAR will be lodged with the South Australian Government through the State Commission Assessment Panel (SCAP) and referred to other government entities for review and comment as required.

In accordance with Schedule 8 of the *Development Regulations 2008*, the prescribed bodies for the applications are the Coastal Protection Board (CPB), the Environment Protection Authority South Australia (EPA), and the Ministers administering the *Adelaide Dolphin Sanctuary Act 2005* and the *Historic Shipwrecks Act 1981*.

In accordance with Section 49 (7d) of the Development Act, the DA will be publicly exhibited for at least 15 business days. This includes provision of the DA for public access at key local and State Government offices.

A report will be prepared by the SCAP, encompassing feedback from the referral agencies, and will be provided to the Minister for Planning for a final decision.

1.4 Stakeholder engagement

Preparation of this Application has been undertaken in consultation with:

- Department of State Development (DSD)
- Department of Environment, Water and Natural Resources (DEWNR)
- Department of Planning Transport and Infrastructure (DPTI)
- Environment Protection Authority (EPA)
- Biosecurity SA
- City of Port Adelaide Enfield (PAE)
- Safework SA
- Australian Maritime Security Authority (AMSA)
- Flinders Ports
- Easement holders, Epic Energy and SEA Gas.

1.5 Project timing

Commercial Operation Date (COD) of Project LISA is anticipated before winter 2019, subject to business case approval by the Origin Board.

Should the project be approved, marine works are scheduled to commence in late winter 2018.

1.6 Structure and content of this report

This DAR has been prepared to support the DA and assessment process.

The DAR summarises the strategic context including project rationale and benefits; a description of the Project and existing environment; a summary of the stakeholder engagement; and a summary of the coastal, marine and social environment, potential impacts from the Project, and appropriate management strategies where required. Management measures are consolidated in Chapter 11.

The DAR includes a range of supporting information and technical studies which can be found in Volume 3:

- Appendix A: Certificates of Title and Project Support
- Appendix B: Geotechnical assessment
- Appendix C: Sediment characterisation
- Appendix D: Marine habitat assessment
- Appendix E: Air quality assessment.

2.0 STRATEGIC BENEFITS

Origin's QPS and AGL's Torrens Island Power Station (TIPS; and soon to be Barker Inlet Power Station) currently use natural gas. When natural gas supply is constrained or when market conditions allow, Origin is proposing to introduce an alternative fuel source, LPG, to Unit 5. The provision of LPG into South Australia will fulfil the following objectives:

- Increase the stability and inertia of the of the South Australian energy market by providing approximately 13,000 MWh of power storage
- Provide security of fuel supply for power generation
- Reduce the impact of potential single point equipment failures of the MAP (owned by Epic Energy) and/or the Port Campbell to Adelaide Pipeline (owned by SEA Gas)
- Open up new markets for the LPG industry.

The Project also aligns with State and Commonwealth policies for increasing energy security. The following sections provide a discussion of the South Australian and Commonwealth Government strategic priorities and how Project LISA aligns with, and contributes to these.

2.1 South Australian Strategic Plan

South Australia's Strategic Plan (SASP) provides a blueprint for the state that identifies the aspirations for future success. The SASP was released in 2004 and has been updated over time to ensure the goals and targets remain relevant. It has developed visions, goals and targets around State prosperity that Project LISA will assist in meeting, as shown in Table 2.

Table 2: South Australian Strategic Plan alignment

	Vision	Goals	Target	Project LISA
Prosperity	A strong, sustainable economy that builds on our strengths	South Australia has a resilient, innovative economy	Exceed the national economic growth rate over the period to 2020 (target 35)	Project LISA involves significant capital and operational investment by Origin that will provide increased reliability in energy supply for economic growth.
			Exceed Australia's ratio of business investment as a percentage of the economy by 2014 and maintain thereafter (target 38)	
		We develop and maintain a sustainable mix of industries across the state.	Maintain Adelaide's rating as the least costly place to set up and do business in Australia and continue to improve our position internationally (target 39)	To achieve this goal and target, reliability in energy is paramount. Project LISA provides increased reliability in energy for businesses and 4.5 days of additional peaking energy security.
	We have a skilled and sustainable workforce	All South Australians have job opportunities.	Unemployment: Maintain equal or lower than the Australian average through to 2020 (baseline: 2004) (target 49)	Project LISA provides ~50 full-time jobs through construction. Project LISA also provides energy security and confidence for other businesses, which is expected to have positive flow-on effects for State investment and employment.

2.2 Strategic Infrastructure Plan for South Australia

The *Strategic Infrastructure Plan for South Australia 2004/5-2014/15* (SIPSA) provides an overarching State framework for the planning and delivery of infrastructure by all government and private infrastructure providers. The SIPSA presents strategies for 14 infrastructure sectors, including energy.

Although the SIPSA is now under review, Project LISA is aligned to Objective 1: Strategic infrastructure – Increase investment in strategic areas of infrastructure, such as transport, ports and energy to support and achieve the targets in South Australia's Strategic Plan. Project LISA is an investment of $15 million into strategic areas of energy to support the SA Strategic Plan with an ongoing commitment of $7 million per annum (operational expenditure).

A summary of how Project LISA is aligned to the SIPSA strategic priorities for energy is outlined in Table 3.

The energy targets of the SIPSA have arguably been superseded by South Australia's Energy Plan (2017).

Table 3: Project LISA and the SIPSA

Strategic Priority	Alignment of the Project
Ensure the market operates in the public interest by providing reliable and affordable sources of energy	■ Provides reliable and economic energy storage to ensure a reliable energy grid ■ Provides a firm and flexible energy generation solution to support a high penetration of renewable resource development in South Australia and reduce reliance on energy imports from Victoria.
Encourage and align private investment with business and community demands	Helps stabilise the energy supply to: ■ Provide reliable energy supply to the community ■ Provide a more attractive investment scenario for businesses and industry looking to invest in South Australia.
Promote the development of market and regulatory arrangements that encourage energy industry developments that minimise growth in greenhouse gas emissions	■ Facilitate the storage and deployment of variable energy sources, providing an alternative to and avoid reliance on traditional fossil fuels ■ Allow higher penetration of alternative energy sources and provide the necessary energy security for a reliable energy grid.

2.3 South Australia's Energy Plan

South Australia's energy plan includes six goals to ensure South Australia will become more self-reliant for its power; and transform the energy network to provide reliable 21st century clean energy.

The Energy Plan vision includes adding stability to local power supplies by requiring developers to include power system security services as part of their projects in South Australia. Project LISA is aligned with this overarching principle of energy security and self-reliance. The Project will preferentially source LPG from Port Bonython, adding an independent fuel supply source sufficient for 4.5 days of continuous operation of Unit 5.

2.4 South Australia's strategic and economic priorities

The State Government has developed seven priorities for South Australia's future. These priorities are areas where we can make the most difference to the lives of everyday working people and the most difference to the future prosperity of our State. Project LISA is aligned to one of the seven strategic priorities as outlined in Table 4.

Table 4: Project LISA and the seven strategic priorities

Strategic Priority	Relevant objective	Alignment of the Project
An affordable place to live	Industries supplying housing, food and utilities are efficient and supply at competitive prices.	Availability of alternative fuel availability to the peaking generator will contribute to secure a resilient and reliable energy supply in South Australia, reducing price pressure on consumers levied through electricity bills.

To help achieve these, the Government has released a 10-point economic plan that will position the State as a place where people and businesses thrive (South Australia's 10 economic priorities). Project LISA is aligned to two of the 10 economic priorities as outlined in Table 5.

Table 5: Project LISA and economic priorities

Economic Priority	Relevant objective	Alignment of the Project
The knowledge state	Build a reputation as a state of knowledge creation and innovation	The use of LPG at QPS is innovative for South Australia as this fuel type is not currently used to power similar scale turbines.
Growing through innovation	Create an environment of innovation	The development model of Origin seeks to foster innovation and adopt new methods for applying existing and new technologies solving today's challenges.

Having a dynamic resources sector that is globally competitive is one of the economic priorities for South Australia. As part of the objectives for 2017, the Government will use regulatory and procurement resources to promote the deployment and uptake of an electricity storage solution. Project LISA is an innovative energy storage solution that provides an additional 4.5 days of storage for peaking energy needs.

2.5 Commonwealth Energy Security

The Commonwealth Government has identified the need to ensure all Australian households and businesses have access to reliable and affordable energy. A key feature of the 2017-18 Commonwealth Government Budget is the provision of funding for practical actions to support infrastructure needed to deliver reliable energy. This includes large investment in new generation, transmission and storage capacity.

Project LISA is aligned to the Commonwealth Government objective of providing reliable energy through increasing storage capacity for use in times of peak energy consumption.

3.0 LEGISLATION AND PERMITS

3.1.1 Legislation

Table 6 outlines the legislation relevant to the proposed development at a local, State and Commonwealth level.

Table 6: Legislation relevant to the Project.

Relevant legislation	Approval authority	Purpose of the legislation	Relevance to the Project
Local Development Plan			
Land Not Within a Council Area (LNWCA) (Metropolitan) Development Plan 2016 (the development plan)	SCAP	Provides objectives and principles of development control for LNWCA.	The proposed development will be assessed against the objectives and principles of this Development Plan.
State legislation			
Development Act 1993 (SA) (Development Act)	Department of Planning Transport and Infrastructure (DPTI)	Provides a framework for planning and regulation of development in SA.	The DA will be assessed under Section 49 provisions of the Development Act with consideration LNWCA
Work Health and Safety Act 2012	Safework SA	Provides the regulatory framework for SA's workplace safety. This includes assessment of safety cases.	Notification of a major hazard facility (MHF) will be required. A safety case will be developed by Origin to demonstrate that Project LISA complies with legislative responsibilities as a part of the MHF license application (more detail provided in Section 3.1.3).
Environment Protection Act 1993 (SA) (EP Act)	EPA	Provides a regulatory framework to protect SA's environment including land, air and water.	The DA must comply with the EP Act and relevant policies for protection of the environment throughout design, construction and operation.The Dredging Contractor must hold the relevant EPA license. The proposed disposal ponds have existing licenses to accept surplus dredge material.
National Parks and Wildlife Act 1972 (NPW Act)	Department of Environment, Water and Natural Resources (DEWNR)	Provides for the establishment and management of reserves for public benefit and enjoyment; and the conservation of wildlife in a natural environment.	Endangered, vulnerable and rare flora and fauna species are protected at a State level under the NPW Act. The Torrens Island Conservation Park is declared under the NPW Act. As the works are within the existing QPS footprint, the Project is not expected to interact with the Conservation Park.

Relevant legislation	Approval authority	Purpose of the legislation	Relevance to the Project
Harbors and Navigation Act 1993 (Harbors and Navigation Act)	DPTI	To provide for the safe, orderly and efficient movement of boating and shipping within harbors.	Notice to Mariners relating to an exclusion zone will be required.
Maritime Services (Access) Act 2000 (Maritime Services Act)	Flinders Ports (under delegation from DPTI)	Provides a regulatory framework for port services including access and commercial terms.	Access to the shipping channel and occupation of the sea bed will need to comply with the Maritime Services Act.
Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987 (Protection of Marine Waters Act)	DPTI	Protection of the sea and certain waters from pollution by oil and other substances.	Vessels accessing the site via Port River will need to comply with the Protection of Marine Waters Act, including the dredge/excavation vessel, Storage Barge and Replenishment Ship.
Native Vegetation Act 1991 (SA) (Native Vegetation Act)	DEWNR	Provides a framework to control the clearance of native vegetation and provide incentives and assistance to landowners in relation to the preservation and enhancement of native vegetation.	There will be no removal of native vegetation for this project, and therefore no requirement for application under the Native Vegetation Act.
Aboriginal Heritage Act 1988 (Aboriginal Heritage Act)	South Australian Department of State Development (DSD) - Aboriginal Affairs and Reconciliation (AAR) Division.	Provide for the protection and preservation of Aboriginal heritage.	Under the Aboriginal Heritage Act, it is an offence to damage, disturb or interfere with any Aboriginal site or object. While areas of Torrens Island are significant in relation to Aboriginal heritage, these areas are outside of the project footprint. There are no impact sources or pathways from the Project on Aboriginal heritage.

Relevant legislation	Approval authority	Purpose of the legislation	Relevance to the Project
Native Title (SA) Act 1994	Attorney-General's Department	Provides a framework for the protection and recognition of native title.	The Project is within the Kaurna Peoples Native Title Claim (SAD6001/2000; not formalised).
Heritage Places Act 1993 (Heritage Places Act)	DEWNR - SA Heritage Council	Provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance.	The TIQS to the north of the Project area is listed on the South Australian Heritage Register. Construction and operation will be managed to ensure no impact to the State Heritage site.
Historic Shipwrecks Act 1981	DEWNR	Provides protection of certain shipwrecks and relics of historic significance.	A number of shipwrecks have been recorded in the Port River and Gulf St Vincent. Two shipwrecks are approximately within 500 m of the river bed deepening activities. The proposed activities are not expected to have an impact on these shipwrecks. The closest proclaimed shipwreck is greater than 60 km from the Project area.
Coast Protection Act 1972 (Coast Protection Act)	DEWNR - Coast Protection Board (CPB)	Provides a framework for the conservation and protection of the beaches and coast of SA.	As the development is situated on coastal land, the DA will be referred to the CPB and assessed against the Coast Protection Act.
Natural Resource Management Act 1994 (SA) (NRM Act)	DEWNR - Adelaide and Mount Lofty Ranges (AMLR) Natural Resource Management (NRM) Board and Natural Resources AMLR	Promotes sustainable and integrated management of the State's natural resources.	The proposed development will not have an adverse impact on natural resources.
Adelaide Dolphin Sanctuary Act 2005	DEWNR	Protects the dolphin population and enhancement of the Port River estuary and Barker Inlet.	The Project area within the Port River is in the Adelaide Dolphin Sanctuary. Referral to the Minister administering the Act will be required.

Relevant legislation	Approval authority	Purpose of the legislation	Relevance to the Project
Fisheries Management Act 2007 (Fisheries Management Act)	Primary Industries and Regions SA (PIRSA)	Provides conservation and management for the aquatic resources of the State.	The Project site is not within an aquatic reserve and a permit will not be required under the Fisheries Management Act for disturbance of water beds, and removal or interference with animals or plants. The Barker Inlet-St Kilda Aquatic Reserve exists to the south and east of Torrens Island. A permit will be required under the Fisheries Management Act for the taking of noxious weeds (Caulpera) from the Port River.
Climate Change and Greenhouse Emissions Reduction Act 2007	Not applicable	This legislation identifies greenhouse gas emission reduction targets	Origin may be required to complete National Greenhouse and Energy Reporting, in line with the National Greenhouse and Energy Reporting Act 2007.
Commonwealth legislation			
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Department of the Environment and Energy (DotEE)	Provides a legal framework to protect and manage Matters of Environmental Significance.	Based on a self-assessment in accordance with the EPBC Act, there were no pathways that indicated a requirement for this project to be referred to DotEE.
Native Title Act 1993	Attorney-General's Department	See Sate Legislation *Native Title Act 1994*	See State Legislation *Native Title Act 1994.*
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	DotEE	Provides a framework for the protection of areas and objects that are of particular significance to Aboriginal people.	See State Legislation *Aboriginal Heritage Act 1988.*
Historic Shipwrecks Act 1976	DotEE	Protects historic wrecks and associated relics that are more than 75 years old and in Commonwealth waters.	See State Legislation *Historic Shipwrecks Act 1981.*

Relevant legislation	Approval authority	Purpose of the legislation	Relevance to the Project
Biosecurity Act 2015 (Biosecurity Act)	Department of Agriculture and Water Resources	Provides requirements and regulatory powers that affect how the department manages the biosecurity risks associated with goods, people and conveyances entering Australia.	The Storage Barge and Replenishment Ship will need to operate in accordance with the Biosecurity Act, specifically relating to ballast water management.

3.1.2 SafeWork SA

The Storage Barge is considered a major hazard facility (MHF) as it is a fuel storage facility where large quantities of hazardous materials are potentially stored, handled or processed.

As the operator of the Storage Barge, Origin will have obligations to:

- Identify all major incidents and major incident hazards for the facility
- Conduct and document a safety assessment of the facility's operation that involves a comprehensive and systematic investigation and analysis of all aspects of risks to health and safety
- Implement control measures that eliminate or minimise the risk of a major incident occurring
- Prepare an emergency plan
- Establish a Safety Management System (SMS)
- Prepare a Safety Case that demonstrates that the SMS will control risks arising from major incidents and major incident hazards, as well as the adequacy of the measures to be implemented to control risks associated with the occurrence of major incidents.

3.1.3 Australian Maritime Safety Authority

AMSA is the authority which implements international and national standards. In accordance with registering requirements, the Storage Barge must be compliant with Australian Standards and regulations. Ship registration is referred to as a flag state. As a flag state administration, AMSA is responsible for making sure that Australian-owned and Australian registered ships comply with international conventions.

3.2 Project alternatives

A detailed assessment was undertaken by Origin to explore the options for LPG storage, river bed deepening method options and dredge material disposal options.

LPG storage options

Origin broadly supports concepts of acceptable and ‘as low as reasonably practicable’ (ALARP) environmental impact and risk management. In consideration of ALARP, a number of options were considered for the storage of LPG in close proximity to the QPS. The Storage Barge was selected as the preferred option for the following reasons:

- Enables fast response to peak energy requirements
- Negligible environmental and heritage impacts on Torrens Island
- Barge can be operated remotely and will not require any staff to be located on a day-to-day basis
- Barge is designed to be unmanned and has no ability to power itself, thereby minimising on-barge mechanical and hydraulic requirements and increasing storage
- With no ability to power itself, the barge has reduced risks of leaks
- Barge can simultaneously supply QPS and be refilled by the Replenishment Ship.

Alternatives to the preferred option and reasons they were not selected are provided in Table 7.

Table 7: Project LISA alternative arrangements

LPG storage alternatives	Constraints
Torrens Island / QPS - transport via road	■ Heavy vehicle road access to QPS is limited. Significant road infrastructure upgrades would be required to facilitate the upgrade which was considered to have unnecessary environmental impact on Torrens Island Conservation Park ■ Additional marine-based works would be required to enable permanent land-based equipment deliveries and facilities to be established
Outer Harbor - transport via shipping channel and pumped across Port River	■ The shipping channel must remain open at all times ■ Fast response time not possible due to time lag for pumping of LPG across Port River ■ Permanently submerged pipeline across the shipping channel not preferred by Flinders Ports.
Using a berth box accessible to ships in Outer Harbor or Port River (note, a barge is still required for storage)	■ Fast response time not possible due to time lag for barge to ship across to Torrens Island and transfer to QPS ■ Barge would require additional vessel support to manoeuvre the barge to a supply position further decreasing response time. Alternatively, barge redesign to enable motive power would be required ■ Likely to cause disruption to shipping channel.

Deepening the river bed

Three methods of deepening the river bed were considered in developing the proposal, namely:

- Bed levelling
- Hydraulic dredging (Trailer Hopper Suction Dredge (THSD) or Cutter Suction Dredge (CSD))
- Mechanical dredging (backhoe or excavator dredge)

Bed levelling was eliminated as a viable option given its inability to deepen below the hard calcrete layer approximately 0.5 – 1.0 m below the overlying sediments on the river bed.

Hydraulic dredging includes using a THSD and a CSD which use water to create a ‘slurry’ that is then pumped onto a barge and then discharges excess water. Generally, a THSD creates the most disturbance to the seabed or river bed through its abrasive suction motion and substantial water use (initially 80% water and 20% solids) which is returned to the river as ‘overflow’, elevating turbidity. A CSD would use similar volumes of water.

CSDs are used in ground conditions that require materials to be broken up sufficiently for them to be able to be pumped. The greater the power of the CSD, the greater its ability to deal with harder materials. CSDs are equipped with ‘spuds’ that provide a solid work platform to ensure sufficient resistance for the cutter head to drive into the hard sediments. This generally limits the turbidity to close to the cutter head when compared to the THSD.

Backhoe (or excavator) dredges remove spoil by digging into it and collecting it in a bucket, just as their land-based counterparts do. Backhoe dredges are usually barge platforms equipped with ordinary land equipment. The barge is equipped with jack-up legs to provide a stable platform for the excavator to work. In practice, material is dumped from the excavator into an open barge alongside the dredge platform. The barge is then taken by tug to a wharf where the material can be removed by shore-based backhoes.

The material recovered from the river bed by the backhoe or excavator reaches the surface without excessive entrained water. Overflow barges are not required, and this results in less overall turbidity at the dredge site.

Backhoe dredges produce dredge material that is at or near to *in situ* moisture content and therefore, the material can be dumped directly to land without the need for extensive ponding.

Origin has selected the use of a backhoe as the preferred method due to its environmental advantages – it minimises turbidity, sediment deposition and impacts on water quality when compared to alternative hydraulic methods. A CSD will be used to work harder materials if required.

Dredge spoil disposal options

Origin is aware that Flinders Ports is seeking approval for sea disposal of dredge material as part of the Outer Harbor Channel Widening (OHCW) project. The OHCW project will dispose 1.55 million m^3 of material at the disposal grounds in Gulf St Vincent.

Origin expects Project LISA dredge material to equate to less than 5% (i.e. 70,000 m^3) of OHCW project and has investigated the ability to coordinate the dredging and subsequent disposal with the OHCW project. However, with significantly different dredge volumes, and to improve project flexibility, Origin has selected to preferentially dispose on land.

Flinders Ports has a series of dredge material disposal pond locations on Le Fevre Peninsula used for dredging and maintenance programs in the Port River and surrounding area. Subject to final agreements being reached, Flinders Ports has agreed in principle to Origin using:

- Pelican Point Dredge Disposal Pond – 180,000 tonne capacity
- Osborne 4 Dredge Disposal Pond – 40,000 tonne capacity.

In January 2018, EPA identified a need for Bird Island to be elevated to improve the breeding habitat of Fairy Terns. Fairy Terns (listed as endangered under the NPW Act) breed on open sandy beaches generally above the high water mark. Given the exposed nature of its nesting, the species is vulnerable to extreme weather events such as storms, floods and high tides and on Bird Island, there have been repeated breeding failures due to such events. EPA has requested that Origin consider placing the dredge material on Bird Island. Subject to additional testing, Origin will work with EPA and other agencies to determine the suitability of Bird Island for beneficial reuse of the dredge material.

4.0 SUBJECT SITE AND SURROUNDS

4.1 Quarantine Power Station

QPS is owned and occupied by Origin. The Certificate of Titles (CT) can be found in Appendix A. QPS site is delineated as Allotment 112 in Deposited Plan 59977 (CT 5907/399) and Allotment 305 in Deposited Plan 90964 (CT 6132/766) in the Area named Torrens Island in the Hundred of Port Adelaide. There are easements/rights of way adjacent to the allotment that contain gas infrastructure (see Appendix A). Origin has consulted with the easement holders.

QPS was built in 2002 (QPS Units 1-4) and expanded in 2009 to include QPS Unit 5. The QPS is owned and operated by Origin and is configured as a peaking power station. The current capacity is 224 MW, produced by open cycle gas turbines. The station is fuelled by natural gas, delivered by the SEA Gas Pipeline.

QPS is located on Torrens Island, approximately 15 km north west of Adelaide, South Australia. The island is joined to the mainland by Grand Trunkway Bridge over the North Arm Creek and connected to Garden Island by a causeway. Torrens Island is bound by the Port River to the west, the Barker Inlet to the south and east and the Section Bank mudflats to the north.

State heritage listed, TIQS, is adjacent QPS to the north. TIQS was used until the 1980’s as an animal quarantine facility. Several old buildings, a jetty and a cemetery remain on the site. It is generally unused, with the exception of an operating avian quarantine facility located in the eastern portion of the TIQS area.

Adjacent to the east of QPS is the Torrens Island Conservation Park, which has an approximate area of 603 ha and covers about three quarters of the island.

The TIPS (owned and operated by AGL Energy) operates on the south western end of the island.

Land use on Torrens Island and surrounding area is displayed on Figure 6.

4.1.1 Native Title

Outer Harbor, including Port River is covered in the area subject to the Kaurna Peoples Native Title Claim (SAD6001/2000). This claim has not yet been formalised.

4.1.2 Biological setting of Torrens Island

Torrens Island is bound by the Port River to the West, the Barker Inlet to the south and east and the Section Bank mudflats to the north. These areas support tide-dominated estuaries, with low tide saline mudflats, mangrove (approximately 60% of the Island) and salt marshes comprising a significant part of the area (EAC Ecological Evaluation (EAC) 2013). The island is part of an 822 ha ecosystem-unit which includes the Adelaide Dolphin Sanctuary and the Barker Inlet/St Kilda Aquatic Reserve, which is listed as a wetland of National Importance.

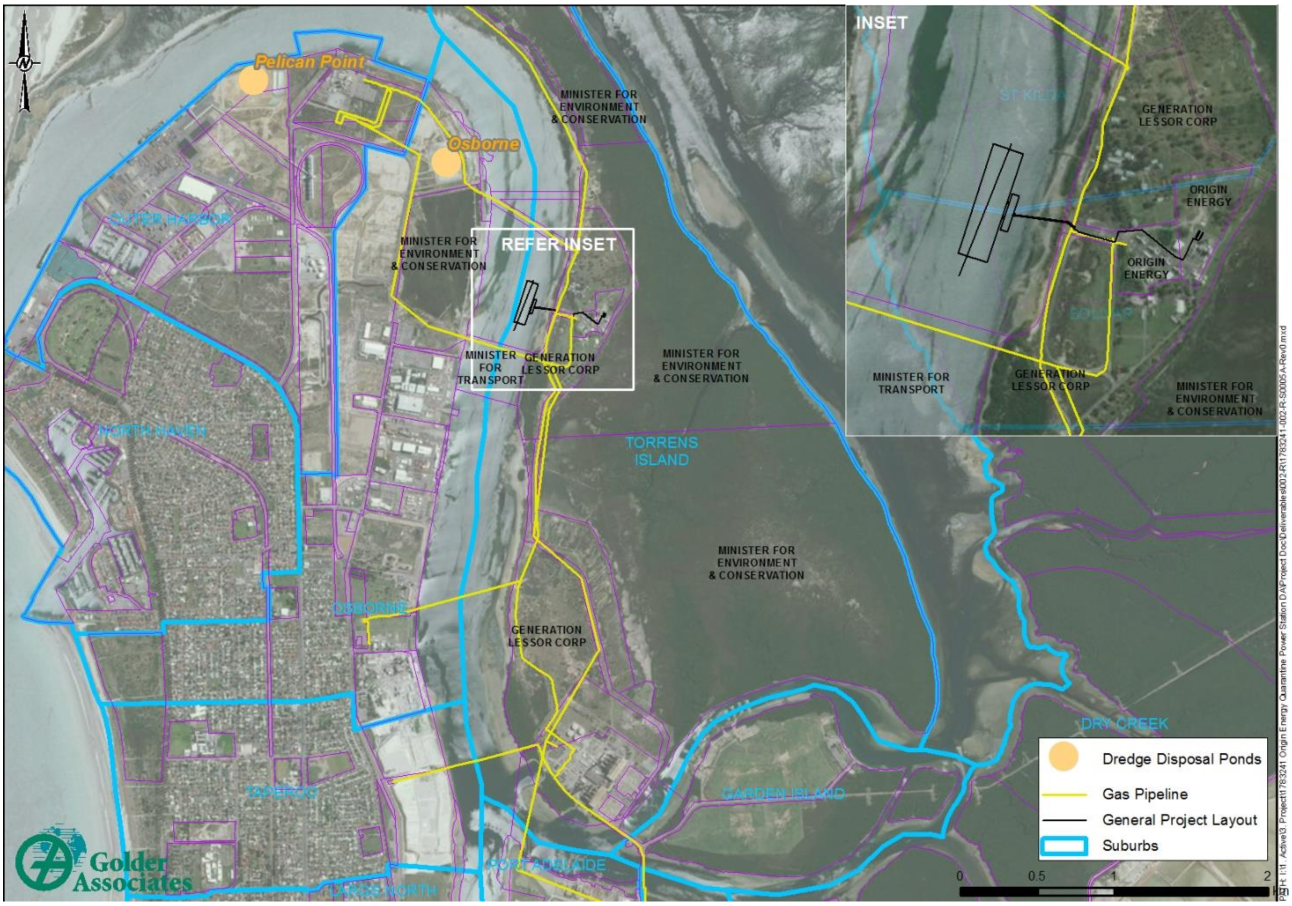

Figure 6: Land use on Torrens Island

4.2 Port River shipping channel

The Port River, where the Storage Barge and moorings will be located, is within Crown Land.

River bed deepening in the Port River will occur to the west of QPS and east of the Flinders Ports' operational shipping channel.

The Port River is a busy shipping channel with multi-berth users along the Inner and Outer Harbor of Port Adelaide. The Port Adelaide Enfield Council is to the west and south of the Port River and the Salisbury Council is to the north-eastern mainland side of the Adelaide coastline, adjacent Torrens Island and Garden Island.

4.2.1 Biological setting of the Port River

The Port River/Barker Inlet system is the largest estuarine feature in Gulf St Vincent.

The estuarine system is comprised of intertidal and subtidal seagrass meadows (*Posidonia australis*, *Heterozostera tasmanica, Zostera muelleri*), intertidal mangrove forests (*Avicennia marina*) and their associated samphire habitats. Barker Inlet has large seagrass meadows that provide a nursery habitat and feeding grounds for many commercially and recreationally important fish and crustacean species. The seagrass extent in the Port River (as presented in Arup 2017) is limited compared to Barker Inlet (Figure 7) and was previously described as being sparse around Torrens Island (Tanner, 2004).

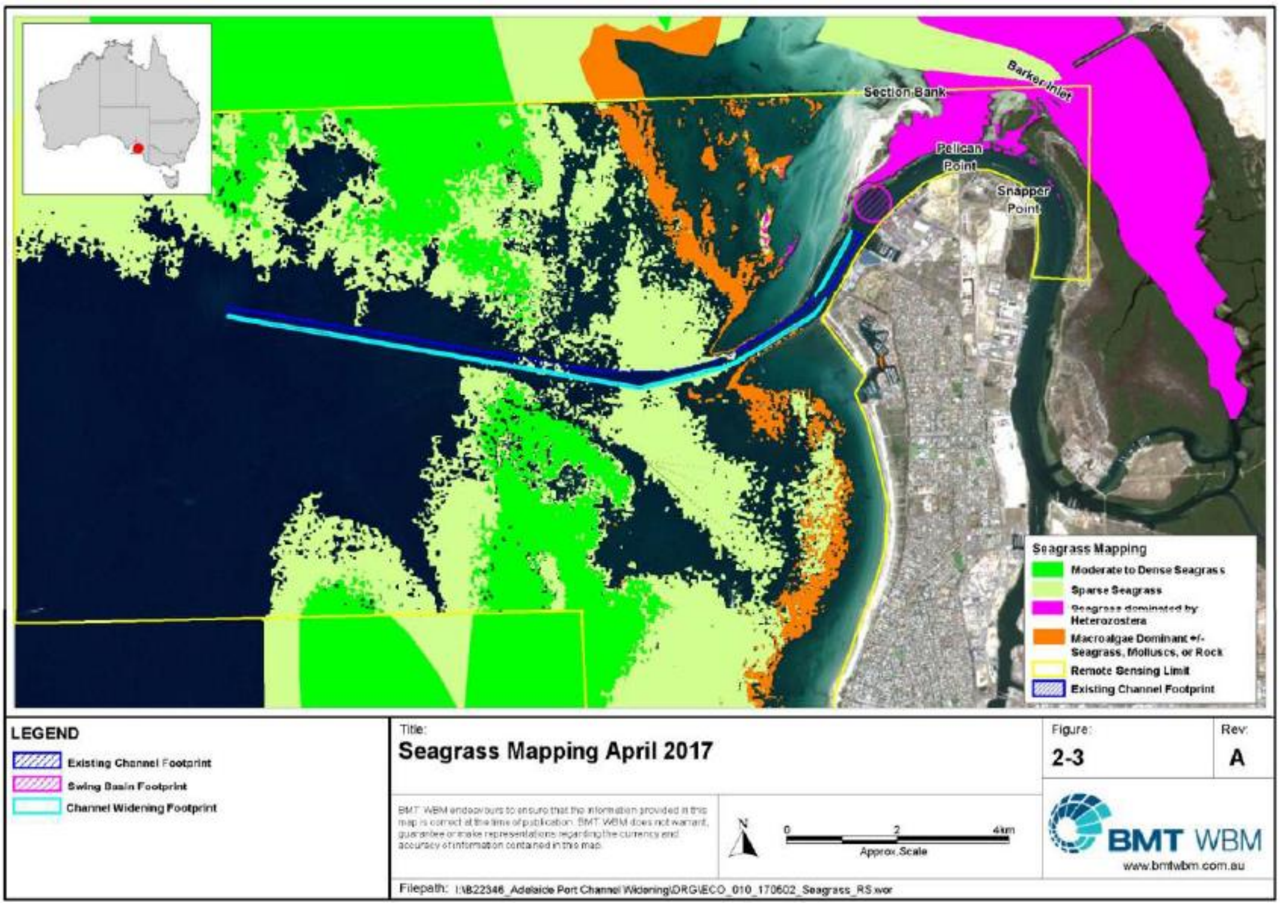

Figure 7: Seagrass mapping in Barker Inlet and surrounding the Shipping Channel (Source: Arup 2017).

Plants or animals that live in or on the bottom of an aquatic environment such as an estuary are termed the ‘benthos’. The benthos of the Port Adelaide area is dominated by a variety of animals living in soft sediments such as bivalves, sponges, fan-worms, sea stars and acorn worms that are largely dependent for food on plankton in the water column and detritus from seagrass meadows.

5.0 PROJECT DESCRIPTION

5.1 Port River bed deepening

Origin proposes to import LPG from Santos's Port Bonython facility via a Replenishment Ship. The draft of the Replenishment Ship requires a minimum depth of 8 m for safe access from the shipping channel to the Storage Barge.

The Storage Barge requires a minimum depth of 5.2 m to allow for below deck storage tanks.

The existing bed levels range from 9.3 m at the edge of the channel to 4.0 m under the proposed Storage Barge location (Figure 8) and river bed deepening will be required. Deepening the river bed for both the transitory Replenishment Ship and moored Storage Barge is expected to generate up to 70,000 m^3 of excess material.

In order to understand the potential impacts of deepening the river bed, Origin has identified a preferred backhoe dredging method (see Section 3.2), however a combination of backhoe and CSD will be used depending on geotechnical properties. Both the backhoe and CSD require the deployment of anchoring spuds to ensure a stable working platform. The backhoe will use a closed bucket to lift materials through the water column and dispose these on a dredge material barge (likely a hopper barge).

The CSD is expected to be required for cutting into harder material which will be pumped to an adjacent barge. As a hydraulic method, CSD dredging is expected to produce a thin slurry of approximately 20% solids to 80% water. The barge overflow will remove excess water and be transported when the dredge mixture is approximately 80% solids and 20% water. There is little turbidity created at the cutter head, however, turbidity is caused by the overflowing water.

The dredge material barge will be transported to three possible locations:

- Osborne 4 Dredge Disposal Ponds
- Pelican Point Dredge Disposal Ponds
- 'Bird Island'.

At the dredge disposal ponds, an excavator will unload the material. These ponds are both designed with outfall screens to ensure that marine weed species are not released back into the Port River. The disposal ponds are licensed by the EPA.

As a new disposal site proposed by EPA, Origin will work with government agencies to determine the suitability of Bird Island as a dredge material disposal site. In principle, placing the dredge material at Bird Island will elevate the existing topography which is expected to promote breeding success for the endangered (SA) Fairy Tern. Additional investigations to confirm comparable particle sizes will be required between the dredge material and Bird Island, as well as analyses into additional engineering costs.

5.2 Mooring

In consultation with Flinders Ports Harbour Master, a concept design for two triangular mooring dolphins has been developed for Project LISA (Figure 8). These two moorings are expected to be between the Storage Barge and the Replenishment Ship.

The two mooring dolphins will be fixed to the Storage Barge via guides that provide restraint, however still allow vertical movements to accommodate tidal variations. New steel piles and a pre-cast concrete cap are envisaged to enable safe access. Fenders will be sized and positioned to protect the Replenishment Ship. Details of the fenders will be developed and provided through the detailed design phase.

Vibrocoring has been undertaken to inform the development of the preliminary mooring dolphin concept. Dimensions and installation depths will be confirmed during detailed design. This will consider loads that accommodate wind and currents, passing vessels, as well as detailed geotechnical conditions.

5.3 Storage Barge specifications

The Storage Barge has been designed to be a non-self-propelled barge. As a new purpose-built barge (built in Shanghai, China), the vessel will have a maindeck with trunk deck and forecastle. The Storage Barge will be in accordance with the following approximate dimensions:

- Overall length: 99.9 m
- Overall breadth: 18 m
- Design draught: 4.2 m
- LPG capacity: 3,000 tonnes.

The Storage Barge will be new steel, fully coated with internationally accepted biofouling paint and fitted with sacrificial anodes or catalytic protection.

The tanks will store LPG at a pressure of 8-12 bar and discharge LPG above 25 bar. A leak and spill detection system will be installed. The Storage Barge will be designed for remote operation and will comprise two cylindrical tanks; two pumps; shutdown valves; and ship-side and shore-side connection points. The ship-side and shore-side connections will be a 6” ANSI 300# swivel flanges. Two shutdown valves will be installed on both connections, one hydraulically operated emergency shutdown (ESD) valve, and one remotely operated valve. The tanks and pumps will be submerged below deck and all piping will be fully welded (except at the battery limits) to eliminate potential leak points.

The Storage Barge will be equipped to international standards for LPG storage, and will be a Regulated Australian Vessel under AMSA. It will also be class certified under DNV GL, the leading international accredited registrar and classification society in the maritime industry.

The Storage Barge will be towed to the mooring location in Adelaide. The intent is not to have ballasting and de-ballasting on the Storage Barge once it is in location.

If the Storage Barge must be ballasted for the passage to Australia, the ballast will be fresh water ballast, and will be de-ballasted prior to entry to Australian waters in accordance with the Biosecurity Act and the Australian Ballast Water Management Requirements 2017.

The concept design has considered transit conditions which provides sufficient operating ranges for the conditions expected within the Port River. The final positioning conditions are compared to transit conditions in Table 8.

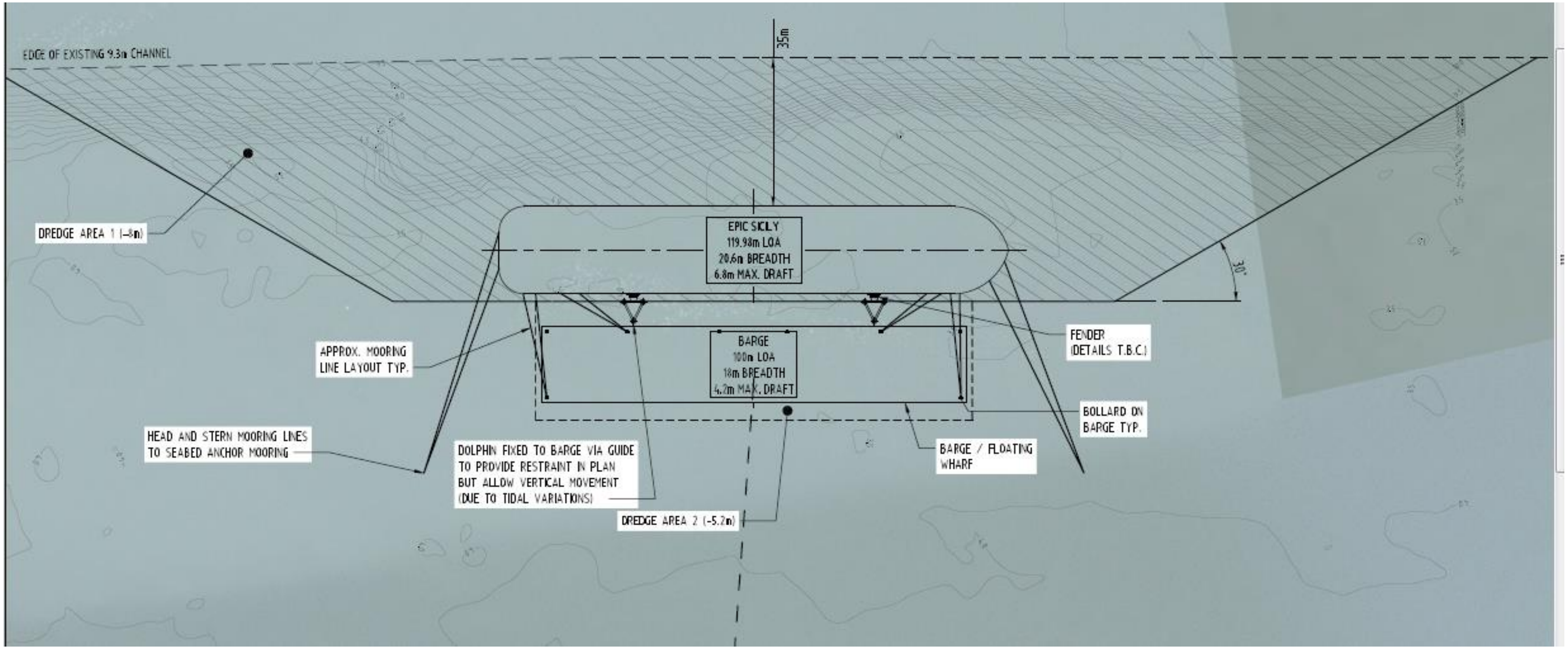

Figure 8: Dredge area and mooring dolphin concept design (provided by Wallbridge Gilbert Aztec)

Table 8: Designed operating range and sea state conditions

	Port River	Transit
Significant wave height	1.0 m	3.0 m
Wave peak period	3.0 – 9.0 s	4.0-10.0 s
Wind speed	33 knots	33 knots
Current speed	NA	2.0 knots
Water depth	Approximately 5.2 m	NA

The Storage Barge will be electrically equipped by an umbilical connected to shore, and although it will be designed to be unmanned, it is likely to be infrequently accessed via small boats (i.e. tenders) using an access platform. Access provisions will be designed per requirements and are indicatively shown in Figure 4.

5.4 Shipment-to-barge transfer

Based on the proposed floating storage capacity of 3,000 tonnes, Project LISA is expected to require approximately 10-12 annual shipments of LPG via the Replenishment Ship depending on market conditions.

The Replenishment Ship will be approximately 120 m in length and is expected to shuttle between the LPG facility at Port Bonython and Port River. When the Replenishment Ship arrives in Port River, it will move into a deepened berthing pocket next to the Storage Barge to unload fuel via ship-to-barge hoses. The process will be managed through Origin's Standard Operating Procedure (SOP) for ship-to-ship transfer and storage. Head and stern mooring lines to river bed anchor mooring, as well as mooring lines to the Storage Barge and mooring dolphins are anticipated (Figure 8).

Ship-to-barge fuel unloading is expected to take approximately 12 hours.

The Replenishment Ship will be an international vessel in compliance with Biosecurity Act and the Australian Ballast Water Management Requirements 2017.

5.5 Barge to Unit transfer

LPG will be transferred from the Storage Barge to Unit 5 via a flexible hose and a rigid 6 inch pipeline.

From the Storage Barge, a marine grade flexible hose connection will connect to a fixed 6 inch pipeline that is attached to the Mooring Dolphin. Once on the river bed, the pipeline is expected to be directionally drilled towards Torrens Island, but may be trenched to the low water mark.

Land-based Horizontal Directional Drilling (HDD) is expected between the low water mark and to the east of the existing access road to avoid impacting existing infrastructure assets such as the sheet piled seawall and the access road (Figure 9). The HDD technique will also avoid interactions with the easement and avoid any impacts to the vegetation within the intertidal zone, such as the fringing mangroves.

Figure 9: HDD is expected to have no impact on (a) the seawall (b) fringing mangroves (c) access road and (d) existing gas owners using the easement.

Once the pipeline is on Origin land it will be installed through a prefabricated culvert that is sealed/joined with removable trafficable grates or concrete lids to Unit 5.

The alignment of the pipeline is shown on Figure 10. A services umbilical (e.g. power and communications) will be placed in the same alignment.

Figure 10: Pipeline alignment showing installation method

5.6 Upgrade of Unit 5

An upgrade to the existing Unit 5 will be required to enable dual fuel capabilities. This will involve installing two new vaporisers and pipework within the existing hardstand area of QPS as well as turbine modifications. Both the vaporisers and turbines will be engineered by others offsite.

The footprint of the new vaporizers will be approximately 3 m length, 1.5m wide and 3 m high each. A small control room will also be installed at 1.5 m length, 1.5 m wide and 2 m height.

The upgraded plant characteristics are shown in Table 9.

All works will be designed to Origin standards which meet and/or exceed the Australian Standards and are anticipated to meet the requirements of SafeWork SA for which Origin is undertaking a separate safety case submission. The upgraded plant will be third-party certified.

Table 9: Project LISA plant upgrade

Plant Characteristic	Parameter
Power Output	Remains unchanged – 128 MW
Start & Ramp-up / Load Flexibility	Remains unchanged – fast start and/or load flexibility required. Unit(s) must be able to respond to changing market conditions and support South Australia network stability
Fuel	Gas – existing well head contracts LPG – 150 TJ on barge (4.5 days of fuel)
Operating Mode	Remains unchanged – operate as a peaking generator in the South Australian market and will strengthen the stability of the network
Transmission Line	Remains unchanged – 66kV
Emissions	Upper limit of 36 ppm in emissions
Operational life	Minimum 5 years – subject to market requirements

5.7 Construction

5.7.1 Workforce and hours

Over the construction life, Project LISA is expected to generate approximately 50 jobs.

Construction works are expected to be between 0700 and 1730, Monday to Saturday, however the hours may extend on occasion. Night works are not routinely anticipated, however when required, will occur between 1730 and 0330.

5.7.2 Temporary construction compound

Up to three separate construction compounds are anticipated within Origin land to enable both the marine and QPS-based works. As there are several other projects being undertaken at QPS during this time, Origin is looking to group temporary construction compounds within the existing footprint of QPS.

Although not anticipated, if a construction compound needs to be located outside of QPS land, Origin will seek to engage with surrounding land owners to determine possible access and management arrangements. Origin is cognisant of the adjacent heritage and conservation values and would seek to manage any construction compound in accordance with community and regulatory expectations.

5.7.3 QPS construction works

The majority of equipment is being fabricated offsite and delivered to QPS in standard shipping containers for hardstand storage. As such, site preparation activities will relate to having clearly identified laydown areas for the pipeline, vaporiser and turbine upgrade.

Origin will establish security measures to ensure all equipment and infrastructure can be safely managed during preparations.

The pipeline construction is expected to include both HDD and prefabricated culvert installation, and is expected to take approximately 3 months:

- HDD pipeline installation
  - Drill at depths that enables free access below the seawall and adjacent road and does not interfere with the easement or fringing vegetation. Detailed engineering design will determine the feasibility of continuing HDD to the mooring (i.e. approximately 80 m)
- Culvert installation
  - Excavation will be limited to installation of the culvert between the seawall and the new vaporiser, adjacent to Unit 5
  - The culverts are expected to be pre-fabricated offsite and installed using mobile cranes and sealed/joined with removable trafficable grates/concrete lids
  - Any surplus soil generated will be located within a designated lay down area and tested in accordance with the EP Act and relevant guidelines and standards, prior to disposal at an appropriately licensed waste disposal facility
  - The steel pipeline will come in 6-12 m lengths and be a combination of fully welded and flanged pipe, depending on what valving and instrumentation is required to ensure safe operations of the facility.

The new vaporisers will be mounted on concrete pads or footings. The footings will be designed during detailed design and meet all local regulatory and Australian Standards. Installation of new footings may require some of the existing concrete surface to be removed and appropriately disposed.

5.7.4 Marine-based construction works

The marine works include deepening the river bed with a backhoe and placing the dredged material on a barge to be transported to existing dredge disposal ponds, as well as mooring installation works. A crew of up to 10 people is expected to complete these works within three months, working during daylight hours.

Installation of the 6 inch pipeline and services umbilical (i.e. power) to the Storage Barge via HDD is expected to take up to 2 months. These works may commence simultaneous to the dredging and mooring installation, however fixing the pipeline and umbilical to the mooring can only occur once the mooring has been installed.

5.7.5 Equipment required

- Backhoe dredge and CSD
- Barges for mooring dolphin installation and dredge material transfer
- HDD equipment
- Dewatering for excavation (culvert)
- Mobile cranes
- Diesel generator
- Portable welding equipment
- Excavators
- Trucks for dredge material removal
- Rollers

5.8 Commissioning

Commissioning of Project LISA will occur once various acceptance stages for each part of the project and testing of equipment has been completed. This includes establishing an emergency plan and a SMS; and preparing a Safety Case that demonstrates that the SMS will control risks associated with having dual fuel capabilities. Origin will have a robust commissioning procedure in place to accept the full operation of the facility in its entirety prior to it becoming operational and being handed over to QPS operations.

5.9 Decommissioning

Origin will ensure processes are in place, as part of each of the principal contractor activities to decommission the Project. Decommissioning will be subject to an approved Decommissioning Environmental Management Plan, and is expected to include:

- Relocating the Storage Barge to another site as required by Origin
- Removal of the mooring dolphin and pipeline
- Replacement or removal of any soil in accordance with the EP Act and relevant EPA guidelines
- Removal of all temporary sheds and amenity areas
- Removal of all construction waste to an appropriately licensed facility
- Laydown and construction areas, whether within Origin's current footprint or adjacent off site leased land will be managed to ensure there is no impact on the surrounding area.

5.10 Project schedule

Commercial Operation Date (COD) of Project LISA is anticipated before winter 2019 with marine works commencing in winter 2018 (subject to Project approvals).

There are a range of long-lead capital items that need certainty of Project approval prior to ordering equipment. The following times are anticipated

- Dredging works to be carried out in winter 2018 to avoid seagrass and Caulerpa growing periods in warmer months; should dredge material be suitable to enhance breeding habitat on Bird Island, winter works also avoid breeding periods of the Fairy Tern
- The purpose-built Storage Barge will take approximately 11 months to build and deliver to South Australia from Shanghai
- Turbine modifications and vaporisers will take approximately 11 months to build and deliver to South Australia
- Onsite modifications for installation is expected to commence in May 2019, with the Project complete prior to winter 2019.

5.11 Security

Security personnel control road-based access to QPS via a 24-hour operational gatehouse at the entrance to the AGL power station. QPS is additionally surrounded by fencing to further limit access.

A 50 m exclusion zone will be established from the channel-side of the Storage Barge to the shoreline. Under the Harbors and Navigation Act, a Notice to Mariners will be issued alerting all Port River users of the new exclusion zone.

6.0 CONSULTATION

Origin has consulted with a number of agencies and regulatory bodies to communicate the intent of Project LISA and to determine any key technical areas of interest. The Agencies consulted, and the key outcomes of consultation are listed below:

- DPC: Sponsoring agency
- DSD: Case manager
- DPTI: recommended consultation with easement holders
- DEWNR: identified approval considerations including native vegetation losses, coastal protection, historic shipwreck interactions and the Adelaide Dolphin Sanctuary
- EPA: recommended that Origin examine alternative dredge material disposal options to the originally proposed disposal in Gulf St Vincent; identified beneficial reuse of the spoil at Bird Island
- Biosecurity SA: discussed methods to reduce *Caulerpa cylindracea* and *C. taxifolia* spread
- SARDI Aquatic Sciences: discussed *C. cylindracea* and *C. taxifolia* spread
- Office of the Technical Regulator: raised no objections to Project LISA; no certificate is required for Project LISA as no additional generation capacity is being connected.
- Worksafe SA: identified Project LISA as a MHF
- AMSA: discussed requirements to adhere to AMSA standards, including ballast management
- Port Adelaide Enfield Council: given the proximity of the project to Council land, Origin undertook information sharing to enable Council to brief elected members if required.
- Flinders Ports: discussed access, permit and lease requirements, potential synergies with the OHCW Project, and available sites for disposal of dredge material.

7.0 RISK ASSESSMENT

The potential environmental risks associated with the construction, operation and decommissioning of the Project were assessed in detail to ensure risks were appropriately characterised and effective management measures could be implemented to reduce or eliminate the risks.

The risk assessment involved mapping the potential source to receptor pathway and assigning an initial risk rating to each potential risk aspect. Where there was a clear and potentially substantive impact(s) from source to receptor, additional information was sourced to provide an appropriate understanding of the risks and suitable mitigation measures.

A review of the existing information regarding the biological, physical and social environment of the QPS, Port River and surrounding area was undertaken and used where appropriate to describe the existing environment, potential impacts and relevant management/mitigation measures.

Where further information, specific to Project LISA, was required, technical studies were undertaken to inform the appropriate design modifications and management measures.

The outcomes of the risk assessment are summarised in the following sections.

7.1 Geology and soils

An existing information review and additional technical studies were undertaken to characterise the geology and soils with the Project footprint and address the potential risks associated with excavation within QPS and the proposed river bed deepening.

Existing information was used to characterise the regional geology as well as the expected soil conditions within the QPS, including:

- Publicly available databases such as SA Resource Industry Gateway (SARIG) and Australian Soil Resource Information System (ASRIS)
- Regional geological conditions described in *The Geology of SA, Volume 2, Chapter 11: Quaternary; Geological Survey of South Australia, Bulletin 54* (Belperio, 2012)
- Soil conditions within the QPS described in the geotechnical investigations undertaken by Coffey (Coffey 2001 and 2012).

Additional technical studies were undertaken specific to Project LISA to characterise the sediments within the proposed river bed deepening footprint including:

- Vibrocore Acquisition Report (Seas Offshore, 2017) to assess the physical characteristics of the sediments
- Sediment Characterisation (Appendix C) to provide a contamination assessment of the sediments and determine appropriate dredge material disposal options.

7.2 Water quality

Existing information was used to characterise the background water quality conditions within the Port River; quantify the potential impacts of Project LISA; and develop appropriate management measures to protect the water quality. The following existing information regarding water quality in the Port River, and potential impacts of Project LISA were used:

- Ambient water quality monitoring report undertaken within the Port River estuary (SA EPA, 2002) additional monitoring data (Golder 2017 and SA EPA 2002) to provide general background conditions of the Port River
- Turbidity increases associated with the Kurnell Port and Berthing Facility Upgrade (URS, 2013) to determine expected turbidity increases as a result of the use of a backhoe dredge
- Turbidity modelling undertaken prior to the Outer Harbor Capital Dredging (OHCD) Project (KBR, 2004) to determine expected turbidity increases as a result of the use of a Cutter Suction Dredge (CSD).

7.3 Coastal ecology

Based on the negligible impacts to coastal ecology, existing information regarding the ecology of Torrens Island was determined to be sufficient for the purpose of this DA. The existing information reviewed included:

- Protected Matters Search Tool provided by the DoEE to assess if species or communities of conservation importance are likely to be present
- The Torrens Island Biodiversity Action Plan (EAC Ecological Evaluation Pty Ltd, 2013) to characterise the broad ecology of Torrens Island
- The Preliminary Ecology Assessment (Jacobs, 2017) to characterise the ecology within the QPS more specifically.

A site walkover was also undertaken by Golder to accurately describe the vegetation communities present within the intertidal area to the west of QPS.

7.4 Marine ecology

The Outer Harbor and Gulf St Vincent have been the focus of numerous regional assessments. The following existing information was used to provide an understanding of the general ecological conditions within the Port River:

- Protected Matters Search Tool provided by the DoEE to assess if species or communities of conservation importance are likely to be present
- Information regarding the Adelaide Dolphin Sanctuary presented in technical reference papers (DENWR 2007a and DEWNR 2007b; KBR 2004, ARUP 2017, Bossley *et al.* 2017 and Steiner 2012)
- Impact of dredging on seagrasses in the Outer Harbor described in the *Review of the South Australian Marine pest records and distribution mapping* (Wiltshire & Tanner 2016)
- Adelaide Coastal Water Study (CSIRO, 2007) for seagrass health
- Gulf St Vincent Bioregional Assessment Report 2010-2011 (EPA, 2013) for general ecological information
- Outer Harbor Channel Deepening (OHCD) Project (KBR, 2004)
- Crown-sponsored Outer Harbor Channel Widening (OHCW) Project Development Application Report (July 2017) –this application is currently being exhibited and seeking removal of approximately 1,500,000 m^3 of seabed material.

A site-specific field survey was also undertaken (Appendix B) to inform Origin’s understanding of the marine infrastructure interactions with Project LISA’s footprint.

7.5 Other considerations

A number of other potential risk aspects were identified, however, were not considered a high risk based on the Project area and proposed activities. Low risk aspects are listed below:

- Groundwater: likely to be encountered during construction and require temporary dewatering. Will be effectively managed through a Dewatering Management Plan (if required) and CEMP
- Aboriginal heritage: there have been no Aboriginal heritage sites identified within the QPS, and infrastructure will be predominately within already disturbed footprint
- Built heritage: there are no impact pathways from Project LISA to the State-heritage listed Torrens Island Quarantine Station (TIQS)
- Air quality: construction impacts to air quality will be negligible and effectively managed through the CEMP. Ground level concentrations in all the modelled scenarios at locations across the model domain outside the QPS boundary are significantly under the established air quality criteria and comply (Appendix E)
- Visual: the proposed new infrastructure is in keeping with the existing surrounding industrial environment, as well as that of a busy port
- Noise: Construction noise levels are expected to be minor and effectively managed through the CEMP. There will be no increase in operational noise levels.

8.0 ENVIRONMENTAL CONDITIONS AND INTERACTIONS

8.1 Topography

The QPS is situated within an area of Torrens Island that ranges between 2.2 m AHD (at the western boundary) and 0 m AHD (to the East at the Port River). The elevation falls to less than 1 m AHD to the west in the intertidal area beyond the western boundary of QPS.

Surface water at the site drains towards the east of the site in areas less than 1 m AHD.

8.2 Geology and soils

The expected geophysical/geotechnical conditions have been used to inform the dredging method and the preliminary mooring designs.

Construction activities on land may result in the generation of surplus soils. Soils will be managed in accordance with SA EPA guidelines. Management measures will be detailed in the CEMP.

The sediments within the proposed dredging footprint are chemically suitable for disposal at the proposed licensed land-based dredge disposal facilities.

Geotechnical understanding will be refined during detailed design.

8.2.1 Regional geology

The quaternary coastal marine and continental facies of the region between Le Fevre Peninsula and Mount Lofty Ranges is shown in Figure 11. Sedimentary deposits in the Port Adelaide region include a sequence of coastal lagoons and intertidal facies comprised of the St Kilda Formation, overlying the Glanville Formation, with areas of the non-marine Pooraka Formation (Belperio, 2012).

The St Kilda formation is characterised by very poorly sorted coastal muds containing *in situ* shell and organic matter and bioclastic sands (Seas Offshore, 2017). The St Kilda Formation includes the Gantheaume Sand Member and the Semaphore Sand Member.

The Glanville Formation is characterised by marine to intertidal shelly sand and clay (based on the Geoscience Australia 'Australian stratigraphic units database' (ASUD). Exposure prior to the Holocene sea level rise resulted in local calcarenited areas in the upper Glanville Formation.

As shown in Figure 11 the Pooraka Formation lies between the Glanville and St Kilda Formations in some areas. The Pooraka Formation is generally characterised as unconsolidated red-brown poorly-sorted clayey sand, gravel, conglomerate and breccia (ASUD). A schematic geological cross section through Port River is shown in Figure 12.

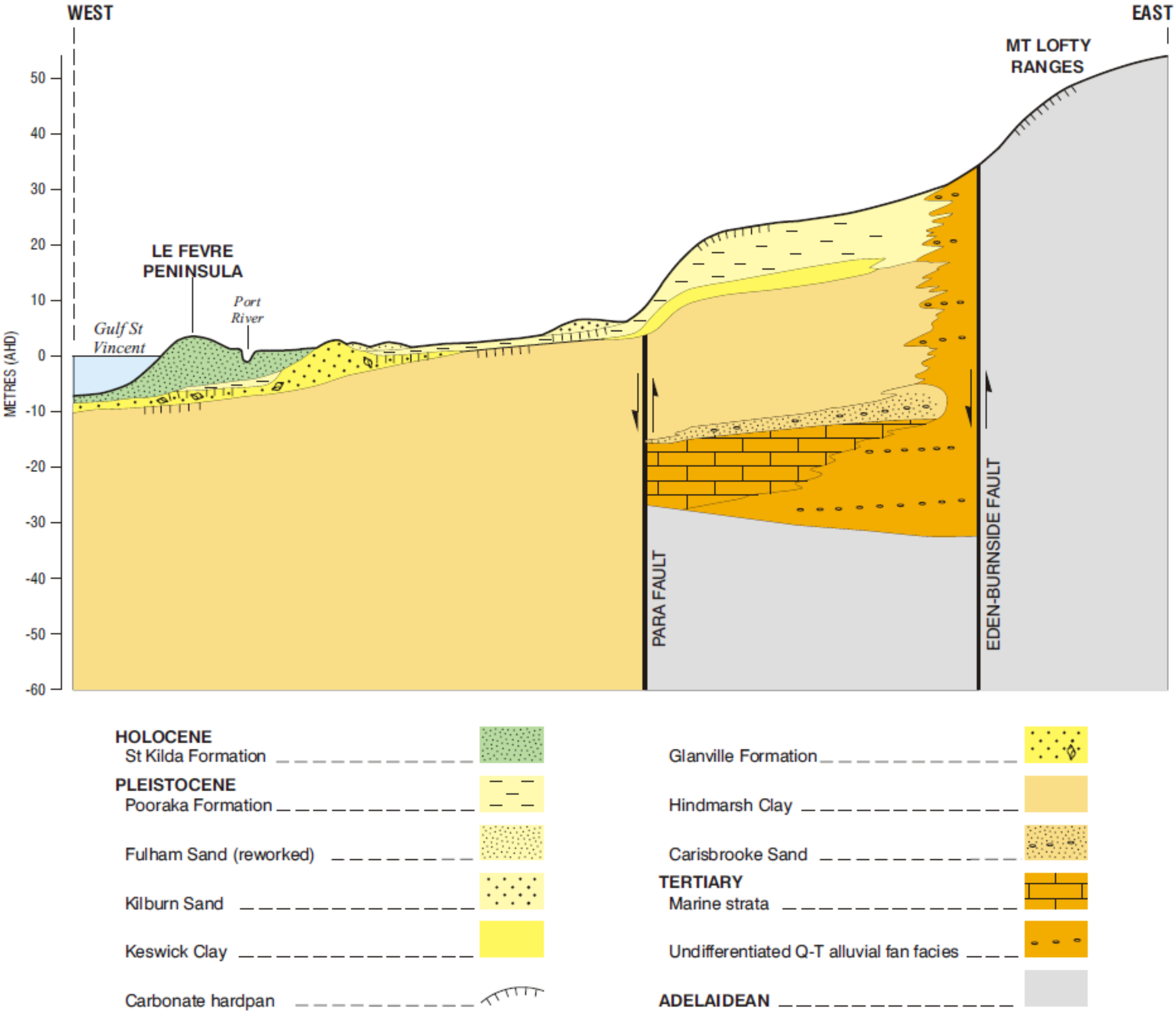

Figure 11: Schematic cross-section from Le Fevre Peninsula to the Mount Lofty Ranges- not to scale (Belperio, 2010)

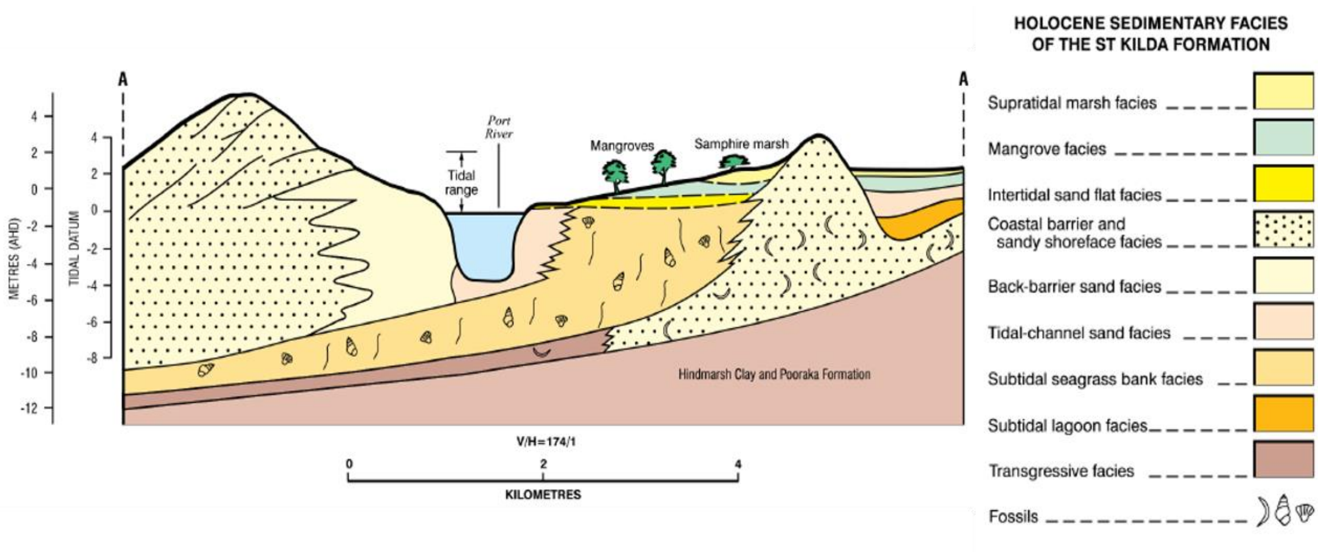

Figure 12: Schematic geological cross section through Port River (indicative scale)

The 1:100,000 regional geology map sources from the SA Resource Industry Gateway (SARIG) shown in Figure 13 indicates the QPS site is within an area characterised by the quaternary-aged Semaphore Sand Member of the St Kilda Formation, comprising unconsolidated white bioclastic quartz-carbonate sand.

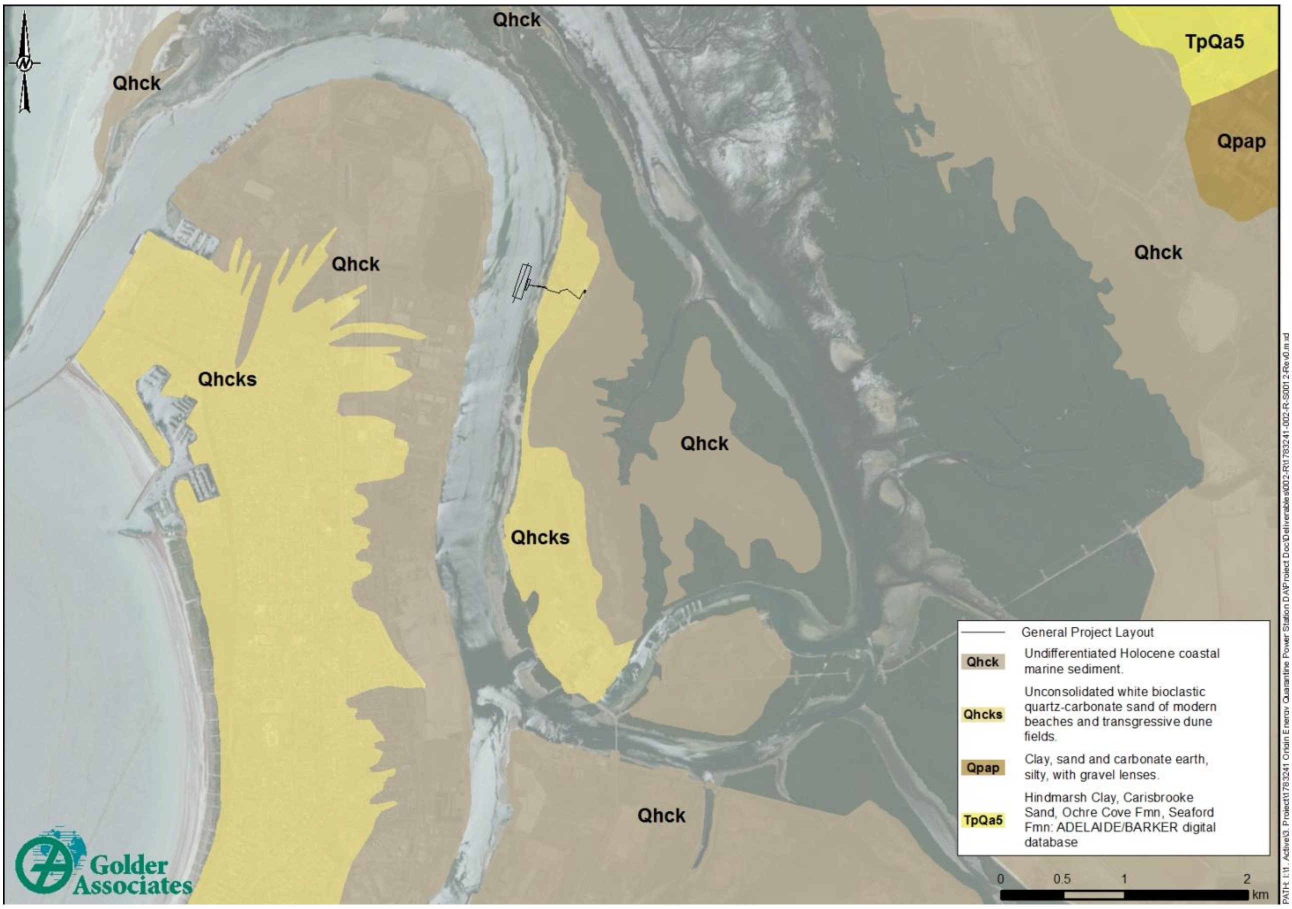

Figure 13: Regional geology (Source: SA Resource Industry Gateway, https://map.sarig.sa.gov.au)

8.2.2 Coastal soil conditions

During geotechnical investigations undertaken at QPS (Coffey, 2012), the following general subsurface conditions were encountered:

- **Fill** (maximum depth 0.65 mbgl): sandy gravel pavement material underlain by gravelly sand, silty sand and sandy clay
- **Semaphore Sand** (maximum depth 1.9 mbgl): light brown and yellow brown dune sand becoming darker and wetter with depth. Typically in a loose to medium dense condition
- **St Kilda Formation** (maximum depth 7.6 mbgl): grey to dark grey sand with organic fibres, shells and shell grit. Typically loose to medium dense
- **Glanville Formation** (maximum depth 9.6 mbgl): interbedded sequence of sandy clay, clayey sand and sand. A calcrete cap (0.1 m think) was encountered in one investigation location
- **Hindmarsh Clay** (to limit of investigation- 11 mbgl): Clay and sandy clay interbedded with lenses of sand and clayey sand.

The Australian Soil Resource Information System (ASRIS) map indicated that the QPS is within an area of high probability of occurrence of acid sulfate soils (ASS). Based on field pH tests, the soil pH ranged between 7.4 and 8.6 indicating that soils have the potential to become ASS.

8.2.3 Marine sediment conditions

Deepening the river bed between 5.2 and 8 m is expected to encounter St Kilda Formation and Glanville Formation.

The shallow sediments of the Port River river bed include sediments of the St Kilda Formation comprising varying thickness soft sandy shelly mud, overlying the Glanville Formation comprising cemented calcarenite/calcrete at the top and stiff calcareous clay (Seas Offshore, 2017).

Vibrocore sampling was undertaken to assess the physical characteristics of the sediments within the proposed barge footprint, to inform mooring design. Both the St Kilda and Glanville Formations were encountered during vibrocoring.

The St Kilda Formation at the proposed Storage Barge location was generally between 0.2 and 0.6 m thick and was very soft with little to no internal strength.

The surface of the Glanville Formation was generally heavily cemented calcrete, with the exception of five assessment locations where the surface was either stiff calcareous clay or a thin fractured calcrete layer over variably cemented, sandy calcareous clay.

The thickness of the calcrete layer and potential interlayering of cemented and non-cemented Glanville Formation below the cemented calcrete was unknown.

An *in situ* contamination assessment of the shallow sediment was undertaken to inform the preliminary designs and the most appropriate and pragmatic disposal options for the surplus sediment (Appendix C).

Sediment samples were collected at 30 locations within the proposed dredging footprint, based on a random grid-based sample design, in accordance with National Assessment Guidelines for Dredging (NAGD). Samples were collected by hand (using accredited divers) (20 locations) and using a ponar dredge sampler (10 locations). The samples were analysed by a National Association of Testing Authorities (NATA) accredited laboratory for a range of contaminants of potential concern including heavy metals, hydrocarbons, per- and polyfluoroalkyl substances (PFAS), Tributyltin (TBT) as well as ASS. Total Organic Carbon (TOC) was also analysed to enable normalisation of TBT results (calculated by dividing TBT by TOC).

The samples collected were described as dark grey / black silty clay / mud with shell inclusions and plant roots.

Concentrations of the tested analytes in the sediment samples were compared against relevant guidelines and criteria selected as the most appropriate to help understand the sediment quality and potential disposal options.

The chemical results are described in detail in Appendix B and summarised below:

Metals

- Concentrations of total trace metals were below the laboratory limit of reporting (LOR)
- Concentrations of total metals were below the SA EPA Waste Fill criteria for land disposal
- Concentrations in 26 of the 31 samples analysed for mercury were marginally greater than the Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines for Fresh and Marine Water Quality and NAGD screening criteria (criteria adopted for sea disposal)
- Other concentrations of total metals were below the ANZECC and NAGD screening criteria.

Tributyltin

- TOC ranged from 0.58 to 0.88%
- Normalised TBT concentrations were below the NAGD and ANZECC guidelines.
- No waste disposal criteria were available for TBT.

Per – and Polyfluoroalkyl Substances (PFAS)

- PFAS was reported in five of the nine samples analysed at concentrations between 0.0002 to 0.0008 mg/kg
- The concentrations of PFAS did not exceed the available human health or ecological guidelines, or criteria for residential and parkland/public open space and commercial/industrial settings; adopted for land disposal
- There were no sediment guidelines available for PFAS.

Other organics

- Concentrations of other organic chemicals including hydrocarbons, phenolics, polychlorinated biphenyls (PCBs) and organophosphorus pesticides (OPPs) were below the LORs, NAGD screening levels, ANZECC guidelines and SA EPA Waste Fill criteria.

Acid sulfate soils

- The soils were classified as potential ASS, based on the chromium reducible sulfur being greater than 0.03 (% sulfur)
- There was sufficient neutralising capacity in the soils and therefore the soils will not need treatment or management.

8.2.4 Project interaction

Coastal soil conditions

Installation of the pipeline from the Storage Barge to Unit 5 is expected to be installed by a combination of Horizontal Directional Drilling at maximum depth of 6 m bgl and by excavating and installing a pre-fabricated shallow culvert.

Directional drilling is expected to be predominately within the sands of the St Kilda Formation (including Semaphore Sand). Waterlogged soils within this profile may have the potential to become ASS when exposed to oxygen.

There is the potential for encountering soil contamination associated with the historical and current use as a power plant.

The method of trench installation selected minimises disturbance at the surface and the surplus soil generated and requiring disposal and/or management.

Marine

Based on the inferred geology, dredging up to LAT depths of 8 m is expected to encounter St Kilda and Glanville Formations. Approximately 70,000 m^3 of sediment, surplus to Project requirements, will be generated as a result of the dredging activities and will require disposal in accordance with the EP Act and associated standards and regulations.

Based on the contamination assessment, the sediment proposed for excavation is suitable for disposal to the proposed licensed disposal facilities without having an adverse impact on the receiving environment.

Preliminary mooring designs have been based on current understanding of the sediment geotechnical characteristics.

8.2.5 General management considerations

The current design of the Project has considered the known geological and geotechnical conditions.

Surplus soils generated as a result of directional drilling (or trenching) will be managed in accordance with SA EPA guidelines, including appropriate soil contamination investigation for disposal or offsite reuse.

The potential for encountering ASS will be included in site inductions and soil management considerations.

Soil management measures during construction including sediment and erosion control will be detailed in a Construction Environmental Management Plan (CEMP).

Further geophysical/geotechnical investigations may be required to assess the Glanville Formation sediments in the detailed mooring designs.

Soil management measures during dredging, including temporary stockpiling and transport requirements will be detailed in the CEMP.

8.3 Groundwater

Groundwater may be encountered during onshore construction and require temporary dewatering. Potential impacts will be effectively managed through a Dewatering Management Plan (if required) and a CEMP.

The depth to groundwater in the Port Adelaide region is generally between 2 and 5 mbgl (SARIG).

Based on the WaterConnect database there is one registered bore within 500 m of the QPS site, situated within the Torrens Island Quarantine Station complex. The standing water level was recorded at approximately 4 mbgl and a yield of 4 L/s. The purpose of this well was listed as ‘observation’.

During geotechnical investigations undertaken at the QPS (Coffey, 2012), groundwater within the Semaphore Sand was encountered at depths of between 1.15 and 1.5 m. Due to the proximity of the site to the Port River, tidal variations in the groundwater level are likely.

Chemical testing undertaken on groundwater samples (Coffey, 2001) found the groundwater to be:

- Slightly alkaline (pH 7.2 to 7.6)
- Moderately to highly saline (TDS 11,000 to 56,000 ppm)
- Relatively high in sulphate (150 to 3,900 ppm) and chloride (5,600 to 29,000 ppm)

The report recommended an exposure classification for steel pipes of severe, in accordance with AS2159 - 1995.

Shallow groundwater beneath the site has the potential to be contaminated, based on the use of the site as a power plant. Potential contaminants are listed in Section 8.2.3.

8.3.1 Project interaction

Groundwater may be encountered during installation of the pipeline from the Storage Barge to Unit 5, dependent on detailed design and final construction methodology.

There will be no further impact to groundwater following shallow excavations associated with pipeline installation.

8.3.2 General management considerations

Where groundwater is encountered, temporary dewatering may be required to facilitate installation of the pipeline, depending on the construction methodology. The extracted water will be appropriately disposed of in accordance with the SA EP Act.

Requirements for dewatering and disposal will be considered and documented in a Dewatering Management Plan (if required) by the Contractor.

Requirements and options for management/disposal of extracted water will be further investigated during detailed design.

8.4 Water quality

Backhoe dredging technique inherently reduces the risk of sediment plumes and turbidity increases within the Port River, however localised turbidity will still increase during dredging. Origin is committed to meeting appropriate water quality criteria at the dredging site and will work with the EPA to establish criteria as a part of licensing.

Return water at the disposal ponds will be in accordance with the existing licence conditions.

Water quality of the Port River is influenced by the highly urbanised and industrial catchment discharging into it. Much of the northern Adelaide Plains drain into the Port River and Barker Inlet (DEWNR 2007). The water is subject to discharges from the Bolivar Wastewater Treatment Plant, the former Penrice Soda facility, Torrens Island Power Station and Pelican Point Power Station. Water quality in the Port River is also impacted by its use as shipping channel. As a result, there have been historical impacts to the water quality through thermal and chemical pollution, nutrients and turbidity.

Thermal pollution can alter the temperature patterns in estuaries. Historically, the main source of thermal pollution in the Port River is from the Torrens Island, Osborne and Pelican Point power stations. These industries use river water for cooling purposes and discharge the warmer water back into the River.

The main source of chemical pollution in the Port River (i.e. lead, copper, zinc and oil) is from industrial sources and urban/road runoff. The major sources of nitrogen and phosphorous pollution in the Port River are wastewater treatment plants, industrial discharges and urban stormwater runoff.

Increases in turbidity can occur directly by increasing suspended loads, and indirectly through nutrients increasing the abundance of planktonic algae and zooplankton. The main contributor to turbidity variations in the Port River is through resuspension of sediments deposited in the River through shipping movements, as well as routine dredging and occasionally storms.

8.4.1 Water quality criteria

Through the Environment Protection (Water Quality) Policy 2015, South Australia adopts the water quality criteria from ANZECC/ARMCANZ (2000) guidelines. These criteria provide indicators of the water quality that is expected to be achieved during dredging. The waters adjacent to QPS are categorised as marine waters for the purposes of guideline application, and support aquatic ecosystems, recreation and aesthetics and primary industries. Default triggers values for marine and estuarine waters in South Australia include a turbidity trigger of 0.5 – 10 nephelometric turbidity units (NTU).

8.4.2 Water quality monitoring

Water quality monitoring was undertaken by the SA EPA between 1996 and 2000 at nine sites within the Port River and Barker Inlet (SA EPA, 2002). Of these monitoring sites, two were relevant to the area surrounding the QPS; Site 1 (approximately 4 km upstream of the QPS) and Site 2 (approximately 700 m downstream of the QPS), as shown in Figure 14.

A summary of the findings of the water quality monitoring as presented in the EPA report, as well as additional monitoring data sourced directly from SA EPA for the years between 2000 and 2008, is as follows:

- The mean temperature at monitoring sites 1 and 2 was 18.5ºC and 18.1ºC, respectively. These values were similar to the mean temperature over the nine monitoring sites (18.4ºC). Based on the results, it was concluded that the large volume of water in the Port River was effective at buffering the impacts of thermal discharges.
- The concentrations of metals over the five-year sampling period were compared to the Australian water quality guidelines for the protection of aquatic ecosystems (ANZECC, 1992). Based on the comparison, generally copper and zinc were found to be elevated. Concentrations of other metals analysed were generally less than the ANZECC guidelines most of the time (90^{th} percentile less than or equal to guidelines).
- The concentrations of ammonia and oxidised nitrogen were identified as a significant issue for algae in the Port River. These nitrogen concentrations were likely to be promoting greater algal growth and therefore higher chlorophyll concentrations in the River.
- Turbidity was generally less than 5 NTU (SA EPA, 2017).

EPA developed a Water Quality Improvement Plan in 2008 that committed to a set of management actions to maintain and improve the environmental values and water quality within the Port region. In 2017, Golder analysed water quality within Port River adjacent to Site 1 and Site 4 as identified in Figure 14. These water quality results are shown in Table 10.

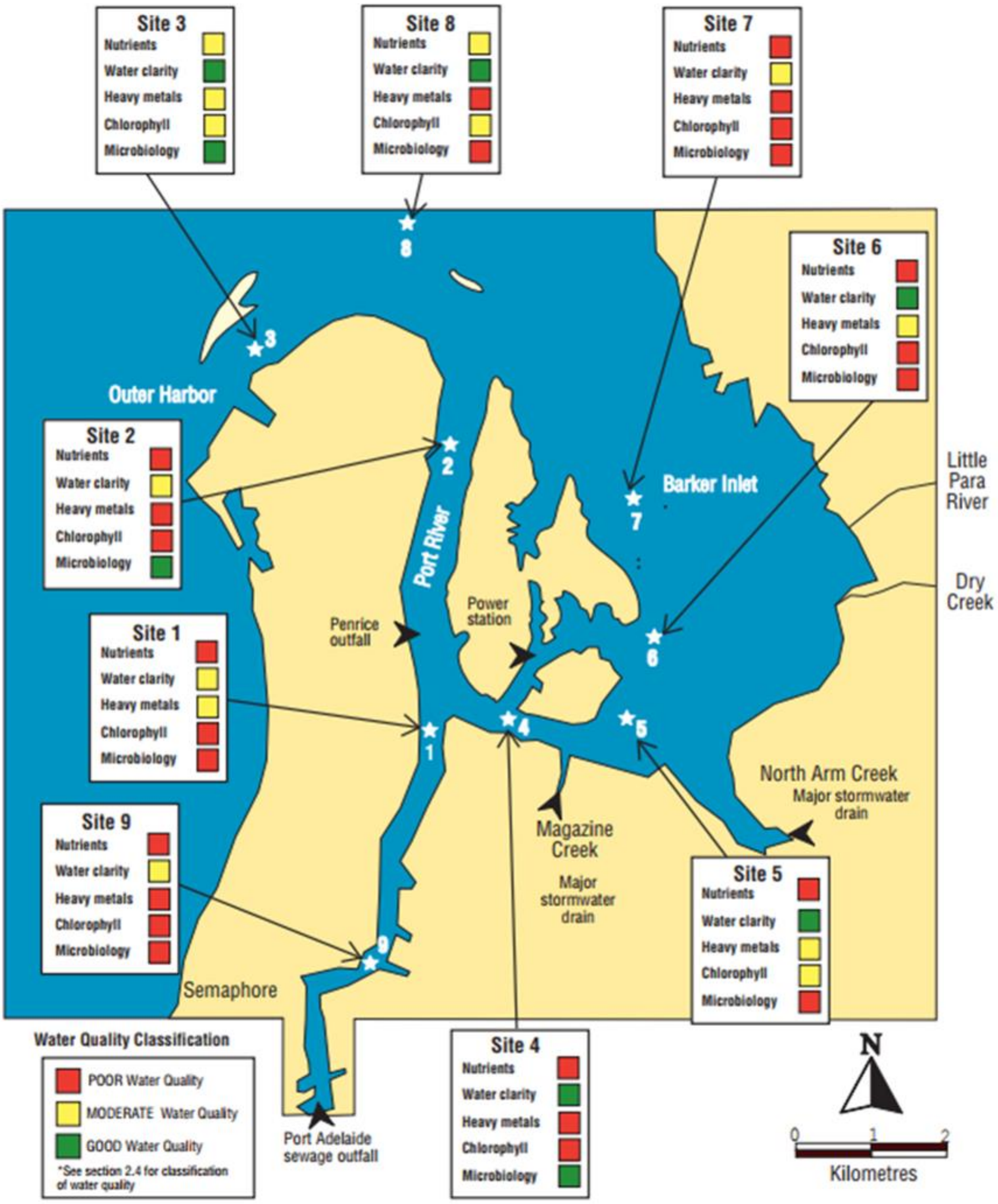

Figure 14: Port River ambient water quality monitoring sites and water quality classification from September 1995 to August 2000 (SA EPA, 2002)

Table 10: Summary of surface water field parameters

Site	Temp (ºC)	Redox (mV)	EC (µS/cm)	pH (pH units)	DO (mg/L)
Site 1	16.5	72.2	42.58	7.87	8.72
Site 4	16.1	78.4	41.94	7.82	8.70

Units: °C – degrees Celsius, mV – millivolts, µS/cm – mircosiemens per centimetre, mg/L – milligrams per litre.

Concentrations of all analytes assessed (metals, nutrients, phenols, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and BTEX (benzene, toluene, ethylbenzene and xylene) were below the Recreation and Aesthetics criteria in the Australian and New Zealand Guidelines for Fresh and Marine Quality, dated October 2010.

Concentrations of the analytes were also compared to the ANZECC guidelines for protection of 95% of marine systems. This protection level is based on the site being considered only slightly-to-moderately disturbed. When compared to these results lead, nickel and zinc exceeded the criteria at Site 4, and copper exceeded the criteria at both locations.

8.4.3 Background turbidity

The marine environment of Outer Harbor is exposed to periods of high levels of turbidity, primarily as a result of the shipping activity in the Port (KBR, 2004).

Based on information collected prior to the Outer Harbor Capital Dredging (OHCD) Project in 2004, turbidity in the Port can be expected to increase up to 35 NTU above background levels during shipping movements. (KBR, 2004)

Background turbidity within Port River near the TIQS Jetty is shown in Table 11. These data show that while turbidity levels within the river remain low during winter and spring, there is significant fluctuation in the summer and autumn months.

Table 11: Seasonal turbidity near the Torrens Island Quarantine Station jetty (data recorded 1995-2008)

	Mean NTU ± SD[1]	Maximum NTU	Minimum NTU
Summer	5.35 ±5.53	21.33	1.07
Autumn	3.84 ±2.79	10.71	1.10
Winter	2.43 ±1.33	5.73	1.30
Spring	2.80 ±1.30	4.80	0.50

1 Standard deviation

8.4.4 Potential impacts

The use of backhoe dredging inherently limits turbidity and sedimentation. Backhoe dredges remove spoil with a closed bucket and load dredged material onto a barge at near-*in situ* water content and does not require overflow barges. Therefore, the resulting turbidity is drastically reduced when compared to hydraulic dredge methods (i.e. THSD and CSD).

Turbid plumes associated with different dredging were computer simulated for the OHCD Project and OHCW Project. The results indicated that using a THSD in soft materials was expected to produce plumes up to 200 mg/L (up to ~ 70 NTU) above background levels (KBR, 2004). Operation of the CSD generated similar turbidity plumes to those of the THSD. While the turbidity is generally higher in the immediate vicinity of the CSD dredge due to the dredge being almost stationary, sediment concentrations away from the immediate vicinity of the dredge were generally lower than the THSD simulation (KBR, 2004).

Elevated turbidity and sediment dispersion

It is recognised that although backhoe dredging provides one of the most accurate methods in terms of limiting turbidity and sediment dispersion, dredging will still result in:

- Sediment impacts from the installation and removal of anchoring spuds
- Dredging operations
  - Disturbance of sediments through operation of the dredger
  - Sediments being washed from the backhoe during descent and recovery during dredging
  - Sediments and dirty water spilling from the bucket during slewing to the disposal barge.

Deployment of dredging spuds

The installation of the anchoring spuds associated with the backhoe dredger and CSD would cause some disturbance of the river bed and suspension of fine sediments. However, this process is only expected to occur approximately once each day and would only occur over a short period of time (i.e. less than 5 minutes per spud). A small cloud of suspended sediment is expected, noting that the backhoe or CSD would not be operating while the spuds were being placed so there would not be any additional coincident sediments. Any suspended plume is expected to disperse quickly via tidal currents following the spud installation.

Dredging operation

Turbidity plumes are expected to be limited to the immediate vicinity of the sediment excavation plumes and are considered to be minor and temporary. Backhoe dredging for the berthing facility upgrade at Kurnell generated little sediment – approximately 5 mg/L above background levels (URS 2013).

Turbidity increases as a result of the use of a CSD for channel deepening are expected to be greater than those resulting from the backhoe dredge as a result of the overflow barge. The turbidity impacts are expected to be minor and temporary and in the context of the use of Port River as a busy shipping channel.

With respect to sedimentation and turbidity impacting environmental values, the benthic environment surrounding the dredging activities are generally highly disturbed and dominated by Caulerpa (see Section 8.5), with a small community of seagrasses in poor condition observed inshore. Origin proposes to protect these inshore seagrasses throughout the deepening works.

Annual shipping movements during operation are expected to be approximately 10-12 annual shipments. This frequency is expected to have a negligible impact on the overall turbidity conditions of the Port River in the vicinity of the site, particularly considering the site is adjacent the shipping channel.

Reduced water quality from mobilised sediment contaminants

Sediment contaminants has been addressed in Section 8.2.3. Briefly, the sediment proposed for excavation is suitable for disposal to the proposed licensed disposal facilities without having an adverse impact on the receiving environment.

Construction is expected to have a negligible impact on water quality.

Contamination from spills and discharges

Maintaining the water quality of the Port River has been central to the Project design. The Storage Barge has been specifically designed with tanks and pumps submerged below deck and all piping fully welded (except battery limits) to eliminate potential leak points and ensure the risk of impact to the Port River water quality during installation of the Storage Barge and operation are negligible.

8.4.5 Management considerations

Origin is committed to protecting sensitive environmental values and has selected a dredging technique to minimise impacts to water quality. Further, land-based disposal of dredge material provides additional protection to water quality.

Origin proposes to protect the seagrass beds adjacent to the dredging area by using sediment curtains. This will be detailed in the CEMP.

Turbidity modelling will be considered to inform the development of a CEMP and will be based on detailed engineering design and dredging plan.

Spill prevention/control, emergency procedures and other management measures to mitigate risks and minimise potential impacts will be implemented through the CEMP. The Storage Barge includes spill detection systems.

8.5 Coastal ecology

Vegetation within the QPS is sparse and highly degraded, with a small area of mangroves and samphire in the intertidal area.

The majority of the Project infrastructure at QPS is within the previously disturbed footprint.

Construction methods have been designed to ensure there are no impacts to vegetation in the intertidal zone.

8.5.1 Torrens Island and QPS ecology

Torrens Island ecological setting

Torrens Island is bound by the Port River to the West, the Barker Inlet to the south and east and the Section Bank mudflats to the north. These areas support tide dominated estuaries, with low tide saline mudflats, mangroves (approximately 60% of the Island) and salt marshes comprising a significant part of the area. (EAC Ecological Evaluation (EAC) 2013) The island is part of an 822 ha ecosystem-unit which includes the Adelaide Dolphin Sanctuary and the Barker Inlet/St Kilda Aquatic Reserve, which is listed as a wetland of National Importance.

The Torrens Island Biodiversity Action Plan 2013 (the Action Plan) was prepared for the Adelaide & Mount Lofty Ranges Natural Resources Management Board (EAC Ecological Evaluation Pty Ltd 2013). As part of the preparation of the Action Plan, a flora and fauna field survey was undertaken.

Vegetation

Torrens Island vegetation has been characterised into four broad categories (Figure 15):

1) Coastal dunes – these are mainly found on the northern end and north western coast of Torrens Island, north of the TIQS and QPS.

2) Samphire shrublands – these are found on the northern end of the Island and southern area, east of the Torrens Island Power Station.

3) Mangroves – found on intertidal mudflats of tidal estuaries and muddy seashores and extending inland along the tidal channels merging into samphire shrublands at the landward limit of the intertidal zone.

4) Introduced grassland/herbland – to the east of the Torrens Island Quarantine Station and in degraded land adjacent salt marshes.

The ecosystem of Torrens Island is threatened by introduced weed species including a number of environmental weeds, and declared plants including Bridal creeper, Skeleton weed, False caper and African boxthorn.

An additional survey of western portion of Torrens Island (outside of the Torrens Island Conservation Park) was conducted in Autumn 2017 (Jacobs 2017). The areas surveyed by Jacobs adjacent the QPS were characterised as tidal mud flats with samphire low open shrublands. Samphire species identified in this vegetation association included Bearded Glasswort, Shrubby Glasswort and Thick-headed Glasswort.

Fauna

The tidal mud flats, samphire and chenopod low open shrublands communities and Mangroves provide habitat for a wide range of species, specifically many threatened bird species (Jacobs, 2017).

The Action Plan identifies the following native fauna as being present on Torrens Island:

- Birds - the Island provides a safe haven for local and migratory birds, including sea birds. Many bird species, including some with conservation significance, rely on the conservation area and surrounding samphire shrublands for foraging and breeding
- Reptiles - two species of sea turtles have been recorded on Torrens Island, however were likely misplaced vagrants in the waters surrounding the Island. Fifteen other reptile species have been recorded on the Island over time.
- It is unlikely that any frogs are naturally present on Torrens Island (EAC, 2013), however a number of species have been introduced.
- There are no records of native terrestrial mammals on Torrens Island, however bats may possibly be present (EAC, 2013).

Environment Protection and Biodiversity Conservation Act

As would be expected near a conservation area and next to the marine environment, a number of ecological communities, threatened species and migratory species that may be present or have habitat present within 10 km of the study area were identified in a Protected Matters search.

The tidal mudflats with mixed samphire low shrubland, recorded adjacent the south western boundary of the QPS, is considered a Threatened Ecological Community, vulnerable (Subtropical and Temperate Coastal Saltmarsh). A population of the Bead Glasswort, listed as Vulnerable nationally and at a State level, was also recorded within this association near the Torrens Island Power Station (over 1 km south of the QPS).

QPS ecology

The QPS facility has been generally characterised as a cleared area with exotic grasses and herbs and amenity plantings (Jacobs 2017).

Exotic grasses and herbs present at QPS include Couch grass, Hare’s Tail Grass and Sea Spurge. Scattered regrowth of native species including Knobby Club-rush and Native pigface are also present. Scattered amenity planting of River Red Gum and Sugar Gum are found adjacent the QPS.

The intertidal area to the west of QPS consists of a regenerating mangrove forest varying from 5 -15 m in width. There is a sparse coverage of samphire beneath the mangroves, increasing in density moving east towards the QPS. Above the seawall / levee bank and high tide mark the project area consists of degraded chenopod shrubland dominated by exotic grasses and low shrubs (Coastal Galenia), with sparse coverage of Saltbush, Nitre-bush and Round leaf pigface.

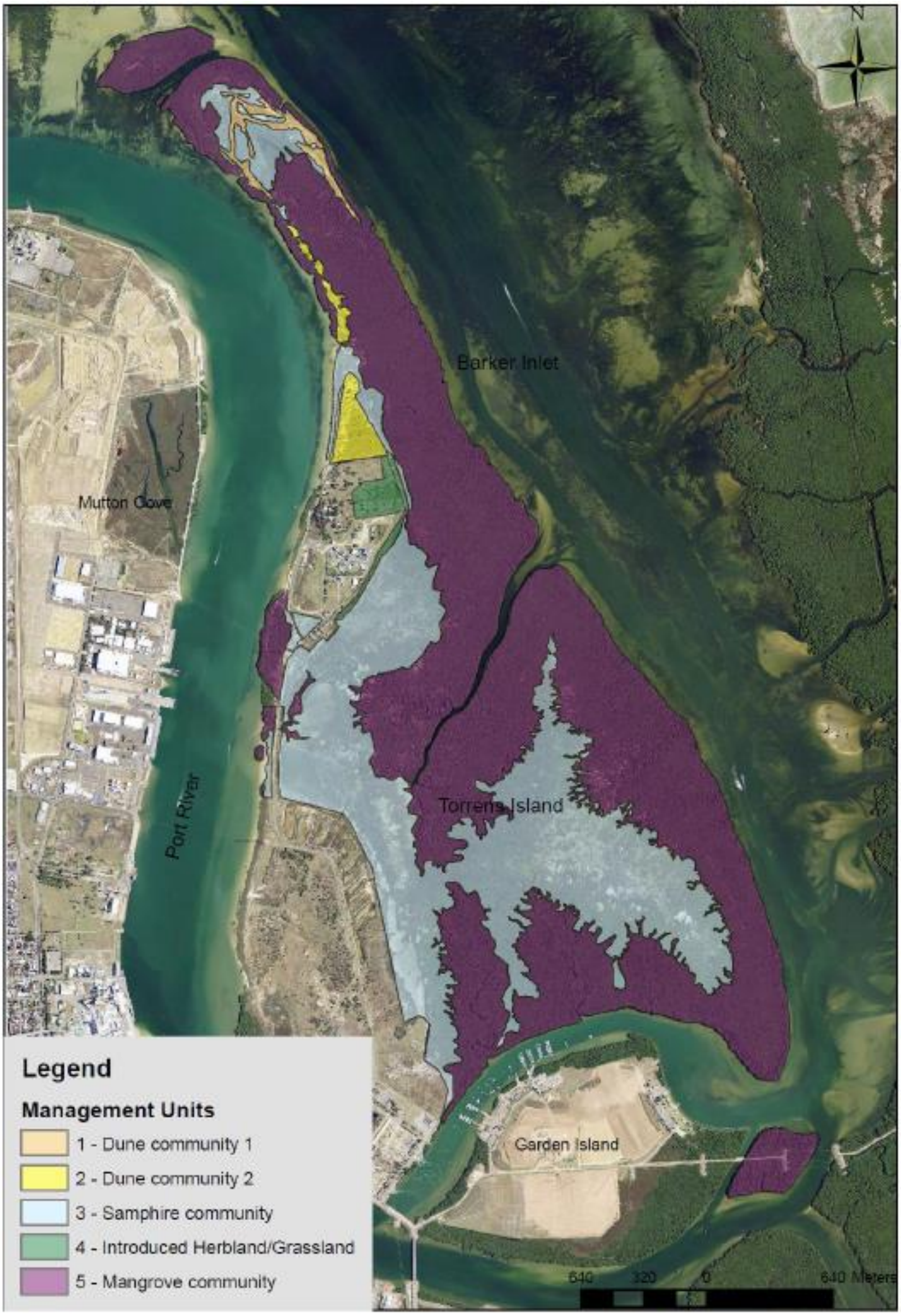

Figure 15: Torrens Island broad vegetation communities (EAC 2013)

8.5.2 Potential impacts

The Project infrastructure and construction method has been designed to ensure there is a negligible impact on the vegetation present at QPS. All of the QPS upgrade infrastructure and majority of the LPG pipeline will be within the existing hardstand area (Figure 16).

Figure 16: Onshore infrastructure location (a) shallow culvert and (b) vaporisers

For the 6 inch pipeline to cross the intertidal areas containing Mangrove and chenopod shrubland, Origin has proposed HDD below the mangrove root zones. This eliminates the need for surface excavation and as such, no vegetation losses in the intertidal zone are anticipated.

With no loss of habitat anticipated, there are no impact pathways to avian fauna.

Environment Protection and Biodiversity Conservation Act

A self-assessment of the project in accordance with the EPBC Act based on a site-based flora and fauna survey (Jacobs 2017) did not identify any pathways that indicated a requirement for this project to be referred to DEWNR.

Operational impacts to vegetation will also be negligible.

8.5.3 General management considerations

Management measures, such as enforcing exclusion zones, will be implemented during construction through the CEMP to ensure potential impacts to existing vegetation are minimised.

As there is no vegetation removal required to facilitate the development, there will be no habitat loss and the impact on fauna will be negligible.

Management measures will be implemented during construction through the CEMP to ensure protection of fauna encountered.

The ecosystem of Torrens Island is threatened by introduced weed species including a number of environmental weeds, and declared plants including Bridal creeper, Skeleton weed, False caper and African boxthorn.

8.6 Marine ecology

The dredge area and its surrounds are generally dominated by pest species Caulerpa taxifolia and C. cylindracea. The dredging method and dredge disposal location options have been selected to minimise the spread of Caulerpa.

Seagrass (Zostera sp.) communities exist inshore and upstream of the dredge area, and will be protected from indirect impacts using silt curtains.

The dredge area is within the Adelaide Dolphin Sanctuary. Dredging activities will be managed through a CEMP to ensure negligible impact to marine fauna.

8.6.1 Protected Matters search

As for the coastal environment, a Protected Matters search was undertaken to assess if marine-based species or communities of conservation importance are likely to be present in the proposed dredge area and surroundings (5 km search radius). A likelihood of impact has been assessed based on presence likelihood and on the potential direct and indirect impacts of the dredging operations and development. Table 12 summarises the database search for marine species and presence likelihood. The results of the full search is presented in Appendix D.

Table 12: Species or communities of conservation importance[1] potentially present in the dredge area and surroundings, and likelihood of impact.

Common name[2]	Latin name	Cons. Status[3]	Presence likelihood
Reptiles			
Loggerhead Turtle	*Caretta caretta*	E	Unlikely
Green Turtle	*Chelonia mydas*	V	Unlikely
Leatherback Turtle	*Dermochelys coriacea*	E	Unlikely
Fish			
Syngnathids (pipefish, pipehorses, seadragons, seahorses)	Syngnathids	P	Potential
Great White Shark	*Carcharodon carcharias*	V; P	Potential
Porbeagle Shark	*Lamna nasus*	M	Unlikely
Mammals			
Whales, seals, sea lions, Dolphins		P	Potential
Bottlenose dolphins[4]		P	Most likely
Bryde's Whale	*Balaenoptera edeni*	M; P	Unlikely
Pygmy Right Whale	*Caperea marginata*	M; P	Unlikely
Southern Right Whale	*Eubalaena australis*	E; P	Unlikely
Dusky Dolphin	*Lagenorhynchus obscurus*	M; P	Unlikely
Humpback Whale	*Megaptera novaeangliae*	V; P	Unlikely
Australian Sea-lion	*Neophoca cinerea*	V; P	Potential

1 EPBC, NPW Act 1972, FM Act 2007

2 Only the strictly marine species were retained.

3 V= vulnerable, E= endangered, CE= critically endangered, R= rare, M=migratory, P= protected in SA).

4 Bottlenose dolphins (Adelaide Dolphin Sanctuary (Adelaide Dolphin Sanctuary Act 2005)).

8.6.2 Marine pests

Over 250 exotic marine organisms have been introduced into Australian waters by vessels and 75% are likely to have arrived as biofouling organisms attached to the external and internal surfaces of vessels. Ballast water also poses a risk for translocating marine pests or diseases.

While more than 20 pest species have been identified in Port River, the presence of some have been directly attributed to shipping movements and poor ballast practices. These include:

- Dinoflagellates
- European fan worm
- Asian date mussel
- Green shore crab
- European sea squirt.

The presence of *Caulerpa taxifolia and C.cylindracea*, green macroalgae have also been recorded in Port River, but these are thought to have been introduced via human-mediated activities such as illegal aquarium plant disposal.

8.6.3 Field survey

An aquatic habitat assessment of the Project area within the Port River was undertaken in July 2017. A diver survey of the benthic environment at 20 sites within the proposed dredged area was undertaken to characterise the vegetation and fauna, including a five meter buffer radius.

Video transects were also used to gain a broad understanding of the distribution of habitats within the proposed dredge area and its surroundings. Five video transects were deployed in the proposed dredge area, which comprised three 300 m transects running parallel to the shore at different depths, and two 80 m transect running perpendicular to the shore. An additional six transects were deployed in the broader vicinity of the dredge area including inshore, upstream and downstream of the proposed Project area to gain an understating of the habitats.

Both macroalgae *C. taxifolia* and *C. cylindracea* were present in the dredge area and surrounding areas. Both *C. taxifolia* and *C. cylindracea* are introduced species to South Australian waters. *Caulerpa taxifolia* is native to tropical areas around the world; however due to extensive use in the aquarium trade and its resilient nature, *C. taxifolia* has colonised many areas outside its natural range and is declared a noxious species in South Australia under the Fisheries Management Act*. Caulerpa cylindracea* is native to the tropics of Australia; however, it is introduced in South Australia and considered an exotic species under the Fisheries Management Act meaning it cannot be deposited, released or allowed to escape without specific authorisation. It was found in abundance in the survey area up to 90% percentage cover forming dense mats, seemingly outcompeting *C. taxifolia*. This is further discussed relative to:

- Storage barge and Replenishment Ship footprint – i.e. where dredging will occur
- The inshore environment between the Storage Barge and the intertidal area – where the pipeline will be HDD at depths
- North and south of the project area.

Storage Barge and Replenishment Ship footprint

The Storage Barge and Replenishment Ship berthing pocket footprint is primarily characterised by dense mats of the cryptogenic green algae (*C. cylindracea),* interspersed with the invasive green algae (*C. taxifolia)*, the introduced European fan worm (*Sabella spallanzanii),* and the razor clam (*Pinna bicolor).* Densities of Caulerpa are typically greatest towards the shore side of the footprint and reduced in density towards the shipping channel. Biomass of Caulerpa increases during warmer months.

A species of epiphytic red algae (*Ceramium* sp.) was found attached to Caulerpa and the shells of razor clams. As Caulerpa densities decrease towards the shipping channel, Red algae becomes the most abundant algae, despite having a relatively patchy coverage of the river bed.

The sediment of the river bed was comprised of a soft silty mud with intermitted patches of shell grit. The presence of burrows in areas of exposed river bed indicate the presence of infauna communities (e.g. worms, molluscs, crustaceans). Additionally, the scattered hard substratum provided by razor clam shells allowed for the settlement of sponges and ascidians.

Dominant species found at the dredge site are shown in Figure 17.

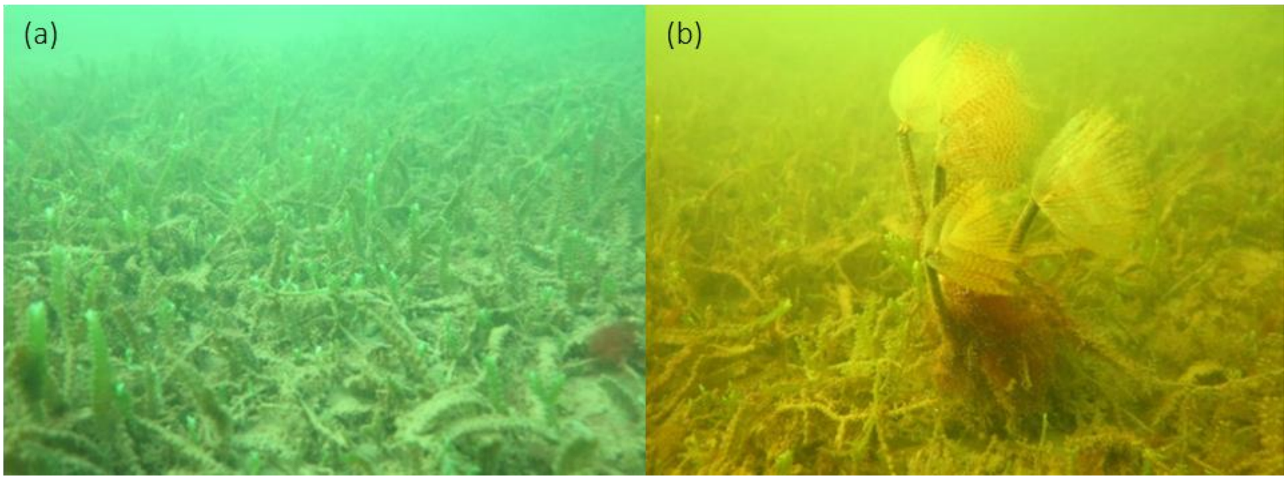

Figure 17: Dominant habitat and species in the dredge area with (a) dense Caulerpa and (b) European fan worms growing on a razor clam and surrounded by Caulerpa

Inshore

The region inshore of the dredge area is primarily dominated by dense mats of Caulerpa (in water depths between 2 m and 5 m) and patches of seagrass (*Zostera* sp) (<2 m depth). These seagrass beds displayed a low to high percentage cover, ranging up to approximately 70% cover in the most established areas. Moderate amounts of epiphyte growth were also observed on the seagrass blades. There are also extensive patches of the unidentified red algae, covering the areas between seagrass meadows. Sponges and ascidians are also observed on the remnants of old jetty pylons in this area.

Dominant species inshore of the dredge site are shown in Figure 18.

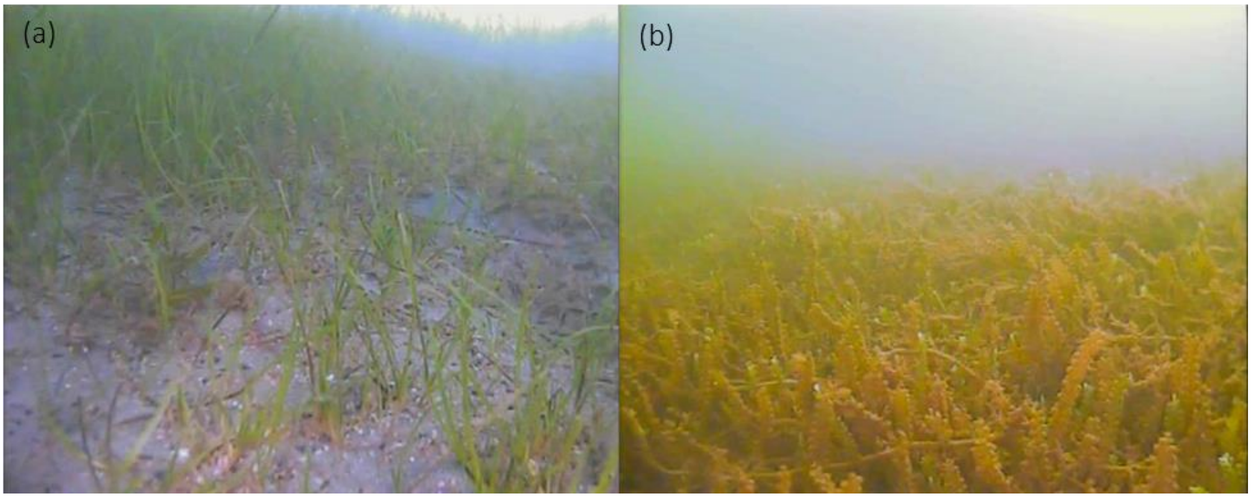

Figure 18: Dominant habitat and species inshore from the Storage Barge with (a) sparse Zostera beds close to the low water mark and (b) Caulerpa beds

North and south of the dredge area

There are extensive seagrass meadows identified in the shallow waters upstream from the dredge area, with a high degree of epiphyte growth on the seagrass blades. In the deeper waters towards the shipping channel, the habitat is dominated by dense mats of Caulerpa.

The river bed downstream of the dredge area is almost completely covered in Caulerpa, with interspersed Razor Clams and European fan worm.

Summary of benthic species

While Caulerpa was a dominant species within the dredge and inshore areas, there were some seagrass species found. As native vegetation, removal of seagrass such as *Zostera* sp. is regulated in South Australia (*Native Vegetation Act 1991*). The marine species and habitats have been summarised in Figure 19.

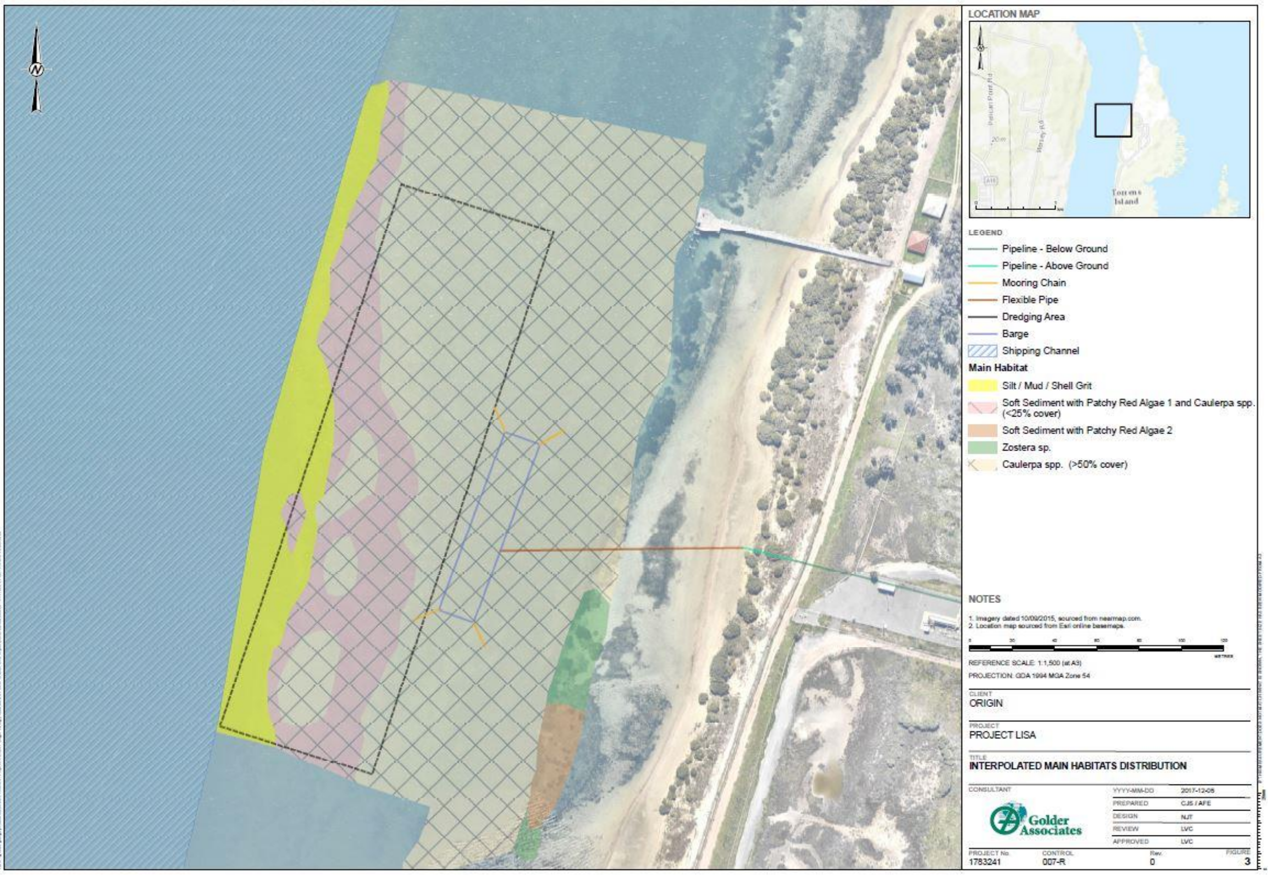

Figure 19: Benthic marine habitat and assemblages in the Project area

Table 13: Species found during the surveys and their conservation status.

Common name	Latin name	Pest species under the Fisheries Management Act	Presence in dredge area
Seagrass			
Eelgrass[1]	*Zostera* sp.	No	Absent
Macroalgae			
Caulerpa	*Caulerpa taxifolia*	Yes[2]	Present
Caulerpa	*Caulerpa cylindracea*	Yes[3]	Present
Red algae 1.	Unknown	No	Present
Red algae 2.	Unknown	No	Absent
Invertebrates			
Tunicate	*Urochordata* spp.	No	Present
Sea anemone	*Actiniaria* spp.	No	Present
Bristle worms	Polychaeta spp.	No	Present
European fan worm	*Sabella spallanzanii*	Yes[2]	Present
Razor clam	*Pinna bicolor*	No	Present
Blue swimmer crab	*Portunus pelagicus*	No	Present

[1]Native vegetation clearance is related under the South Australia Native vegetation Act 1991.
[2]*Caulerpa taxifolia* and the European fan worm are declared as noxious species in South Australia under the Fisheries Management Act- “It may not be held or traded in South Australia without specific authorisation” (PIRSA 2017).
[3]*Caulerpa cylindracea* is an exotic species in SA under the Fisheries Management Act 2007 - “It may not be deposited, released or allowed to escape into any waters in South Australia without specific authorisation” (PIRSA 2017).

8.6.4 Marine megafauna

The Port River/Barker Inlet comprises the Adelaide Dolphin Sanctuary which was established in 2005 to protect the resident population of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*). The sanctuary covers 118 km^2 including Inner Port, Outer Harbor, North Haven Marina and stretches north to Port Gawler. Key ecological features combine within this area to provide habitat for the dolphins and their food sources including mangroves, seagrasses, saltmarshes, tidal flats, and tidal creeks. Other marine megafauna may potentially occur in the Port River, although their occurrence is not common (KBR, 2004)

Although the Indo-Pacific bottlenose dolphin is protected under the Adelaide Dolphin Sanctuary Act, it is considered common in coastal waters and not listed as a threatened species under the NPW Act or the EPBC Act.

Dolphin sightings in Port River has increased annually at a rate of 6% since the 1980’s (Bossley *et al.* 2017). Observations have identified more than 300 individual dolphins that have visited the Port River and Barker Inlet waterways and it is thought that up to 30 individuals are permanent residents or frequent visitors.

There are no seasonal differences in dolphin activity budgets (i.e. time spent foraging, feeding, socialising etc.; Steiner 2012) however breeding occurs during December and March.

8.6.5 Potential impacts

Pest species

Ballast water and fouling of hulls have the potential to carry marine pest species, particularly with the Storage Barge being built and then travelling to South Australia from an international port. Pest species in ballast can quickly become established in new marine environments and outcompete local species, causing disruption to the ecosystem. Ballast water can also spread new diseases to local species. By adhering to Ballast Water Management Guidelines and National Biofouling Management Guidelines, the risk of introducing new species is considered low.

The spread of Caulerpa through dredging can also occur if the dredged material is not appropriately handled and disposed of. All works will be undertaking within the existing PIRSA containment area – i.e. within the Port River.

With land disposal anticipated, the risk of further spreading Caulerpa in South Australian waters is considered low.

Vegetation

Based on the survey and the existing information, the dredging operations should have a limited direct impact on the benthic environment.

There were no seagrasses identified in the dredge area. While *Zostera sp.* has been recorded inshore from the dredging area, no direct losses are anticipated from Project LISA. Indirect impacts are also expected to be negligible as the dredging technique uses a backhoe dredge. The material recovered by backhoes reaches the surface at near in situ moisture content. Overflow barges are not required, thus there is less overall turbidity at the dredge site.

Deepening is likely to require limited use of a CSD in parts to break up some of the harder material and turbidity will be generated during this process. Post dredging surveys conducted for the Outer Harbor Channel Deepening Project have demonstrated that seagrasses indirectly impacted by dredge plumes have recovered and remained stable over time (Wiltshire & Tanner 2016). With turbidity in Port River increasing with each ship movement, any short term impact from the CSD to the eelgrass is considered minor.

Invertebrates

Benthic invertebrates such as blue swimmer crabs and razor clams were observed within the proposed dredge area, as well as numerous sediment burrows indicating the presence of infauna communities. Sessile fauna and low mobility species will be directly impacted by the dredging activities, although those impacts will be confined to the dredge area. Mobile species such as crabs are not expected to be significantly impacted given the small extent of dredging proposed.

Dolphins

It is recognised that dolphins are attracted to dredging activities due to the disturbance of sediments causing fish to aggregate. Backhoe operations or movement of the CSD and its dredge head may pose a strike risk, however this is minimised through the dredging technique requiring the barge to be fixed by spuds.

Within the project area, existing underwater noise sources include those associated with shipping movements. Dredging activities will contribute to underwater noise, however acoustic assessments within the Port River for the OHCW Project (which requires approximately 94% more dredging activity than Project LISA) indicated that dredging noise will have negligible impacts on sensitive marine fauna that are approximately 100-200 m from the dredging activity. Hearing damage is only expected if animals remain in the immediate vicinity of the dredge (i.e. 10 m from the vessel) for prolonged periods and this is considered unlikely (ARUP 2017).

The potential impacts (direct and indirect) of dredging on the benthic environment are summarised in Table 14.

Table 14: Potential impacts of dredging operations on Port River environment.

<table>
<tr><th>Source</th><th>Pathway</th><th>Receptor</th><th>Impact</th></tr>
<tr><td rowspan="3">Dredging</td><td rowspan="3">Direct impact</td><td>Vegetation</td><td>The impact to vegetation is considered negligible, given noxious species are dominant within the dredging footprint.

No direct losses of Zostera (identified inshore) are anticipated from Project LISA.</td></tr>
<tr><td>Fauna habitats</td><td>Habitat loss will be limited to algal communities and soft sediment fauna which are expected to recolonise following disturbance.</td></tr>
<tr><td>Sessile and low mobility species</td><td>Sessile fauna and low mobility species will be directly impacted, although those impacts will be confined to the dredging footprint.

Mobile species such as crabs are not expected to be significantly impacted given the small extent of dredging proposed.</td></tr>
<tr><td rowspan="2">Permanent installation (e.g. mooring and flexible pipe)</td><td rowspan="2">Direct impact</td><td>Vegetation</td><td>As above, impact to vegetation is negligible.</td></tr>
<tr><td>Habitat</td><td>Habitat loss will be minor and limited to algal communities and soft sediment fauna. These species are expected to recolonise around the permanent infrastructure.</td></tr>
<tr><td>Marine construction (i.e. dredging and mooring installation)</td><td>Underwater noise</td><td>Marine mammals; dolphins</td><td>There will be a temporary increase in underwater noise. Dolphins are highly mobile and are expected to temporarily move away from the Site during dredging. Works will temporarily cease when a Dolphin enters within a designated Exclusion zone.</td></tr>
<tr><td rowspan="2">Marine construction</td><td rowspan="2">Increase of turbidity</td><td>Vegetation (especially seagrass)</td><td>Indirect impacts are expected to be negligible as the selected dredging technique results in minor turbidity impacts. Winter dredging will also limit impacts as this avoids active growth periods.

Silt curtains will be used where required to manage impacts.</td></tr>
<tr><td>Sessile organisms</td><td>Indirect impacts to sessile organisms are expected to be negligible.</td></tr>
<tr><td rowspan="2">Disposal of dredge spoil</td><td rowspan="2">Dispersal of noxious marine pests</td><td>Land receiving environment (Osborne dredge disposal ponds)</td><td>Impacts from noxious weeds on land will be negligible.</td></tr>
<tr><td>Marine receiving environment (through runoff from the dredge disposal ponds)</td><td>The facility is fitted with an overflow valve to ensure water returned to the Port River does not contain Caulerpa.</td></tr>
</table>

8.6.6 General management considerations

The following controls will be in place to ensure the risk of importation of pest plants and animals due to the introduction of the barge, mooring infrastructure and replenishment ship is negligible.

Pest species

Ballast water exchanges are regulated by port rules and national regulations which limit the potential for ballast water impacts from Project LISA. These include the National Biofouling Management Guidance for Non-trading Vessels, and the Australian Ballast Water Management Requirements.

Origin has further managed the risk of introducing new pests by requiring:

- The barge will be built on land in China and limiting the time spent in international ports prior to travel to Port Adelaide.
- The barge to be inspected prior to the internationals port and on arrival at Port Adelaide (and cleaned as required).

The spread of Caulerpa during the dredging will be managed by adopting the recommended Primary Industries and Regions SA guidelines for managing Caulerpa. This will include thorough inspection of any construction-based vessel and equipment (e.g. ropes, anchors etc.) before it is used and at the completion of works. The dredge disposal ponds have filter screens to prevent Caulerpa fragments from returning back to the Port River.

Appropriate permits will be sought to remove Caulerpa from Port River, in accordance with the Fisheries Management Act.

The management of pest species will be addressed in a CEMP.

Vegetation and invertebrates

Minimising the general impacts of dredging will be considered in a CEMP. Dredging is planned to occur during winter months to avoid summer growth periods.

A silt fence will be placed around the inshore seagrass bed.

Dolphins

Risk mitigation measures for potential impacts on dolphins will be in accordance with the National Parks and Wildlife (Protected Animals- Marine Mammals) Regulations 2010, including adopting the appropriate work exclusion zone for marine mammals (150 m).

These requirements as well as other measures to mitigate risks and minimise potential impact on marine fauna will be included in the CEMP.

9.0 SOCIAL CONSIDERATIONS AND INTERACTIONS

9.1 Aboriginal heritage

The risk of impacting an Aboriginal site through construction and operation is considered negligible given there are no registered sites and Project LISA is located within already disturbed areas.

Marine and estuarine areas were used extensively by the local Kaurna people, prior to European settlement.

Prior to the 1980s sand mining on Torrens Island, a stone hand axe and an Aboriginal midden were discovered immediately to the west of the QPS site. The midden contained artefacts shaped from glass and broken clay tobacco pipes, indicating that occupation of the site continued after European colonisation. After the discovery of the midden, a thorough survey of the island was undertaken, but no other artefacts or middens were found elsewhere.

The remains of almost 70 Kaurna people from the Port area were reburied on Torrens Island in December 2010, to a site north of the heritage-listed Quarantine Station. As part of this relocation, a search of DSD-AAR sites was undertaken. The search indicated there are eight recorded archaeological sites on Torrens Island, as shown on Figure 20.

9.1.1 Potential impacts

The risk of impacting an Aboriginal site through construction and operation is considered negligible, considering the following:

- There are no sites registered within the QPS site
- Additional infrastructure to be installed will be predominately within previously disturbed areas
- The LPG pipeline is likely to be installed using HDD at depth, or will be above ground with minimal ground disturbance
- There will be no further ground disturbance following construction.

9.1.2 Management considerations

Measures to minimise any potential impact on Aboriginal heritage will be included in the CEMP and may include:

- Inductions for construction personnel including potential indicators of encountering a site of Aboriginal heritage significance
- A Chance Finds procedure.

Figure 20: Results of the DSD-AAR search for Torrens Island (EAC, 2013)

9.2 Built heritage

The construction and operational activities will have a negligible impact on the adjacent Torrens Island Quarantine Station or the historic shipwrecks identified within 500 m of Project LISA.

9.2.1 SA heritage register

Torrens Island Quarantine Station was established by the South Australian Government in 1879 to stop passengers from bringing diseases such as small pox into the State. It has been the site of the continuous practice of animal quarantine in South Australia since the early 1850s.

The TIQS complex (Figure 21) was designated a State Heritage Place in the South Australian Heritage register in 1993 (State heritage ID 13931; Heritage Number 17297). The complex includes multiple buildings and a jetty which has since been damaged by fire.

9.2.2 Maritime heritage

The following historic shipwrecks may exist within 500 m of the river bed deepening activities:

- Flying Dutchman (1851)- within Port River approximately 500 m south of QPS
- Jupiter (1940)- within Mutton Cove approximately 500 m west of QPS
- Napperby (1928)- within Port River approximately 500 m north of QPS

The locations of these historic shipwrecks in relation to the Project are shown in Figure 21.

Two of these shipwrecks are located adjacent the Port River shipping channel, and one within a conservation area.

The closest proclaimed shipwreck is greater than 60 km from the Project area.

Figure 21: State heritage listed places

9.2.3 Potential impacts

Impacts to the Torrens Island Quarantine Station during construction and operation are expected to be negligible, given the footprint of the QPS will not change.

Impacts to the historic shipwrecks potentially within 500 m of the river bed deepening activities are expected to be negligible.

9.2.4 General management considerations

The Torrens Island Quarantine Station complex (including the jetty), will be identified to site personnel during inductions to ensure it is protected during construction.

Construction risks will be effectively mitigated, and potential impacts managed, through implementation of a CEMP.

9.3 Air quality

Project LISA will have no operational impact on air quality, specifically NO_2 levels.

Potential impacts to air quality from construction activities will be effectively managed through implementation of a CEMP.

9.3.1 Existing air quality

There are a variety of industries operating in the Torrens Island and Port Adelaide area. A search of the National Pollutant Inventory for the 2015-2016 reporting year identified 11 other facilities with emissions of the same key pollutants as the QPS. The most significant local source of NO_x emissions is the TIPS located approximately 3km south of QPS. Emissions from selected facilities are summarised in Table 15. The selected facilities are electricity generation facilities, including Birkenhead Cement Plant which manufactures cement. The QPS has approved limits and monitoring requirements in line with the current EPA Licence (13697).

The nearest sensitive receptors to QPS are located over 2 km west of the site (Appendix E).

Table 15: Emissions inventory of NOx, CO and particulates for facilities within 6km of QPS*

Facility	**Location**	**Emission rate (kg/year)**		
		NOx	CO	PM10
QPS	Torrens Island	73,135	11,141	4,778
TIPS	Torrens Island	3,115,936	323,921	107,941
PPPS	Outer Harbor	105,122	17,061	6,689
Osborne Cogeneration Plant	Osborne	326,473	13,701	412
Birkenhead Cement Plant	Birkenhead	2,966,640	611,083	121,734

*adapted from Table 3, Appendix E.

The EPA currently monitors air quality at Le Fevre Peninsula (Station name: Le Fevre 2) which is historically rated ‘very good’, the highest category based on a comparison between pollutant concentrations and the relevant NEPM standards.

9.3.2 Potential impacts to air quality

An air quality assessment was prepared in accordance with the EPA’s document: *Ambient air quality assessment* (SA EPA, 2016), regulatory requirements (Section 4) and best practice approaches. The proposed methodology was developed with agreement from EPA personnel prior to the assessment being conducted. Appendix E describes the meteorological models and information sources used to generate site-specific data. Emission rates and stack characteristics were selected for dispersion modelling based on historical stack testing data, emission limits specified in the Environment Protection (Air Quality) Policy 2016 (Air Quality EPP) and manufacturer’s specifications or performance guarantees.

The assessment focused on nitrogen dioxide (NO_2) as the key pollutant emitted to the atmosphere from gas turbines. Other pollutants that may be emitted were not explicitly assessed, as they are typically emitted in trace amounts. NO_2 was considered a suitable indicator of the overall risk to air quality posed by Project LISA.

The cumulative impact to air quality from Project LISA and other proposed developments at QPS (which do not form a part of this application) was undertaken with existing emission sources of NO_2 in isolation (i.e. not including ambient background concentrations), and with the background conditions. The air quality assessment showed that Project LISA has no impact on 1 hour average NO_2 or the annual average NO_2 (Table 16).

9.3.3 General management considerations

Construction activities will have a negligible impact on air quality and will be effectively managed through implementation of a CEMP.

The dual fuel upgrade will be designed to ensure emissions remain within current approved limits and will be monitored in line with the current licence. Based on the air quality assessment, operation of the dual fuel facility will have no impact on current emissions from the QPS.

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Table 16: Maximum predicted ground level concentrations of NO_2 outside the QPS boundary ($\mu g/m^3$)

Scenario	Averaging period	Project in isolation	Project plus background	Air quality criteria ($\mu g/m^3$)	% of air quality criteria
Existing Units 1-4, **existing Unit 5** and QPS expansion works	1 hour average NO_2	48.3	85.9	250	34%
	Annual average NO_2	0.5	15.1	60	24%
Existing Units 1-4, **Project LISA** and QPS expansion works	1 hour average NO_2	48.3	85.9	250	34%
	Annual average NO_2	0.5	15.1	60	24%
Upgraded Units 1-4; **existing Unit 5** and QPS expansion works	1 hour average NO_2	42.6	80.2	250	32%
	Annual average NO_2	0.5	15.1	60	24%
Upgraded Units 1-4; **Project LISA** and QPS expansion works	1 hour average NO_2	42.6	80.2	250	32%
	Annual average NO_2	0.5	15.1	60	24%

9.4 Visual

The visual on-shore impact will be negligible.

The appearance of the Storage Barge and Replenishment Ship will be in keeping with the expected visual features of an operational shipping channel.

New infrastructure installed within the QPS will not be visible from any public vantage point.

The barge-to-Unit pipeline will be installed underground through the intertidal area and will not be visible from the shoreline.

The Storage Barge and mooring dolphins will result in a noticeable change to Port River. As shown in Figure 3, the additional features will present as relatively low, ship-like structure, similar to those regularly using the adjacent shipping channel.

The Replenishment Ship is a transitory feature of the project and is representative of general shipping channel activities.

9.4.1 Potential impacts and management considerations

The visual on-shore impact will be negligible.

Port River is an operational shipping channel; therefore, the appearance of the Storage Barge and Replenishment Ship will be in keeping with the existing environment and expected visual features.

There are no publicly visible features from Unit 5 upgrades.

10.0 PLANNING ASSESSMENT

Within this zone, the Development Plan does not list complying developments, rather, it lists those developments that are considered non-compliant. Power stations are not listed as non-complying developments, and further to this, the site area is within the QPS which was previously approved for development in this Zone.

The Objectives and Principles of Development Control (PDC) of the Port Adelaide Enfield Council Development Plan that are considered to be relevant in the assessment of the proposed development are provided in Table 17.

Table 17: Development plan provisions

Relevant Objective/Principles of Development Control (PDC)		Proposed development details
Metropolitan Adelaide		
Industrial Development	Objective 29: Development at the interface between industrial activities and sensitive uses that is compatible with surrounding activities, particularly those in adjoining zones.	No change to the interface is proposed. The new infrastructure will include two vaporisers, and an upgrade of the turbine in Unit 5.
Conservation	Objective 34: The preservation of buildings or sites of architectural, historical, or scientific interest. Objective 35: The retention of environmentally-significant areas of native vegetation	The proposed development will not result in a change to the current QPS land use and therefore will not have an impact on the adjacent State heritage listed TIQS. The adjacent Torrens Island Conservation Park will also not be impacted by the proposed upgrade to the QPS. There are no interactions with historic wrecks, which are more than 500 m from any works. The design includes buried pipework that is HDD below the root zone of the intertidal mangroves to the west of QPS. The backhoe methodology selected ensures the dredging will not have a negative impact on the surrounding marine ecology, including the seagrasses observed inshore of the dredging area. Construction activities will be carefully managed through the CEMP to ensure sensitive areas surrounding the site (including mangroves, sea grasses and the State Heritage areas) are protected.
Coastal Areas	Objective 45: Preserve and manage the environmentally-important features of coastal areas including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas. Objective 46: Preservation of sites of heritage, cultural, scientific, environmental, educational or landscape importance	As described above, scattered mangroves will be protected throughout construction and operation of the upgraded QPS. Assessment of the benthic ecology within the dredging area did not indicate that the area is of conservation significance. Further to this, the dredging operations are expected to have a limited impact on the marine environment. Coastal areas upstream and downstream will not be impacted by the proposed development, and seagrasses inshore of the development will be protected.

Relevant Objective/Principles of Development Control (PDC)		Proposed development details
		The Storage Barge has been designed to ensure the risk of accidental discharge of LPG is negligible. A spill detection system will be installed on the Storage Barge. The coastal environment surrounding Port River is largely industrial and is not generally used for recreational purposes. Further, Port River is Adelaide's main shipping channel. The proposed development will not impact on the amenity value of the Torrens Island coast and is not considered outside of the expected activities in this location.
Council Wide		
Coastal Development	Objective 6: Protect the coast from development that will adversely affect the marine and onshore coastal environment by pollution, erosion, damage or depletion of physical or biological resources, or by interference with natural coastal processes. Objective 7: Development which does not interfere with environmentally important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas. Objective 8: Development which does not detract from or reduce the value of sites of ecological, economic, heritage, cultural, scientific, environmental or educational importance.	The Storage Barge has been designed to ensure the risk of accidental discharge of LPG is negligible. A spill detection system will be installed on the Storage Barge. The upgrade design includes buried pipework that is HDD below the root zone of the intertidal mangroves to the west of the QPS. The alignment of the pipework will ensure that no mangroves will be impacted through construction and operation. Assessment of the benthic ecology within the dredging area did not indicate that the area is of conservation significance. Seagrasses observed inshore of the dredging area will be protected. The dredging operations are expected to have a limited impact on the marine environment. Coastal areas upstream, downstream and inland of the development will not be impacted by the proposal. The coastal environment surrounding Port River is largely industrial and is not generally used for recreational purposes. Further, Port River is Adelaide's main shipping channel. The proposed development will not impact on the amenity value of the Torrens Island coast and is not considered outside of the expected activities in this location.
Industrial Development	PDC 13: Industrial development should be located in industrial areas.	The proposed development is within the industrial area of QPS and the Port River shipping channel. There is no infrastructure required to be installed outside of an already industrial area.

Relevant Objective/Principles of Development Control (PDC)		Proposed development details
Conservation	PDC 42: Natural vegetation should be preserved wherever possible and replanting should take place, wherever practicable.	The above ground pipeline alignment has been designed to protect the native vegetation (mangroves) to the west of the QPS. The small area of seagrasses in shallow areas (>2 m) inland of the proposed development will not be impacted by the proposed development.
Appearance of Land and Buildings	PDC 45: The appearance of land, buildings, and objects should not impair the amenity of the locality in which they are situated.	The infrastructure within the QPS, as well as that being installed adjacent the Port River shipping channel is in keeping with the general activities expected within an industrial facility and the impact on amenity will be negligible.
Preservation of scenic, heritage, amenity and other values	PDC 60: Development should not result in the disturbance or the devaluation of sites of heritage, cultural, scientific or educational significance. PDC 64: Marine aquaculture and other offshore development should: (b) avoid adverse impacts on: (i) National parks, Conservation Parks and Conservation Reserves (ii) Marine Parks and Reserves. PDC 65: Marine aquaculture and other offshore development should be located at least: (a) 550 metres from a proclaimed shipwreck (b) 1000 metres seaward from the boundary of any reserve under the National Parks and Wildlife Act, unless a lesser distance is agreed with the Minister responsible for that Act	The proposed development will not result in a change to the current QPS land use and therefore will not have an impact on the adjacent State heritage listed TIQS. The proposed development within the QPS will not impact on the adjacent Torrens Island Conservation Park. Potential construction impacts are expected to be negligible and will be managed through implementation of a CEMP. The proposed development within the Port River is expected to have a negligible impact on the Adelaide Dolphin Sanctuary given: - There will be no loss of habitat or resources for dolphins - Construction activities within the River will be temporary and short term - The impact is not expected to be greater than that of the Port River shipping channel. - Dolphins have the ability to temporarily avoid the area. The closest proclaimed shipwreck is greater than 60 km from the proposed development. The proposed development is within 1000 m of the Torrens Island Conservation Park, however, given the QPS exists between the Conservation Park and proposed offshore development, there will be no impact on the Conservation Park from the offshore development. This Development Application will be referred to DEWNR for agreement from the Minister of the development within this exclusion zone.

Relevant Objective/Principles of Development Control (PDC)		Proposed development details
Maintenance of public access	PDC 77: Marine aquaculture and other offshore development should: (b) Be located to take into account the requirements of traditional fishing grounds. (c) Be located not to obstruct nor interfere with navigation channels, access channels, frequently used natural launching sites, safe anchorage areas, known diving areas, commercial shipping movement patterns or activities associated with existing jetties or wharves. (f) Where possible use existing and established roads, tracks, ramps and paths to or from the sea.	The Storage Barge will be located adjacent the Port River Shipping Channel. The appropriate buffers have been allowed for to ensure the permanent Storage Barge, as well as periodic temporary anchoring of the Replenishment Ship alongside the storage barge do not interfere with shipping movements. Dredging activities will be undertaken in consultation with Flinders Ports to ensure Shipping Channel operations are not interrupted. There is no requirement for new tracks, ramps or paths for the construction or operational activities.
Coastal zone		
	PDC 7: Development, including dredging, within the Port of Adelaide (including Outer Harbor, Pelican Point, Osborne, Inner Harbor) should: (a) Minimise the potential for harm to the marine, estuarine and coastal environment, such as spreading of pest plants and/or animals, and public health posed by the disturbance and removal of material; (b) Minimise the potential harmful effects of turbidity and sedimentation on the marine, estuarine and coastal environment, and (c) Ensure dredged materials are treated and disposed of in an appropriate manner.	The dredging methodology has been selected as the most appropriate, largely based on reduced impact to the marine and estuarine environment. The dredging area is largely colonised by Caulerpa. This area will be ploughed inland into other areas already colonised by Caulerpa. The Caulerpa will be turned over and buried and will likely lead to a temporary loss in Caulerpa. A silt curtain will be used to ensure fragmented Caulerpa is contained and cannot colonise further downstream. The silt curtain will also ensure turbidity plumes are contained. The silt curtain will only be removed when turbidity has reduced to an acceptable level. The removed sediment will remain within the Port area in either existing dredge disposal ponds, or will be reused for environmental benefits. No treatment is required.

Relevant Objective/Principles of Development Control (PDC)		Proposed development details
Public Notification	PDC 9: All kinds of development, except those designated as non-complying, associated with port activities at the Port of Adelaide (including Outer Harbour, Pelican Point, Osborne, Inner Harbour West and Inner Harbour) are assigned to Category 2 notification.	Notification will be undertaken in accordance with the Section 49 assessment process which will satisfy Category 2 notification.
Public Purpose (Quarantine Station) Zone		
	Objective 3: The protection and conservation of heritage items.	The proposed development will not result in a change to the current QPS land use and therefore will not have an impact on the adjacent State heritage listed TIQS. Items of Aboriginal heritage significance are not expected to be encountered, however, the CEMP will include a 'chance finds procedure' to minimise impact in the event that an Aboriginal site is encountered.
	PDC 4: Development should not exceed two-storeys in height. PDC 5: Development should provide buffers and limit access to the adjoining MOSS (Conservation) PDC 6: No development is **complying** either absolutely or conditionally in the Public Purpose (Quarantine Station) Zone.	The development will not exceed two-storeys and will not reduce the current buffers between the QPS and Torrens Island Conservation Park. While no development is complying in this zone, the proposed upgrade is not considered non-complying.

11.0 SCOPE ENVIRONMENTAL MANAGEMENT PLAN

11.1 Potential impacts to marine environment

This section outlines environmental management actions necessary to mitigate potential impacts to marine water quality and ecology. Potential impacts to water quality are mainly through generation of a turbidity plume and the resuspension of sediments during river bed deepening.

A range of mitigation measures will be committed to and required to be undertaken by Origin and its Contractors during construction. The mitigation measures listed will be used to inform in the Construction Environmental Management Plan (CEMP) which will be developed by the Contractor based on their experience; final design and methodology; and direction from Origin.

The following are the key potential risks to the marine environment:

- Marine water quality and benthic ecology
- Marine megafauna
- Marine pests and ballast water
- Waste management

11.1.1 Objectives and proposed mitigation measures

Water quality and benthic ecology	
Objective	To minimise impacts to water quality from river bed deepening
Mitigation Measures	- Dredging plant to remain within the proposed river bed deepening footprint at all times - Silt fence to be constructed around the inshore seagrass bed during activities with the potential to cause sediment plumes - Background water quality monitoring to be performed to set performance triggers at designated monitoring locations - Dynamic Dredge Management Plan to be implemented including procedures for when performance triggers are exceeded

Marine megafauna	
Objective	To minimise risk of disturbance or injury to marine megafauna (especially dolphins) To protect acoustic amenity and minimise nuisance noise on sensitive receivers

Marine megafauna	
Mitigation Measures	- Inductions to include marine megafauna awareness and procedures to minimise disturbance - A pre-start survey for marine mammals to be undertaken by a designated Marine Fauna Observer - A soft start procedure will be implemented for noise generating activities within the Port River - River bed deepening activities to cease where dolphins are within 150 m of operations - Ensure engines and equipment on board the dredge are properly maintained in good working order - Dredge pumps to remain off until the CSD head is close to the river bed - Plant and machinery to be switched off whenever possible - Works will cease where a dolphin is showing signs of distress including vocalisation, tail slapping, prolonged diving, excessive milling, signs of injury, entanglement or illness - Any instance of animal injury to be reported to the appropriate authorities and to Origin.

Marine pests	
Objective	To minimise risk of introducing marine pests
Mitigation Measures	- Appropriate biofouling of all vessels in accordance with National Biofouling Management Guidance for Non-trading Vessels - A risk assessment will be undertaken for all vessels and submerged equipment prior to arrival on site including appropriate management/mitigation measures prior to mobilising equipment - Regular inspections of bio-fouling and appropriate maintenance to be undertaken - Inspect ship and dredge equipment to ensure that no material which may transport organisms (sediment, organic material, water) is retained - Ballast to be managed in accordance with International Maritime Organisation (IMO) Ballast Water Convention 2004 and Australian Ballast Water Management Requirements; including a Ballast Water Management Plan - Dredge operation in accordance with Department of Agriculture and Water Resources and Australian Quarantine regulations 2000 - Hull inspections to be carried out and plant certified as free of marine pests to DAWR standards - Caulerpa will be managed in accordance with PIRSA guidance and appropriate permits for taking Caulerpa from the Port River will be sought prior to dredging works commencing.

Waste management – marine	
Objective	No loss of waste overboard to the environment
Mitigation Measures	- Solid waste will be placed in suitable containers and recycled or disposed of via licensed contractor - Bins of vessels to be secured, clearly marked and fitted with secure lids - Bins will be collected and emptied at a maximum 75% capacity - Hazardous waste will be stored and labelled in an appropriate manner prior to disposal, and disposed of via a licensed contractor to a licensed hazardous waste facility.

11.2 Potential general construction

There are a number of risks to the environment, in addition to the risks to the marine environment discussed above, as a result of the general construction activities. The CEMP will include mitigation measures for these risks.

The key potential risks aspects as a result of general construction activities are:

- Ecology
- Soil erosion and drainage
- Air quality, noise and vibration
- Contamination
- Heritage
- Waste management.

A framework for the mitigation measures and management strategies that may be required to manage these potential impacts is included below.

11.2.1 Objectives and proposed mitigation measures

Ecology	
Objective	To minimise adverse impacts to existing vegetation and fauna from construction activities and weeds
Mitigation Measures	- Exclude construction activities from retained vegetation (i.e. mangrove community) using high visibility flagging - Minimise vehicle movement around retained vegetation where possible - Vehicles, plant and machinery to be cleaned prior to entering and leaving the Project area - Appropriate permits will be sought prior to transport of declared plants on public roads - Open trenches to be inspected for trapped fauna at the beginning of each working day - Contact the relevant authority in the event of encountering injured fauna

Soil erosion and drainage	
Objective	To minimise erosion of soils and protect surface water drainage pathways
Mitigation Measures	- Induct all site personnel to provide an understanding of the issues associated with erosion and drainage and the management strategies in place - Soil to be stockpiled at least 40 m away from drainage pathways - Treatment measures such as sediment fences, silt socks and temporary swales and basins placed and utilised to manage erosion and drainage. These should be used in sequence where sediment loads are expected to be high - Control the entry and exit of stormwater runoff from work areas including to divert clean stormwater away from and around materials storage areas - A dewatering management plan to be developed and implemented where there is the potential for groundwater to be encountered during excavation

Air quality, noise and vibration	
Objective	To minimise impacts to air quality
Mitigation Measures	- Maintain all plant machinery and equipment for efficient operation and minimise engine idle times and queuing - All vehicles and equipment will be appropriately serviced and maintained - Covering or wetting-down soil and construction material stockpiles to minimise dust mobilisation - Regularly water exposed surfaces, including exposed stockpiles and unsealed roadways, where dust generation is occurring - Machinery to operate in accordance with relevant sections of the SA Environment Protection (Noise) Policy 2007 (S23 (b)) and the SA EPA Noise Information Sheet (2014), such as shutting or throttling equipment down whenever not in actual use; and ensuring noise reduction devises are fitted (applicable only where noise is impacting amenity) - Maintain communication lines for community members to contact the Construction Manager (or delegate).

Contamination	
Objective	Comply with Environment Protection Act and relevant SA EPA Guidelines and minimise adverse impacts to soil as a result of contamination
Mitigation Measures	- Induct all site personnel to provide an understanding of the indicators of contaminated soil and groundwater and appropriate procedures for encountering contamination - Incident Plan to be developed and implemented for significant accidental spills and encountering contaminated soil or groundwater - Spill kits including containment and treatment equipment will be provided at the site - Contaminated material to be separated - No waste disposal is to occur on site - Any material removed from the site to landfill, or for reuse at another site, will be done so in accordance with SA EPA regulatory requirements such as a waste soil assessment on surplus soils - Any soil or other material spilled onto public roadways having originated from vehicles to be removed.

Heritage	
Objective	Avoid impacts to Aboriginal sites and the Torrens Island Quarantine Station and comply with the South Australian Aboriginal Heritage Act and Heritage Places Act
Mitigation Measures	*Aboriginal heritage:* - Induct site personnel to provide an understanding of the issues associated with cultural heritage, including examples of indications of potential cultural significance - Develop a Chance Finds procedure to ensure potential cultural heritage is managed appropriately. *Built heritage:* - Induct site personnel to ensure the State Heritage listed Torrens Island Quarantine Station (including the Jetty) is identified and maintained as an exclusion zone.

Waste management- onshore	
Objective	Prevent negative environmental impacts associated with construction waste
Mitigation Measures	- Site personnel inductions to include appropriate storage (including separation) and disposal/recycling of waste - Work areas maintained in a neat and orderly manner - Waste disposed of regularly by the persons/organisation undertaking the activities, with appropriate signage and separation of reusable / recyclable material - Off-site waste disposal in accordance with SA EPA and Zero Waste SA guidelines/requirements.

11.3 Dynamic Dredge Management Plan

A Dynamic Dredge Management Plan (DDMP) will be development by the successful Contractor prior to dredging that covers all aspects of the Project, based on the following elements:

- Dredging
- Vessel movements
- Disposal methods
- Vessel management (e.g. bunkering, ballast water exchange).

The Contractor will be required to develop agreed objectives and general controls as part of their contractual obligations. The DDMP will include the following:

- Relevant legal and other requirements and how compliance with these will be achieved
- A description of Origin’s environmental requirements, procedures and processes for the project
- An outline of the environmental management roles and responsibilities
- Promotion of environmental best practice
- Performance objectives for the construction phase of the project that the Contractor must meet
- Outline incident procedures, monitoring and reporting requirements for the dredging program

- Procedures to minimise, monitor and manage water quality impacts, including trigger levels and appropriate responses when these are exceeded
- Processes for handling and storage of all waste materials on the dredge vessel
- Processes for handling and management of fuel and wastewater transfer operations
- Processes for reducing the risk of translocation of organisms in ballast water or on the hull of the dredge vessel
- Processes for minimising nuisance noise from the dredging on surrounding facilities, users and visitors
- Processes to minimise the risk of an environmental incident occurring with the dredging operations such as a megafauna strike, oil spill, vessel collision or similar.

12.0 CONCLUSION

Project LISA is an innovative way to provide a dual fuel source into South Australia. Project development has considered the impact pathways that construction and infrastructure placement may present to the environmental and social values of the Port River and its surrounds. In response to regulatory and agency stakeholder meetings, Origin has:

- Adopted a dredging technique that inherently reduces the impact of dredging on water quality
- Adopted a disposal technique that uses existing licensed dredge disposal ponds
- Planned for Horizontal Directional Drilling under the seawall and intertidal area, and potentially to the Storage Barge to avoid impacts to vegetation (specifically mangroves), and interactions with the easement holders
- Planned for shallow excavations for the installation of a prefabricated covered culvert
- Minimised the works required on QPS for Unit 5 upgrade
- Considered and managed community and amenity interactions.

With Project LISA strategically aligned with the goals and objectives for state infrastructure and energy, and principally meeting the requirements of local and State Government, Origin seeks Development Approval consent to enable procurement processes and detailed design phases to commence.

Report Signature Page

GOLDER ASSOCIATES PTY LTD

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Environmental Scientist

Lissa van Camp
Principal Environmental Consultant

HK/LvC/gp

A.B.N. 64 006 107 857

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APPENDICES

24 January 2018

ORIGIN ENERGY POWER LIMITED

LPG Into South Australia Appendices

VOLUME 3: Appendices

Submitted to:
Zoe Delmenico
Department of Planning, Transport and Infrastructure

On behalf of:
Origin Energy Power Limited

Report Number. 1783241-002-R-Rev0

Distribution:

1 E-copy- Origin Energy Power Limited
1 E-copy- Golder Associates

Golder Associates

APPENDIX A

Certificates of Title and Project Support

PURPOSE: DIVISION AND REDESIGNATION OF PARCELS

AREA NAME: TORRENS ISLAND

RE-APPROVED: STEVE ANDREWS 21/01/2014

D90964

MAP REF: 6628/30/K, 6628/30/H, 6628/30/J

COUNCIL: OUTSIDE L.G.A. BOUNDARIES

DEPOSITED: DEAN WATSON 21/01/2014

LAST PLAN:

DEVELOPMENT NO:

36684_text_01_v19_Version_19

AGENT DETAILS: LSG - LAND BOUNDARIES BRANCH
LEVEL 1 101 GRENFELL ST
ADELAIDE SA 5000
PH: 82264042
FAX: 82263990

AGENT CODE: SISK

REFERENCE: 2012/23935/01

SURVEYORS CERTIFICATION: I SIME ROSKO , a licensed surveyor do hereby certify - 1) That this plan has been made from surveys carried out by me or under my personal supervision and in accordance with the Survey Act 1992. 2) That the field work was completed on the 16th day of November 2012
21st day of January 2014 Sam Rosko Licensed Surveyor

SUBJECT TITLE DETAILS:

PREFIX	VOLUME	FOLIO	OTHER	PARCEL	NUMBER	PLAN	NUMBER	HUNDRED / IA / DIVISION	TOWN	REFERENCE	NUMBER
CT	6086	610		ALLOTMENT(S)	114	D	59977	PORT ADELAIDE		SECTION	1030
								PORT ADELAIDE		SECTION	1031
CT	6128	657		ALLOTMENT(S)	115	D	59977	PORT ADELAIDE		SECTION	1030

OTHER TITLES AFFECTED:

EASEMENT DETAILS:

STATUS	LAND BURDENED	FORM	CATEGORY	IDENTIFIER	PURPOSE	IN FAVOUR OF	CREATION
EXISTING	302*	LONG	EASEMENT(S)	BBB.CCC		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 10024460
EXISTING	300.302*.304.305. 306*	LONG	EASEMENT(S)	KK		NATURAL GAS AUTHORITY OF SOUTH AUSTRALIA	TG 6641578
EXISTING	300.306*	LONG	EASEMENT(S)	LL			TG 8894091
EXISTING	300.306*	LONG	EASEMENT(S)	MM			TG 8894092
EXISTING	302*.304	LONG	EASEMENT(S)	TT			TG 8920535
EXISTING	306*	LONG	EASEMENT(S)	A			TG 9802717
EXISTING	302*.304.306*	LONG	EASEMENT(S)	PP			TG 9858620
EXISTING	302*.304	LONG	EASEMENT(S)	QQ			TG 10490935

EASEMENT DETAILS:

STATUS	LAND BURDENED	FORM	CATEGORY	IDENTIFIER	PURPOSE	IN FAVOUR OF	CREATION
EXISTING	302*.305	LONG	RIGHT(S) OF WAY	UU			RTC 9433645
EXISTING	302*	LONG	RIGHT(S) OF WAY	RR		305	RTC 9153825
EXISTING		LONG	EASEMENT(S)	10.20 IN D55734		300.301.302*.304.305.306*	TG 9031530
EXISTING		LONG	RIGHT(S) OF WAY WITH LIMITATIONS	10.20 IN D55734		300.301.302*.304.305.306*	TG 9114323
EXISTING		LONG	RIGHT(S) OF WAY	DD IN D55734		300.301.302*.304.306*	TG 9528574
EXISTING		LONG	RIGHT(S) OF WAY WITH LIMITATIONS	EE IN D55734		300.301.302*.304.305.306*	TG 9114321
EXISTING	300.302*.304.305. 306*	LONG	EASEMENT(S)	POSITION NOT DEFIN ED			SECTION 9 NGA 1967
EXISTING	305	LONG	EASEMENT(S)	F		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 10632456
EXISTING		LONG	RIGHT(S) OF WAY	DD IN D55734		305	TG 9470347
EXISTING	302*.304.306*	LONG	EASEMENT(S)	D		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 11260482
EXISTING	302*.306*	LONG	EASEMENT(S)	E		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 11260482
EXISTING	305	LONG	EASEMENT(S)	TTT		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 11356863
EXISTING	306*	LONG	EASEMENT(S)	EEE		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 10024460

EASEMENT DETAILS:

STATUS	LAND BURDENED	FORM	CATEGORY	IDENTIFIER	PURPOSE	IN FAVOUR OF	CREATION
EXISTING	302*.304	LONG	EASEMENT(S)	HHH		DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000)	TG 10024460
EXISTING	302*.304	LONG	EASEMENT(S)	AAA		TRANSMISSION LESSOR CORPORATION OF 1 UNDIVIDED 2ND PART (SUBJECT TO LEASE 9061500) AND ELECTRANET PTY. LTD. OF 1 UNDIVIDED 2ND PART	TG 11630599
EXISTING	305	LONG	EASEMENT(S)	H			TG 11286735
NEW	306*	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	FF		300.301	
NEW	306*	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	FFF		301	
NEW	302*	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	AA		300.301.305.304.306*	
NEW	304	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	G		300.301.302*.305.306*	
NEW	305	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	GG		300.301.306*	
NEW	306*	LONG	RIGHT(S) OF WAY WITH LIMITATIONS	GGG		300.301	
NEW	302*	LONG	RIGHT(S) OF WAY	T		300.301.304.305.306*	

ANNOTATIONS: NO OCCUPATION ON SURVEYED BOUNDARIES UNLESS SHOWN OTHERWISE
ALLOTMENT 305 (CT 6128/657) NOT PART OF THIS DIVISION

D90964

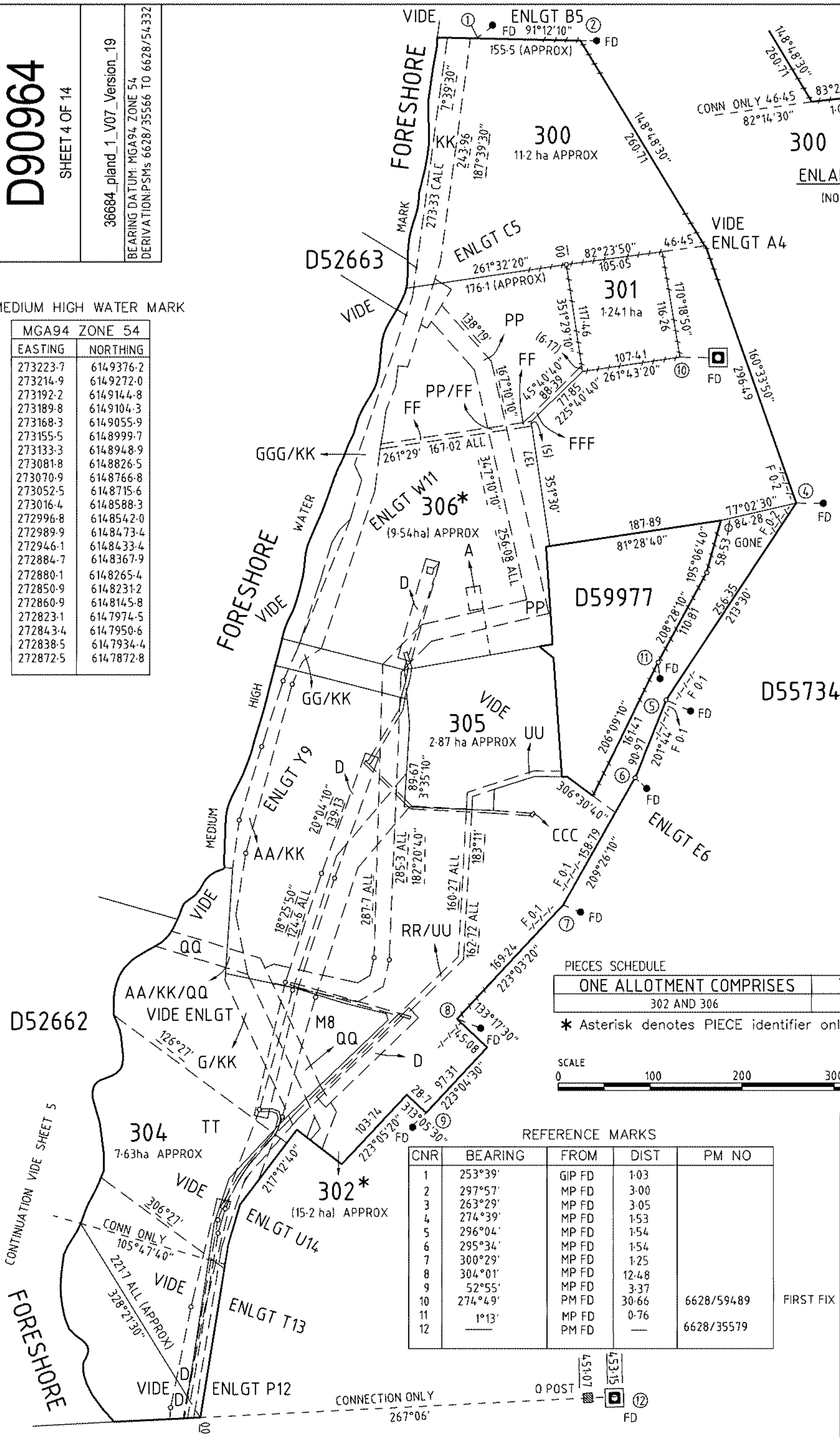
SHEET 4 OF 14

36684_pland_1_V07_Version_19

BEARING DATUM: MGA94 ZONE 54
DERIVATION:PSMs 6628/35566 TO 6628/54332

MEDIUM HIGH WATER MARK

MGA94 ZONE 54	
EASTING	NORTHING
273223·7	6149376·2
273214·9	6149272·0
273192·2	6149144·8
273189·8	6149104·3
273168·3	6149055·9
273155·5	6148999·7
273133·3	6148948·9
273081·8	6148826·5
273070·9	6148766·8
273052·5	6148715·6
273016·4	6148588·3
272996·8	6148542·0
272989·9	6148473·4
272946·1	6148433·4
272884·7	6148367·9
272880·1	6148265·4
272850·9	6148231·2
272860·9	6148145·8
272823·1	6147974·5
272843·4	6147950·6
272838·5	6147934·4
272872·5	6147872·8



PIECES SCHEDULE

ONE ALLOTMENT COMPRISES	TOTAL AREA
302 AND 306	24·7ha APPROX

* Asterisk denotes PIECE identifier only.

SCALE 0 100 200 300 400 METRES

REFERENCE MARKS

CNR	BEARING	FROM	DIST	PM NO
1	253°39'	GIP FD	1·03	
2	297°57'	MP FD	3·00	
3	263°29'	MP FD	3·05	
4	274°39'	MP FD	1·53	
5	296°04'	MP FD	1·54	
6	295°34'	MP FD	1·54	
7	300°29'	MP FD	1·25	
8	304°01'	MP FD	12·48	
9	52°55'	MP FD	3·37	
10	274°49'	PM FD	30·66	6628/59489
11	1°13'	MP FD	0·76	
12	—	PM FD	—	6628/35579

FIRST FIX

LAND SERVICES GROUP
DEPARTMENT FOR PLANNING, TRANSPORT AND INFRASTRUCTURE
LAND BOUNDARIES BRANCH
SURVEY INVESTIGATION SECTION
REF:2012/23935/01
SR

D90964

SHEET 5 OF 14

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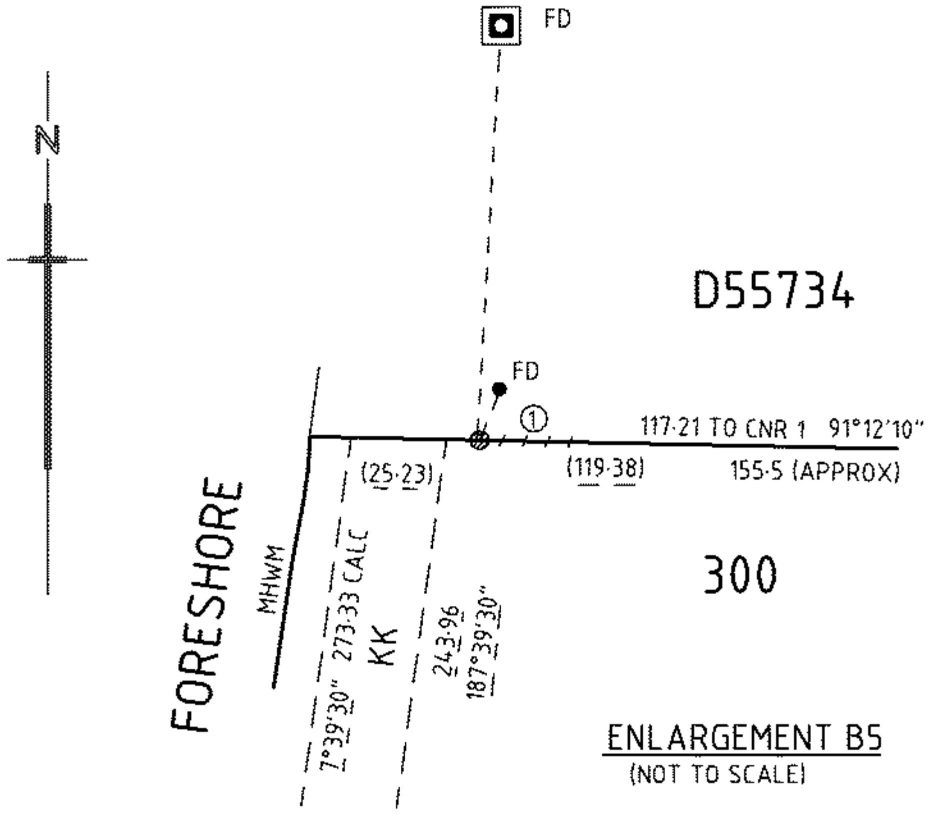

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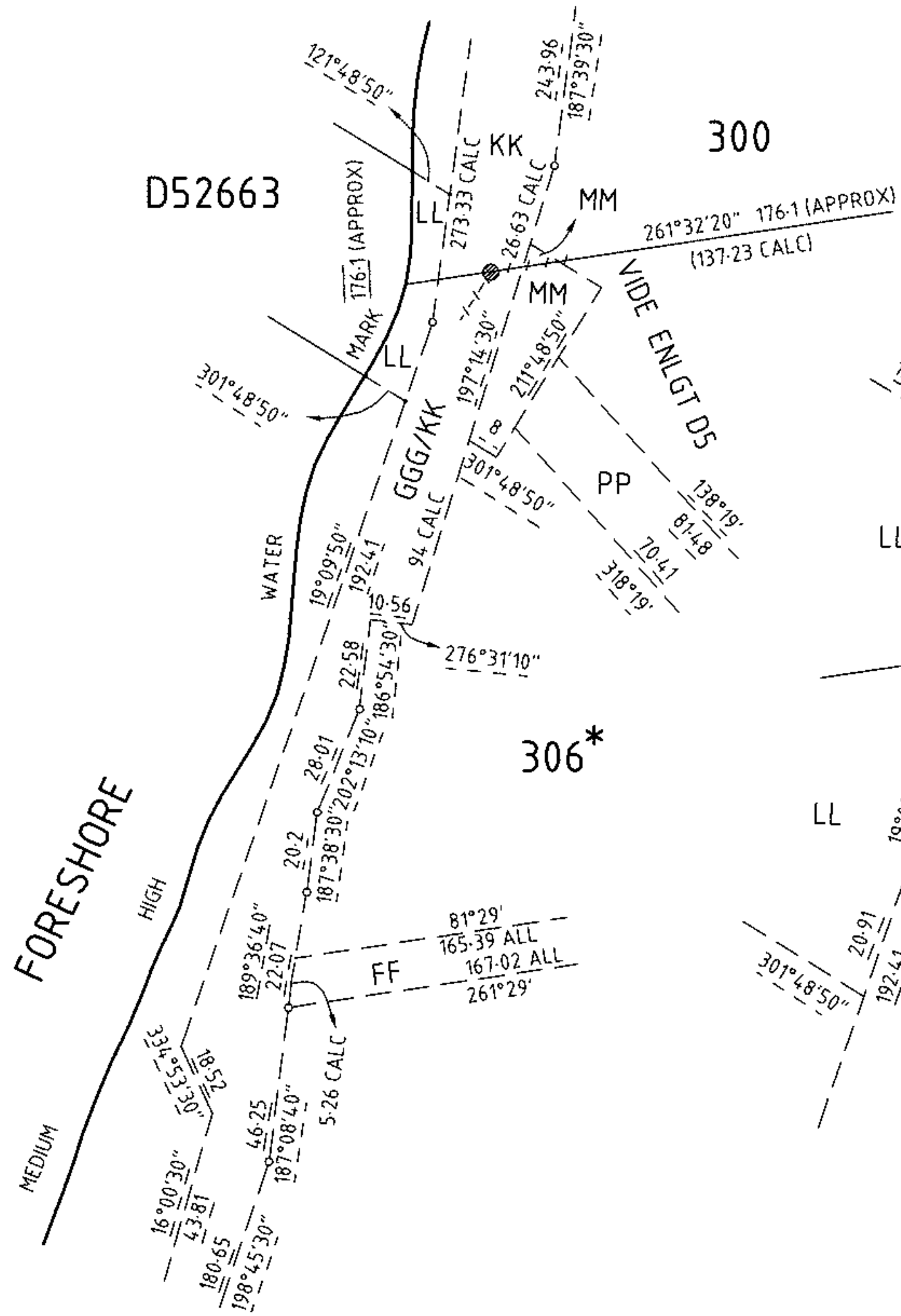

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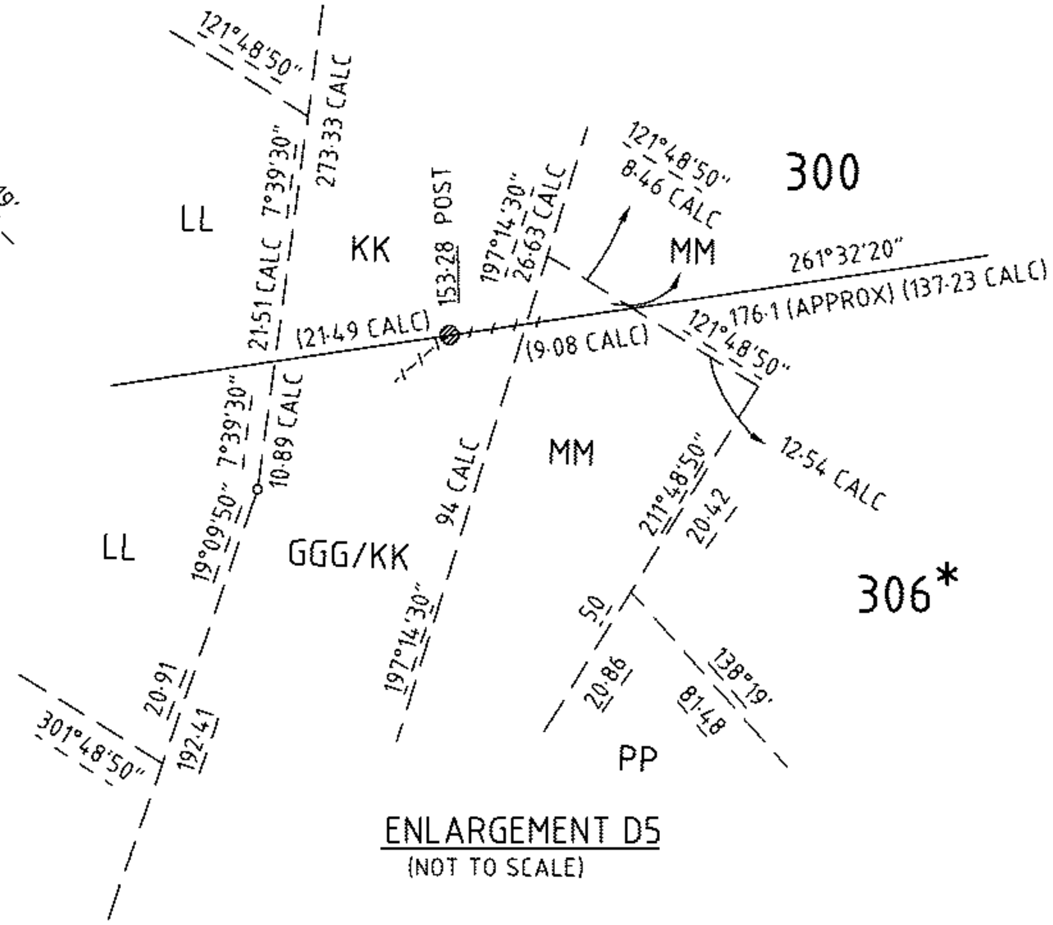

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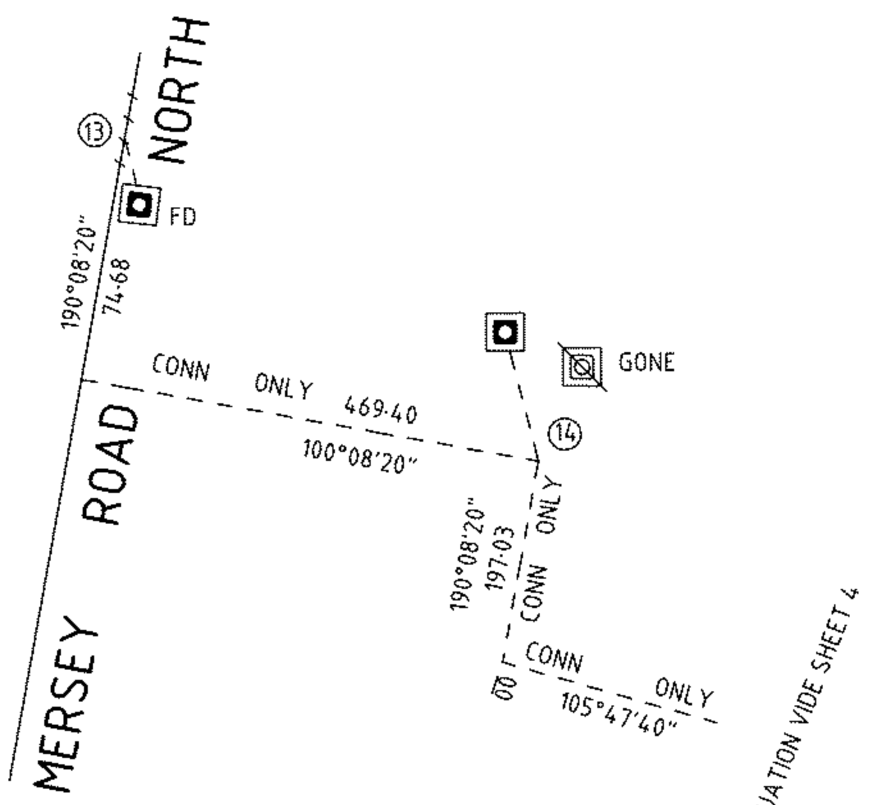

CONTINUATION VIDE SHEET 4

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13	355°24'	PM FD	1·00	6628/45892	
14	144°11'	PM	66·50	6628/60198	
14	——	PM GONE	——	6628/35576	

REFERENCE MARKS

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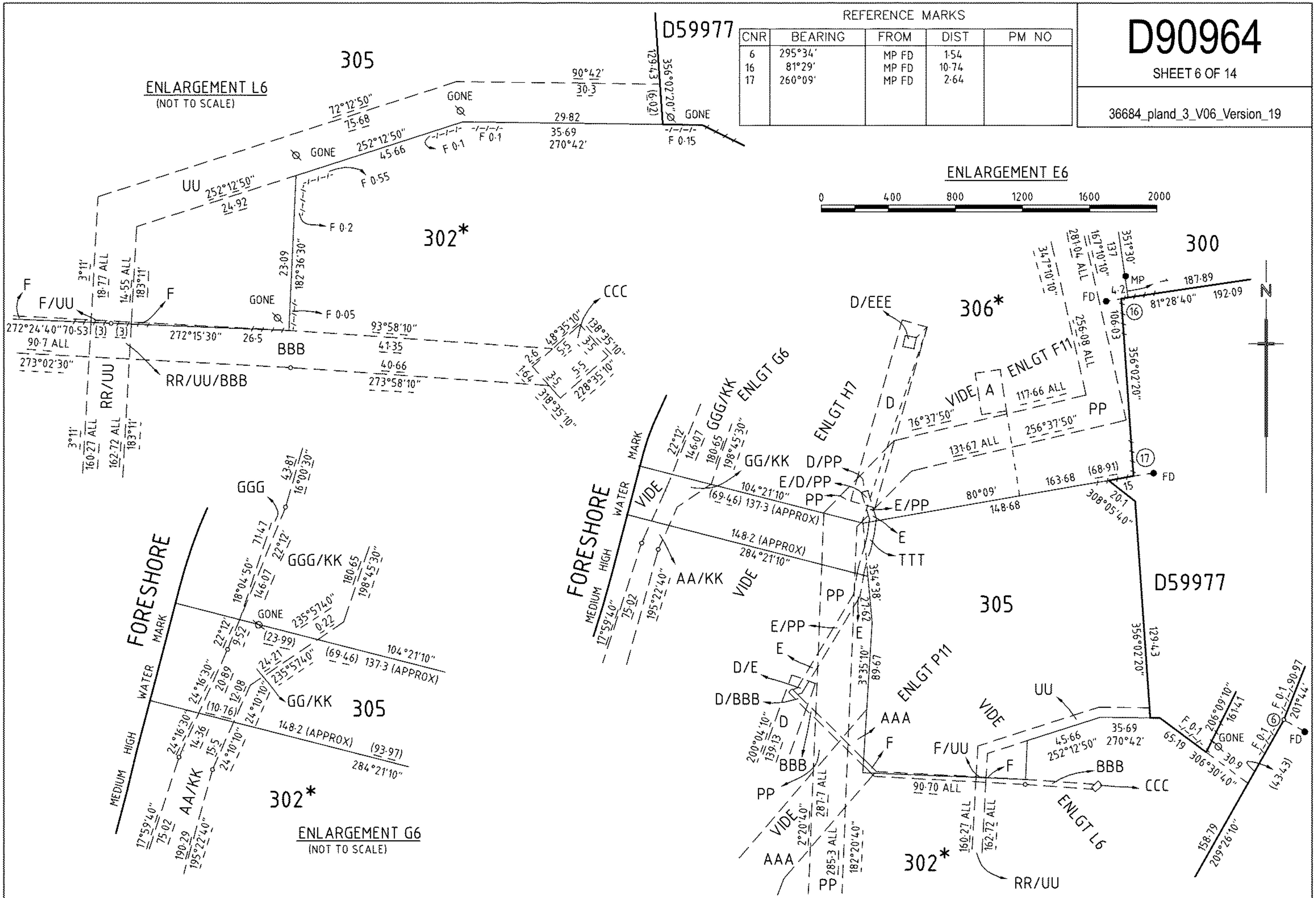
17	260°09′	MP FD	2·64	



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SHEET 7 OF 14

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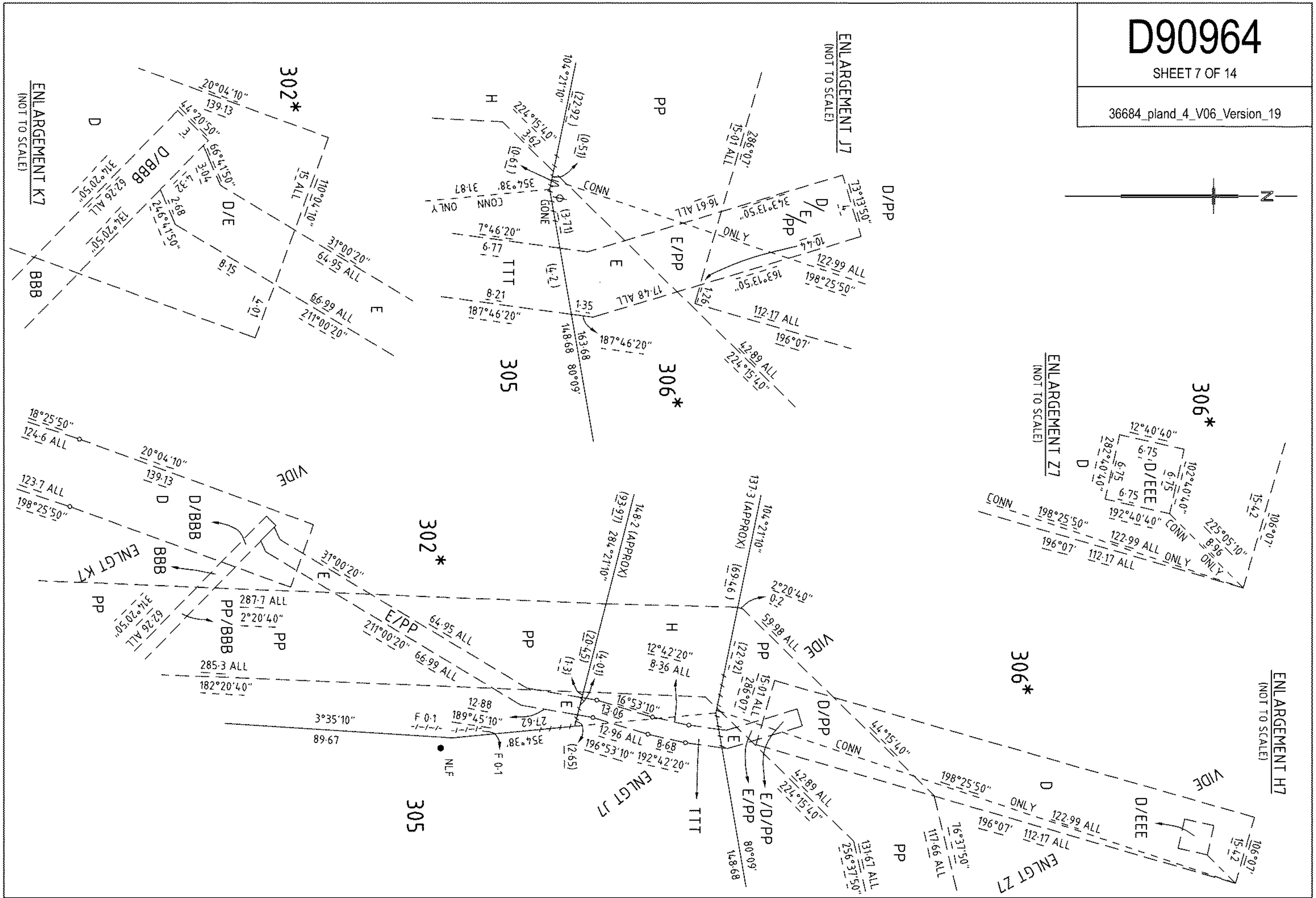

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SHEET 8 OF 14

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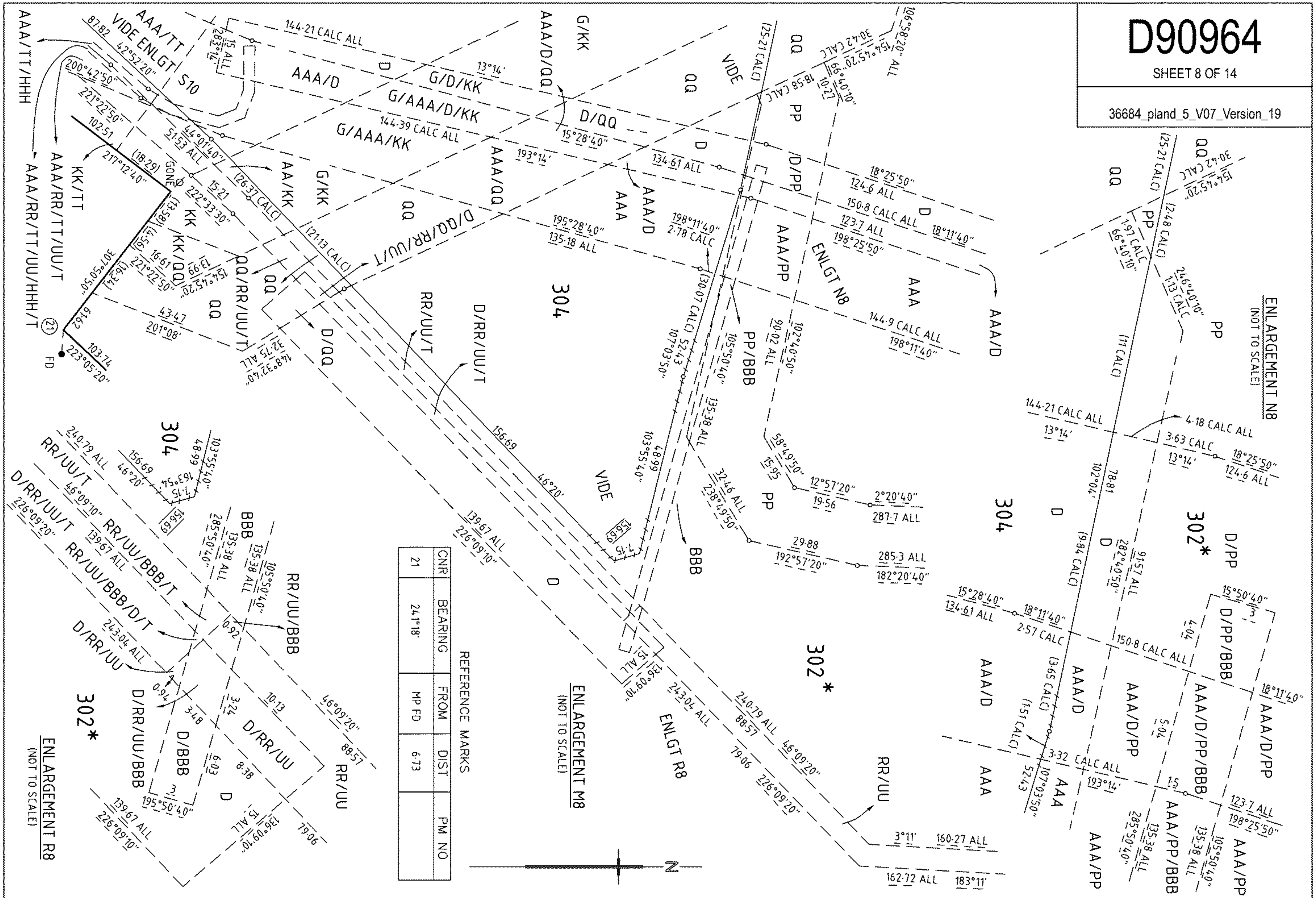

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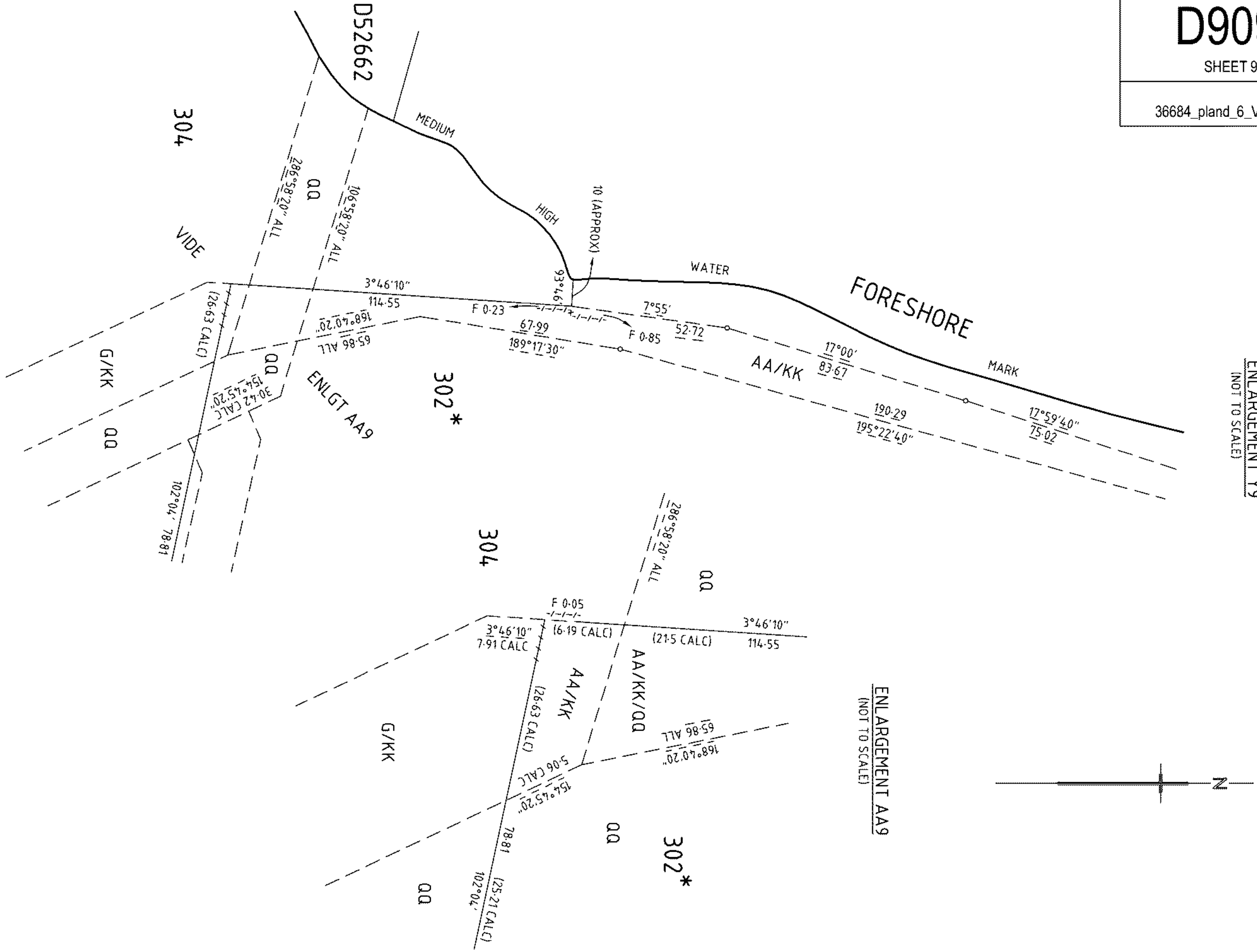
D52662
304
VIDE
286°58'20" ALL
106°58'20" ALL
QQ
MEDIUM
HIGH
10 (APPROX)
WATER
FORESHORE
MARK
93°46'
3°46'10"
114·55
F 0·23
7°55'
52·72
F 0·85
168°40'20"
65·86 ALL
67·99
189°17'30"
(26·63 CALC)
G/KK
QQ
154°45'20"
30·42 CALC
ENLGT AA9
302*
AA/KK
17°00'
83·67
190·29
195°22'40"
17°59'40"
75·02
102°04' 78·81
ENLARGEMENT Y9
(NOT TO SCALE)
304
286°58'20" ALL
QQ
F 0·05
3°46'10"
7·91 CALC
(6·19 CALC)
(21·5 CALC)
3°46'10"
114·55
AA/KK
AA/KK/QQ
(26·63 CALC)
G/KK
65·86 ALL
168°40'20"
5·06 CALC
154°45'20"
78·81
102°04'
(25·21 CALC)
QQ
302*
QQ
ENLARGEMENT AA9
(NOT TO SCALE)
N

D90964

SHEET 10 OF 14

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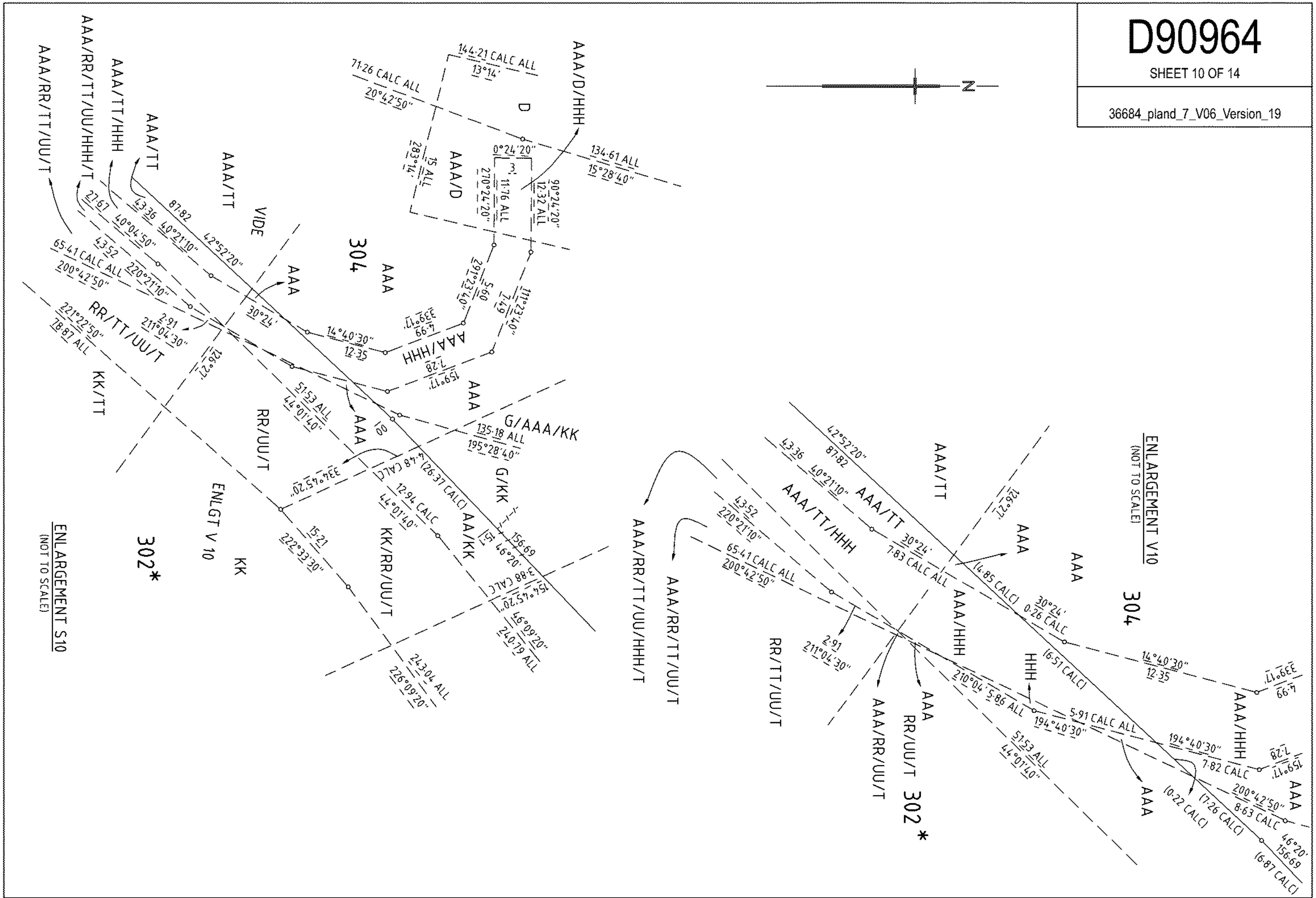

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SHEET 11 OF 14

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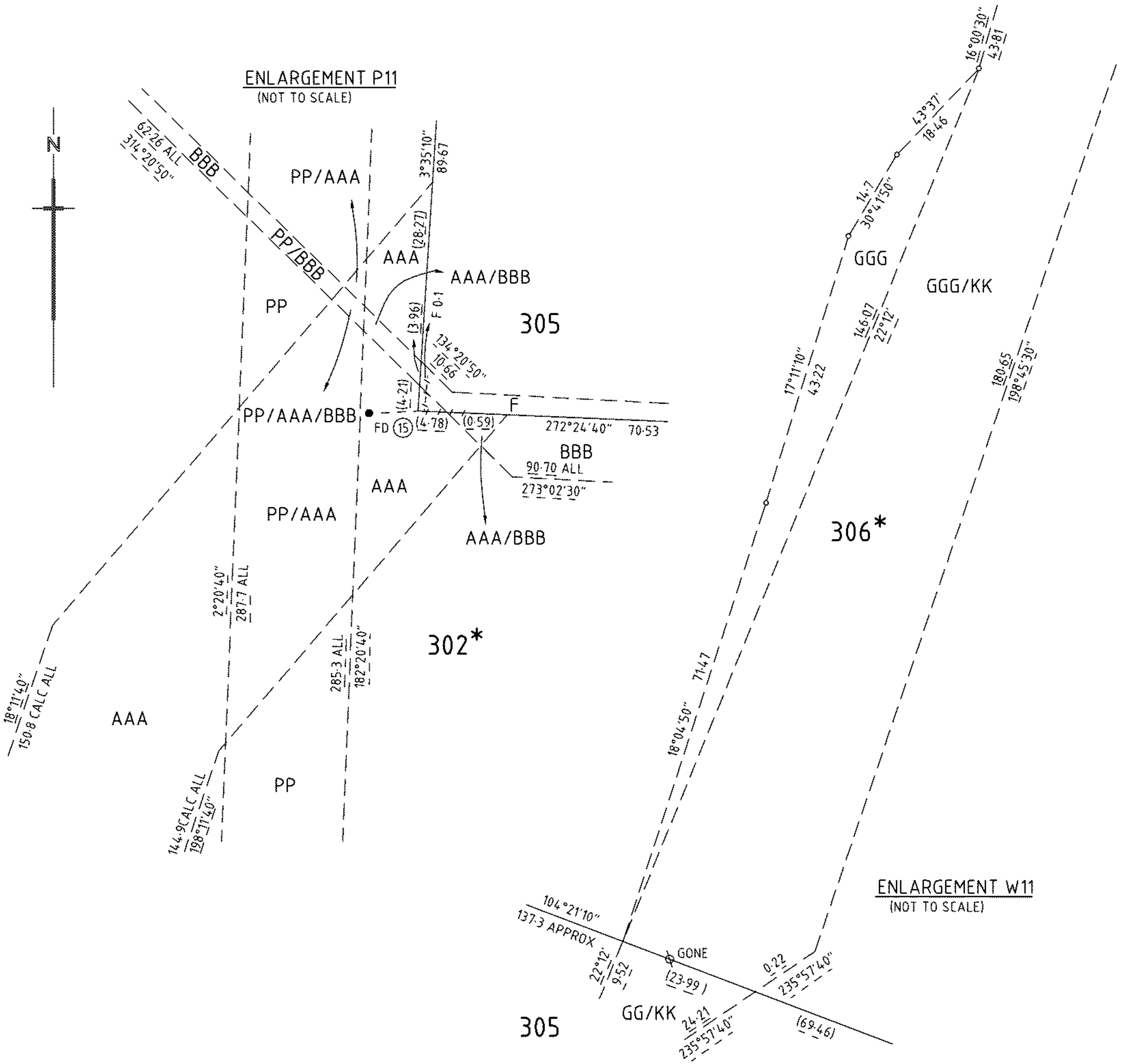

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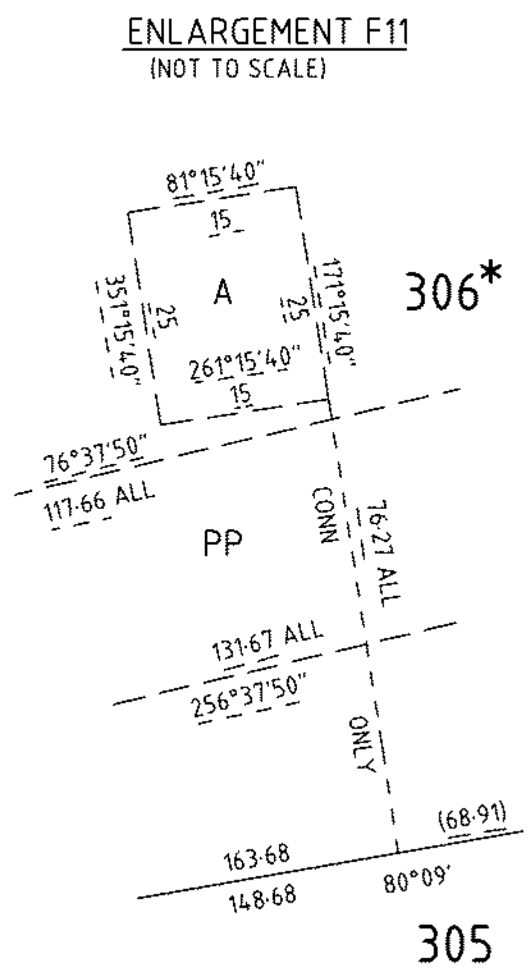

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SHEET 12 OF 14

36684_pland_9_V08_Version_19

REFERENCE MARKS

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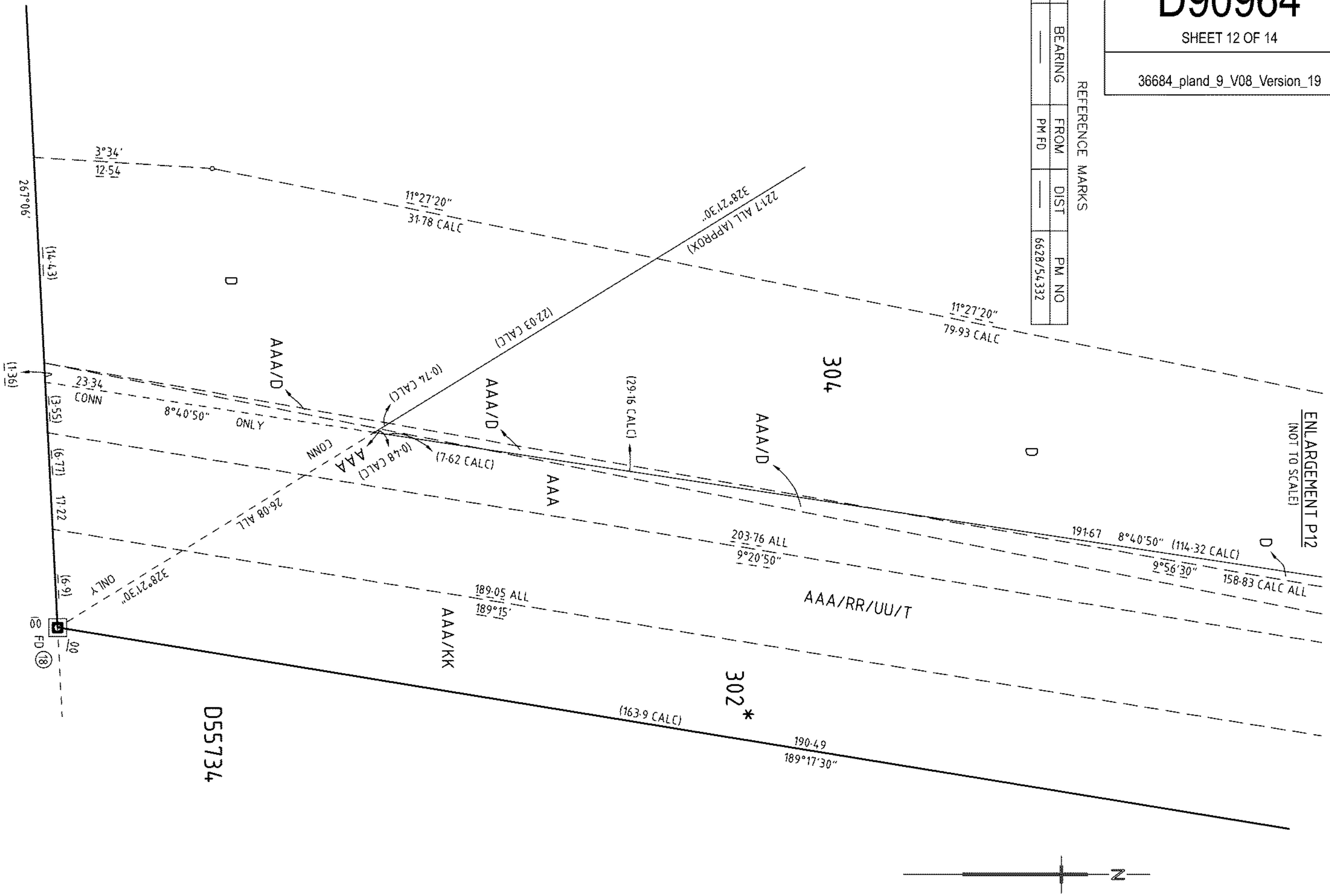

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SHEET 13 OF 14

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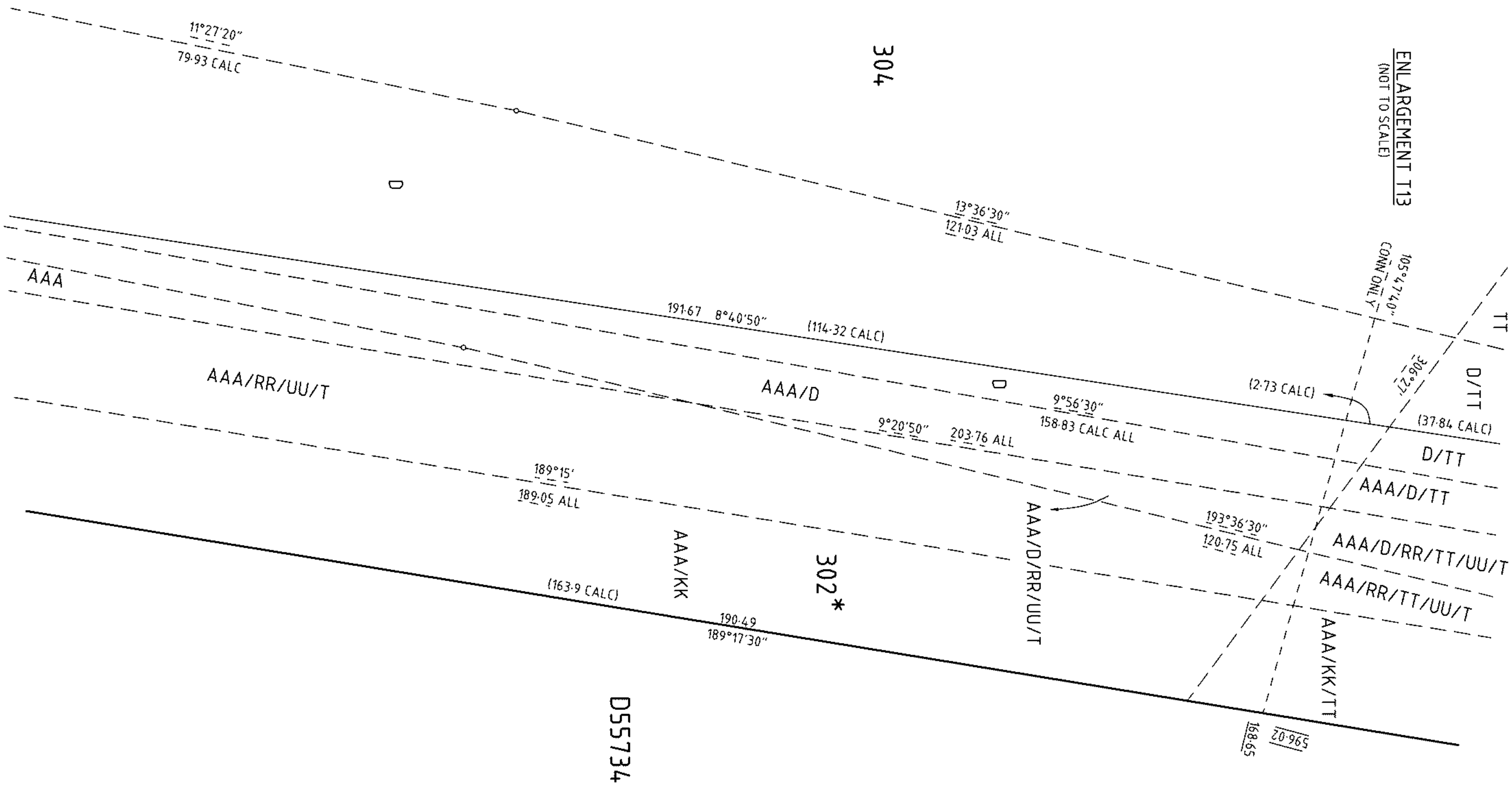

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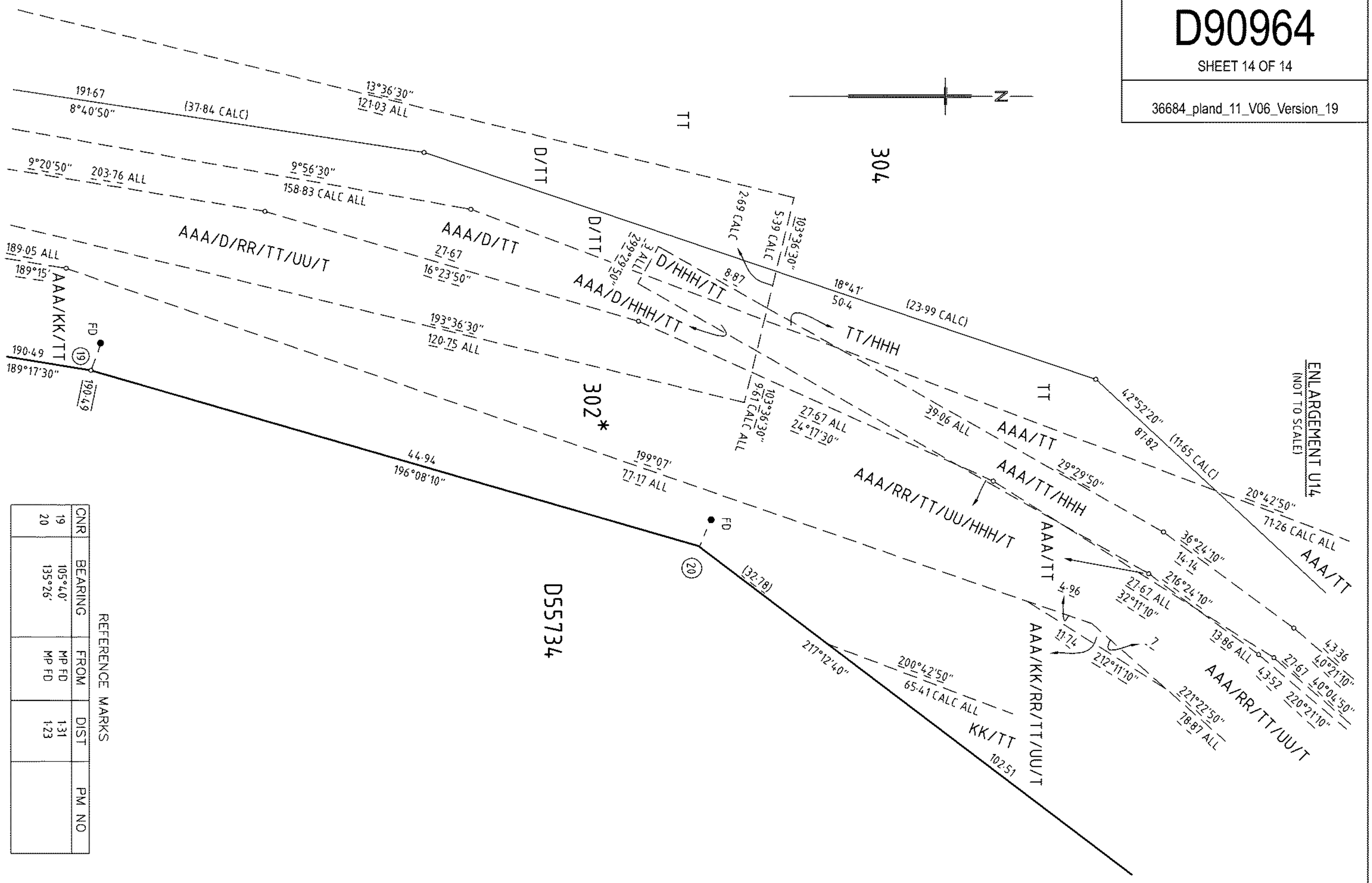
SHEET 14 OF 14

36684_pland_11_V06_Version_19



REFERENCE MARKS

CNR	BEARING	FROM	DIST	PM NO
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20	135°26'	MP FD	1·23	

Product	Register Search
Date/Time	20/01/2016 08:24AM
Customer Reference	14572
Order ID	20160120000423
Cost	$27.25

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

Registrar-General

Certificate of Title - Volume 5907 Folio 399

REAL PROPERTY ACT, 1886
South Australia

Parent Title(s) CT 5885/650

Dealing(s) Creating Title T 9528575

Title Issued 25/11/2003

Edition 1

Edition Issued 25/11/2003

Estate Type

FEE SIMPLE

Registered Proprietor

ORIGIN ENERGY POWER LTD. (ACN: 008 289 398)
OF 1 KING WILLIAM STREET ADELAIDE SA 5000

Description of Land

ALLOTMENT 112 DEPOSITED PLAN 59977
IN THE AREA NAMED TORRENS ISLAND
HUNDRED OF PORT ADELAIDE

Easements

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9031530)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9114323)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED UU (RTC 9433645)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED EE (TG 9114321)

Schedule of Dealings

Dealing Number	Description
9528576	ENCUMBRANCE TO GENERATION LESSOR CORPORATION (SINGLE COPY ONLY)
11953763	CAVEAT BY GENERATION LESSOR CORPORATION

Notations

Dealings Affecting Title

NIL

Priority Notices

NIL

Notations on Plan

NIL

Registrar-General's Notes

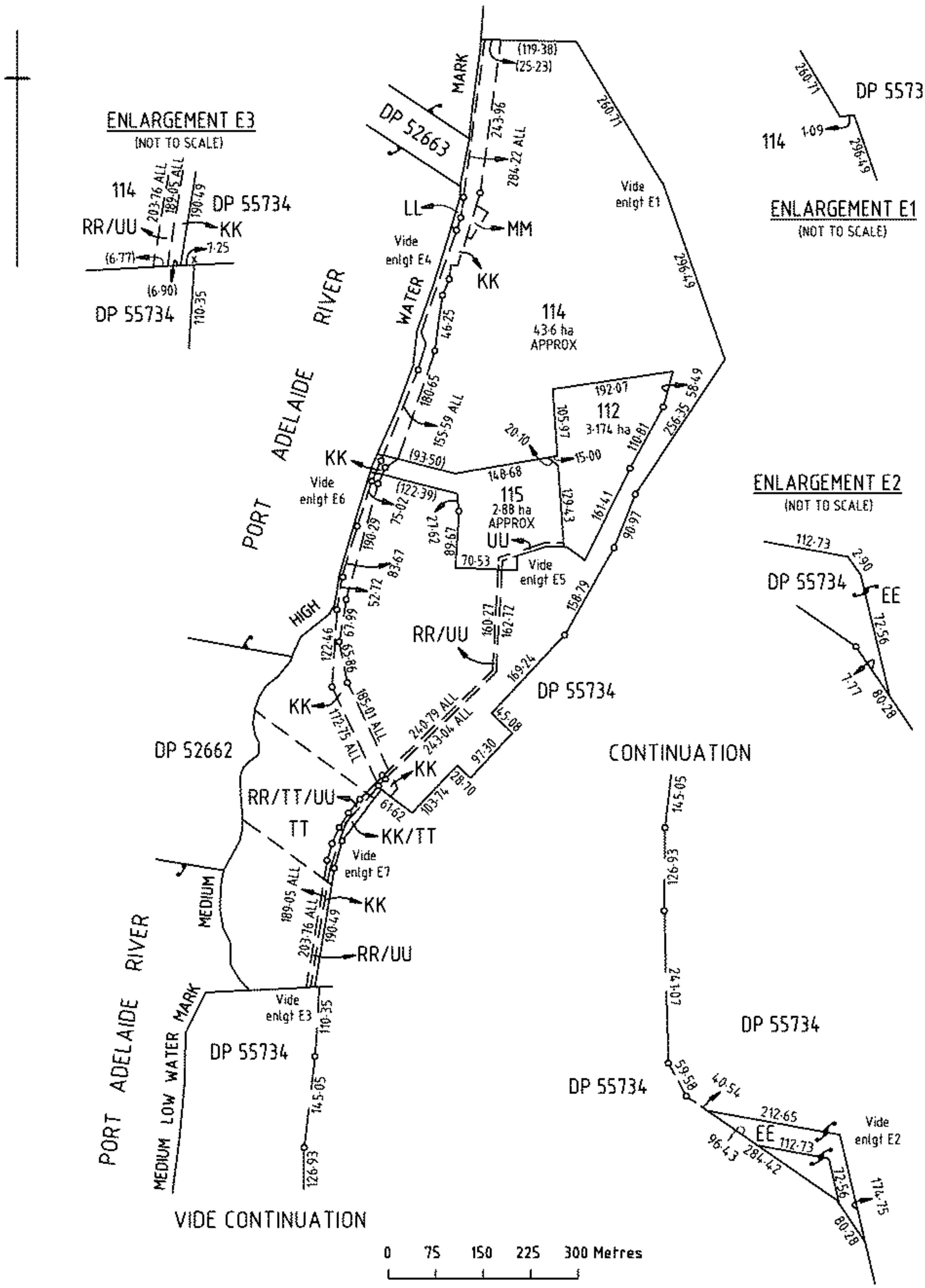
UNAPPROVED FX43708

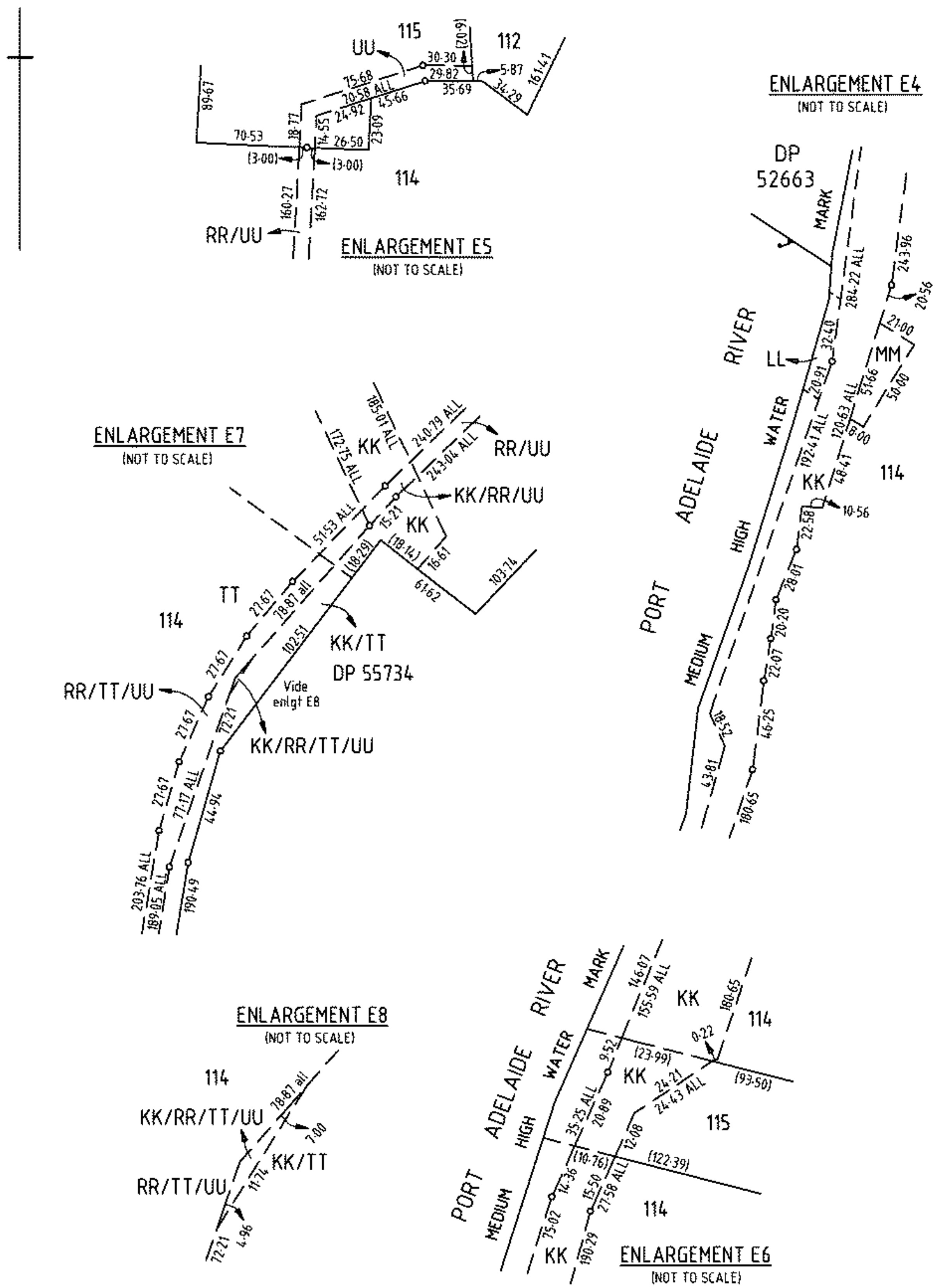
Administrative Interests

NIL

* Denotes the dealing has been re-lodged.

Product	Register Search
Date/Time	20/01/2016 08:24AM
Customer Reference	14572
Order ID	20160120000423
Cost	$27.25




ENLARGEMENT E5
(NOT TO SCALE)
115
112
114
UU
RR/UU
ENLARGEMENT E4
(NOT TO SCALE)
DP
52663
PORT ADELAIDE RIVER
HIGH WATER MARK
MEDIUM HIGH WATER
LL
MM
KK
114
ENLARGEMENT E7
(NOT TO SCALE)
KK
RR/UU
KK/RR/UU
KK
TT
114
RR/TT/UU
KK/TT
DP 55734
Vide
enlgt E8
KK/RR/TT/UU
ENLARGEMENT E8
(NOT TO SCALE)
114
KK/RR/TT/UU
KK/TT
RR/TT/UU
KK
114
KK
115
114
KK
ENLARGEMENT E6
(NOT TO SCALE)

Product	Register Search
Date/Time	20/01/2016 08:23AM
Customer Reference	14572
Order ID	20160120000411
Cost	$27.25

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

Registrar-General

Certificate of Title - Volume 6132 Folio 766

Parent Title(s) CT 6086/610, CT 6128/657

Dealing(s) Creating Title RTC 12054788

Title Issued 03/03/2014

Edition 1

Edition Issued 03/03/2014

Estate Type

FEE SIMPLE

Registered Proprietor

ORIGIN ENERGY POWER LTD. (ACN: 008 289 398)
OF 1 KING WILLIAM STREET ADELAIDE SA 5000

Description of Land

ALLOTMENT 305 DEPOSITED PLAN 90964
IN THE AREA NAMED TORRENS ISLAND
HUNDRED OF PORT ADELAIDE

Easements

SUBJECT TO THE EASEMENT(S) AS PROVIDED FOR BY SECTION 9 OF THE NATURAL GAS AUTHORITY ACT 1967

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED KK ON DP 90964 TO THE NATURAL GAS AUTHORITY OF SOUTH AUSTRALIA (TG 6641578)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED F ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 10632456)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED H ON DP 90964 (TG 11286735)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED TTT ON DP 90964 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) (TG 11356863)

SUBJECT TO RIGHT(S) OF WAY OVER THE LAND MARKED UU ON DP 90964 (RTC 9433645)

SUBJECT TO RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED GG ON DP 90964 (RTC 12054788)

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9031530)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER ALLOTMENTS 10 AND 20 IN DP 55734 (TG 9114323)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED DD ON DP 55734 (TG 9470347)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED T ON DP 90964 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED G AND AA ON DP 90964 (RTC 12054788)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED EE ON DP 55734 (TG 9114321)

TOGETHER WITH RIGHT(S) OF WAY WITH LIMITATIONS OVER THE LAND MARKED RR ON DP 90964 (RTC 9153825)

Schedule of Dealings

Dealing Number	Description
9209686	ENCUMBRANCE TO GENERATION LESSOR CORPORATION
9211546	CAVEAT BY GENERATION LESSOR CORPORATION

Notations

Dealings Affecting Title

NIL

Priority Notices

NIL

Notations on Plan

NIL

Registrar-General's Notes

PLAN FOR LEASE PURPOSES VIDE G251/2000
APPROVED FILED PLAN FOR LEASE PURPOSES FX55252
APPROVED FX45301

Administrative Interests

CONFIRMED IN SA HERITAGE REGISTER 21/10/1993

* Denotes the dealing has been re-lodged.

20 January 2017

Origin Energy Power Pty Ltd
GPO Box 148
BRISBANE QLD 4001

Attention: Zi Ying Koh

Dear Zi Ying,

Re: Easement Review
Quarantine Power Station,
Torrens Island SA

I confirm that you have sought our review of the existing Certificate of Titles relating to the Quarantine Station Power Station and the surrounding land to better understand the nature and implications or benefits of any easements, encumbrances or other rights of way associated with that land.

Origin Energy are the registered Proprietors of the following land parcels:

- Allotment 305 in Deposited Plan 90964, Certificate of Title – Volume 6132 Folio 766; and
- Allotment 112 in Deposited Plan 59977, Certificate of Title – Volume 5907 Folio 399.

Adjacent and surrounding allotments which have 'Easements' and or 'Rights of Way' that exist together with or are subject to the above allotments are listed below:

- Allotments 10 and 20 in DP 55734 Certificate of Title - Volume 5850 Folio 551;
- Allotment comprising pieces 302* and 306* in DP 90964, Certificate of Title – Volume 6154 Folio 53; and
- Allotment 301 in DP 90964, Certificate of Title – Volume 6134 Folio 545.

The Origin Energy owned land parcel exist together with "Rights and Way" and "Easements" over adjacent land and are subject to a series of "Rights and Way" and "Easements" as depicted upon the attached Deposited Plans.

Please note, that the term "Together with" infers that the subject land enjoys an easement or a right of way over adjoining or adjacent land, while the term "Subject to" infers that the allotment is encumbered with an "Easement" or "Right of Way" in favour of adjoining or adjacent land.

Allotment 305 has the following easements and rights of way registered:

- Subject to the easement(s) as provided for by section 9 of the Natural Gas Authority act 1967
- Subject to easement(s) over the land marked KK on DP 90964 to the Natural Gas Authority of South Australia (TG 6641578)
- Subject to easement(s) over the land marked F on DP 90964 to Distribution Lessor Corporation (subject to lease 8890000) (TG 10632456)
- Subject to easement(s) over the land marked H on DP 90964 (TG 11286735)
- Subject to easement(s) over the land marked TTT on DP 90964 to Distribution Lessor Corporation (subject to lease 8890000) (TG 11356863)
- Subject to right(s) of way over the land marked UU on DP 90964 (RTC 9433645)
- Subject to right(s) of way with limitations over the land marked GG on DP 90964 (RTC 12054788)
- Together with the easement(s) over allotments 10 and 20 in DP 55734 (TG 9031530)
- Together with right(s) of way with limitations over allotments 10 and 20 in DP 55734 (TG 9114323)
- Together with right(s) of way over the land marked DD on DP 55734 (TG 9470347)
- Together with right(s) of way over the land marked T on DP 90964 (RTC 12054788)
- Together with right(s) of way with limitations over the land marked G and AA on DP 90964 (RTC 12054788)
- Together with right(s) of way with limitations over the land marked EE on DP 55734 (TG 9114321)
- Together with right(s) of way with limitations over the land marked RR on DP 90964 (RTC 9153825)

Allotment 112 has the following easements and rights of way registered:

- Together with the easement(s) over allotments 10 and 20 In DP 55734 (TG 9031530)
- Together with right(s) of way with limitations over allotments 10 and 20 In DP 55734 (TG 9114323)
- Together with right(s) of way over the land marked UU (RTC 9433645)
- Together with right(s) of way with limitations over the land marked EE (TG 9114321)

Of relevance to the easements and rights of way registered on the titles are the documents TG 9031530 and TG 9114323 which provide the long form description of the rights enjoyed over the adjacent land in terms of easements for infrastructure and rights of way noting that neither Lot 305 nor Lot 112 have frontage to a public road.

In summary, both allotments 112 and 305 enjoy a right of way over allotments 302*/306*, 10 and 20 provide access to the closest public road to the south being the Grand Trunkway and intersection with Garden Island Road south of the causeway connecting Torrens Island.

The Rights of way and Easements over Allotments 10 and 20 are enjoyed over the whole of those land parcels while the Rights and way and easements over Allotment 302*/306* are enjoyed solely over the portion of land marked RR, EE, UU, G and AA respectively which align closely with the existing roadway leading to the primary entry point of the Quarantine Station Power Station.

The easement and Rights of Way affecting Lot 305 exist over the portion of land or “Handle” connecting Lot 305 to the High Pressure Natural Gas Pipeline and existing for the purpose of an easement for the High pressure Gas Pipeline, Right of way Access to adjacent land to the north of the land parcel and for power transmission to the northern land parcels.

Please contact me should you have any queries regarding the above summary of Easements and Rights of Way.

Yours sincerely

Greg Vincent
MasterPlan SA Pty Ltd

enc:	CT 5907/399 Lot 112	– Proprietor: Origin Energy Power ltd.
	CT 6132/766 Lot 305	– Proprietor: Origin Energy Power ltd.
	Document TG 9031530.	
	Document TG 9114323.	
	CT 6154/53 Lot 302*/306*	– Proprietor: Minister for Transport and Infrastructure.
	CT 6154/52 Piece 302	– Proprietor: Transmission Lessor Corporation / Electranet
	CT 6134/53 Lot 301	– Proprietor: Minister for Transport and Infrastructure.
	CT 5850/551 Lots 10 and 20	– Proprietor: Minister for Sustainability, Environment and Conservation.
	Deposited Plan D90964.	
	Deposited Plan DP55734.	
cc:		

Government of South Australia
Department of the Premier and Cabinet

In reply please quote:D17021233

Mr Steven Rigby
General Manager, Asset Manager and Development
Origin Energy
339 Coronation Drive – South
MILTON QLD 4064

Dear Mr Rigby,

PROJECT LISA – LPG IN SOUTH AUSTRALIA

I refer to your letter of 18 August 2017 regarding the request for support and specific endorsement pursuant to Section 49(2)(c) of the *Development Act 1993* for the proposed Project LISA – LPG in South Australia on Torrens Island.

Given that the proposed works meet the definition of "public infrastructure" as outlined in Section 49(1)(a) of *Development Act 1993*, and the project will provide additional back-up to the State's existing power generation supply, I am prepared to support and specifically endorse, pursuant to Section 49(2)(c) of the *Development Act 1993*, the works as detailed below:

> Upgrading Quarantine Power Station Unit 5 so that it is capable of running dual fuel capabilities (LPG and natural gas) and which will require upgrades to existing infrastructure, as well as dredging within the Port River to allow maritime-based LPG delivery and storage

A conceptual site layout of these works is detailed in Attachment 1 as per your letter of 18 August 2017.

The Department of the Premier and Cabinet make no representations or gives no warranties in relation to the outcome of the development application or time that it takes to secure a planning outcome for the project.

It is Origin Energy's responsibility to obtain all other statutory approvals, licences and permits from relevant authorities, manage community expectations and to fund the project. The State Government makes no commitment to purchase any product or services related to the project.

Office of the Chief Executive

State Administration Centre. 200 Victoria Square, Adelaide SA 5000 | GPO Box 2343, Adelaide SA 5001
Tel (+61) 08 8226 3500 | Fax (+61) 08 8226 3535 | www.dpc.sa.gov.au | ABN 945 004 15644

A development application must be lodged by Origin Energy at its cost with the Development Assessment Commission on or prior to 22 September 2018. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* for the RPPS works will lapse.

Please contact Mr Chris Lim, Case Manager Delivery & Engagement, Department of State Development if you have any queries in relation to this advice or require further information. He can be contacted on (08) 82078762, mobile 0439 873 104 or email chris.lim@sa.gov.au

Yours sincerely,

Dr Don Russell
CHIEF EXECUTIVE

Attachment 1: conceptual site layout (D17024300)

18 September 2017

Office of the Chief Executive

State Administration Centre. 200 Victoria Square, Adelaide SA 5000 | GPO Box 2343, Adelaide SA 5001
Tel (+61) 08 8226 3500 | Fax (+61) 08 8226 3535 | www.dpc.sa.gov.au | ABN 945 004 15644

296 St Vincent Street Port Adelaide
South Australia 5015
PO Box 19 Port Adelaide South Australia 5015
Tel +61 8 84470611 Fax +61 8447 0606

21 December 2017

Jay Divakar
Portfolio Trader – LPG
Origin
Level 7, 20 Bond Street
SYDNEY NSW 2000

RE: Letter of Support for Project LISA

Dear Capt. Conrad Saldanha and Jay Divakar,

We understand that Origin is proposing to import LPG into South Australia by way of mooring a barge and refuelling using a small LPG vessel and that this project is referred to as Project LISA.

On the basis of the information provided to us to date, noting that further details will be required in due course as well as agreements being negotiated, Minister's consent and subject to Origin complying with Flinders Ports Rules and other normal requirements for vessel operations, Flinders Ports does not foresee any restriction on Origin's ability to execute and operate Project LISA.

In relation to the four specific aspects that Flinders Ports is asked to address, and subject always to our comments above:

Dredging

- Subject to obtaining the necessary approvals and to final internal approvals, Flinders Ports is proposing to undertake a winter 2018 dredging program. Flinders Ports will assist Origin in exploring whether that dredging program can be expanded to cover Origin's requirements without and adverse impact on Flinders Ports' program.

- Flinders Ports will assist Origin to identify suitable land disposal dredge ponds if any relevant Development Application is limited to onshore disposal.

Safety

- I understand that a mooring design and passing vessel study is required to be undertaken by Origin's chosen/preferred consultants. Flinders Ports would like to review the results from that study to ensure the site is safe for the intended operation.

296 St Vincent Street Port Adelaide
South Australia 5015
PO Box 19 Port Adelaide South Australia 5015
Tel +61 8 84470611 Fax +61 8447 0606

- A Flinders Ports requirement of a minimum 55-metre clearance from the edge of the Port River channel to Origin's proposed floating facility is expected. This will need to be confirmed from the above studies.

- Flinders Ports does not anticipate that any additional clearance is required during loading and unloading of LPG as long as the study shows no adverse effects to the vessel and floating storage unit.

Security

- Security of the barge and ships coming alongside the barge will fall under the Flinders Ports security plan. Flinders Ports will participate with Origin to undertake a risk assessment and formulate a security plan for the barge. Boundary, marking etc can be determined once Origin has Developmental Approval.

- If required by the Department of Planning, Transport and Infrastructure, a restricted zone can be gazetted around the floating storage unit within Flinders Ports waters.

Operations

- Should Project LISA proceed, Flinders Ports will be in a position to negotiate to grant a licence to Origin over an area over the water in the Port River for the berth pocket and barge mooring (see the area in red on the attached diagram).

- Flinders Ports will work with an estimated 14 LPG ships that will be re-fuelling the barge per annum.

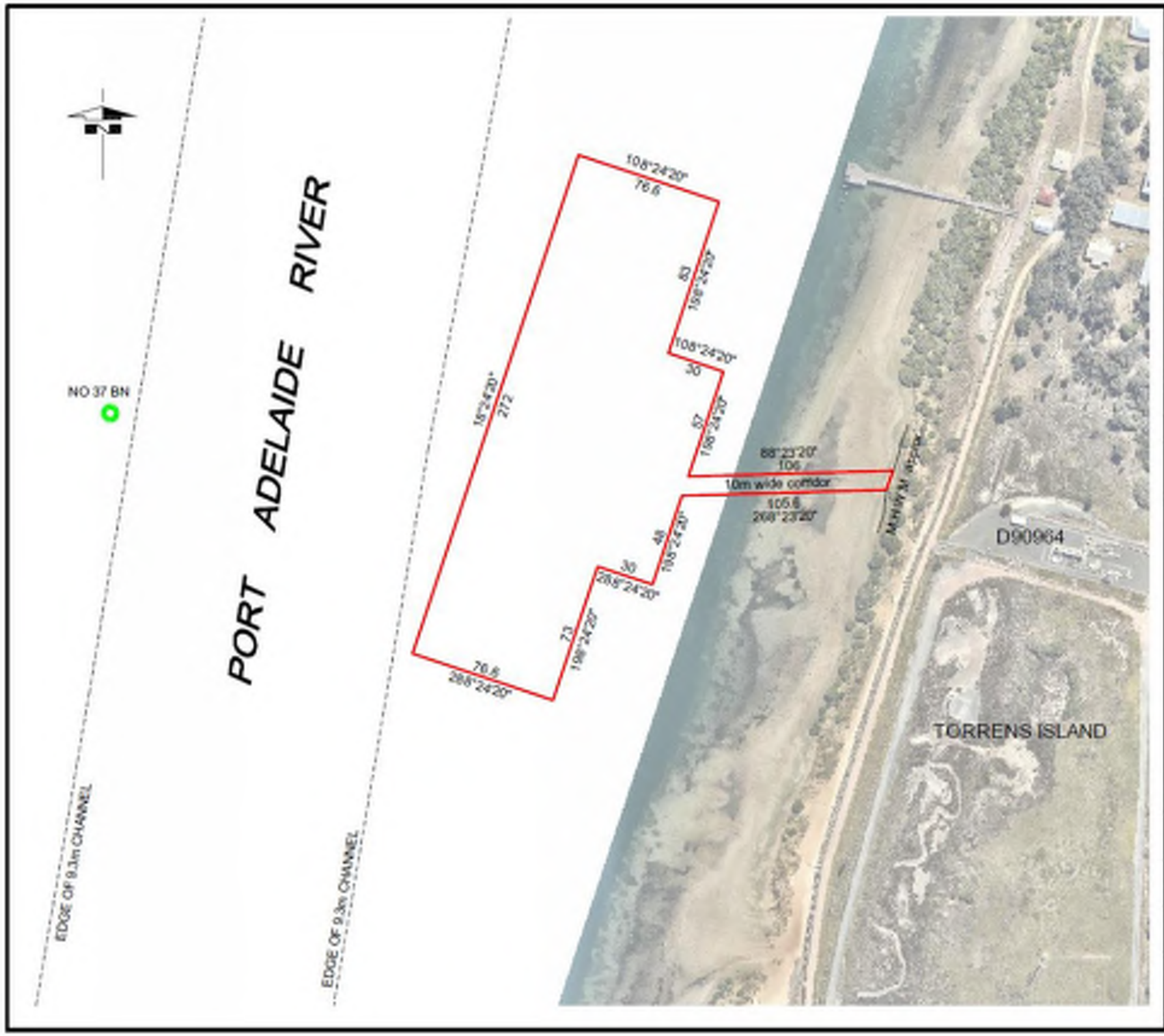
Yours sincerely

C.B. Kavina

Carl Kavina
GENERAL MANAGER MARINE OPERATIONS

Flinders Ports

296 St Vincent Street Port Adelaide
South Australia 5015
PO Box 19 Port Adelaide South Australia 5015
Tel +61 8 84470611 Fax +61 8447 0606



Flinders Ports SOUTH AUSTRALIA	
TORRENS ISLAND **ORIGIN ENERGY SERVICES LIMITED** LICENCE PLAN	
LAND USE: COMMERCIAL	DRAWN: Add 7/09/17
PARCEL IDENT.	CHECKED
	C.T.
REFS. ADEL17_TORRENS ISLAND _FPxxxx ORIGIN PORT RIVER LICENCE.dwg	
JOB NO. HA2007	SHEET 1 of 1
MAP SHEET	DATUM MGA 94 ZONE 54
SCALE 0 20 40 60 80 100 120 METRES	

NOTES

AREA DELINEATED BY BOLD BLACK LINES TO BE LICENCED TO ORIGIN ENERGY SERVICES LIMITED.
AREA = 2.54 ha approx.

PRELIMINARY ONLY

DATA IS APPROXIMATE ONLY AND SUBJECT TO SURVEY

REV.	DESCRIPTION OF REVISION	ALTERED / DATE / CHECKED	SURVEYOR / C.H.S. / M.S.

LOC 315	TYPE 12
DRG. NO. FPXXXX	
SUPERSEDES DRG.	

APPENDIX B

Geotechnical assessment

seas

Submersible Equipment and Services

Vibrocore Acquisition Report

Port Adelaide River

Adelaide, SA

Jim Phipps
Consultant Geologist

Nov 2017	**SEAS OFFSHORE PTY LTD**

DISCLAIMER:

While every effort has been made to ensure the information provided in this report is true and complete to the best of our knowledge, all recommendations are made without guarantee on the part of the author or SEAS Offshore. The author and publisher disclaim any liability in connection with the use of this information.

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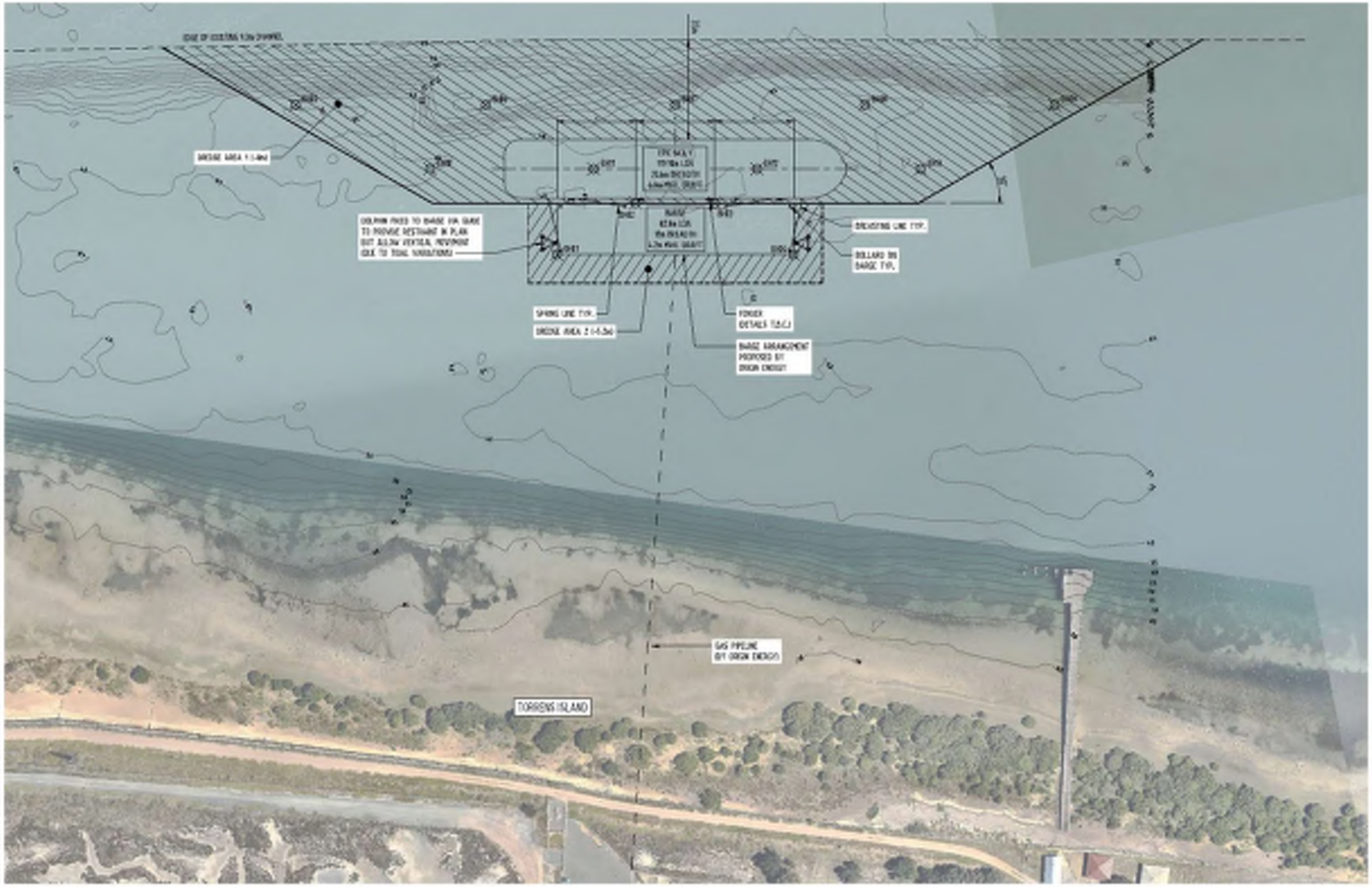
Executive Summary

Seas Offshore was contracted by Origin Energy to acquire Vibrocore samples from 13 locations to a maximum depth of 6m or refusal, adjacent to Quarantine Jetty, Port Adelaide River as part of a site survey for the Torrens Island Gas Import Vessel and Barge Mooring. Target sample locations were provided by the client as per Figure 1. The Vibrocore samples penetrated sediments from the Holocene St Kilda Formation and Late Pleistocene Glanville Formation, with most cores refusing in calcarenite or stiff clay at the top of the Glanville Formation.

Sediments of the St Kilda Formation comprised varying thicknesses of soft sandy shelly mud while the Glanville Formation, where penetrated, comprised cemented calcarenite / calcrete and stiff calcareous clay.

Further geophysical and targeted geotechnical investigation is required to fully assess the Glanville Formation sediments to the required piling depth. It is recommended to conduct a detailed high resolution electro-resistivity survey (Aquares) to determine the sub-surface structure and lithological distribution. Targeted rotary boreholes and / or CPT should also be acquired to validate the geophysical model and provide engineering data through the profile.



VESSEL TO BARGE MOORING
GENERAL ARRANGEMENT - OPTION 1

BOREHOLE LOCATIONS:

BOREHOLE	LATITUDE	LONGITUDE
BH01	-34.7783433	138.5148182
BH02	-34.7780859	138.5178826
BH03	-34.7778428	138.5179466
BH04	-34.777634	138.5180325
BH05	-34.7796678	138.5172276
BH06	-34.7784032	138.517370
BH07	-34.7778986	138.5175464
BH08	-34.777314	138.5176198
BH09	-34.7767293	138.5178532
BH10	-34.778697	138.5175866
BH11	-34.7781955	138.5177295
BH12	-34.7776876	138.5178527
BH13	-34.777186	138.5179869

INFORMATION ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT	ENG.	CHKD
A		ISSUED FOR INFORMATION			
B		ISSUED FOR INFORMATION - BOREHOLE LOCATIONS ADDED			
C		BOREHOLES BH09-BH13 ADDED			

WGA
WALLBRIDGE GILBERT AZTEC

ORIGIN ENERGY
TORRENS ISLAND GAS IMPORT
VESSEL & BARGE MOORING
GENERAL ARRANGEMENT - OPTION 1

A1
DRAWING NUMBER
Design M.H. Drawn O.E.
ADL170714 SK11 C

Figure 1

Introduction

The late Quaternary sedimentary deposits in the Port Adelaide area comprise a sequence of coastal lagoon and intertidal facies, Glanville and St Kilda Formations, with non-marine Pooraka Formation present in some areas (Figure 2 and Figure 3). Typically, the sediments of the Glanville Formation a sequence of coastal biogenic carbonates ranging from mottled shelly clay to moderately cemented skeletal calcarenite and coquina (Belperio, 2012). Subaerial exposure prior to the Holocene sea-level rise resulted in significant cementation and calcretisation of the upper Glanville Formation resulting in variable hardpan horizons.

Contemporaneous non-marine deposits of the Pooraka Formation lie between the Glanville and St Kilda Formations and comprise reworked aeolian deposits and coastal dune carbonates.

The overlying St Kilda Formation refers to all Holocene coastal and shelf sediments, and comprises sedimentary facies deposited by a variety of marine processes. The St Kilda Formation at the study location is characterised by very poorly sorted coastal muds containing *in situ* shell and organic matter and bioclastic sands. Its base is clearly defined, as it disconformably overlies Pleistocene marine or continental sediments.

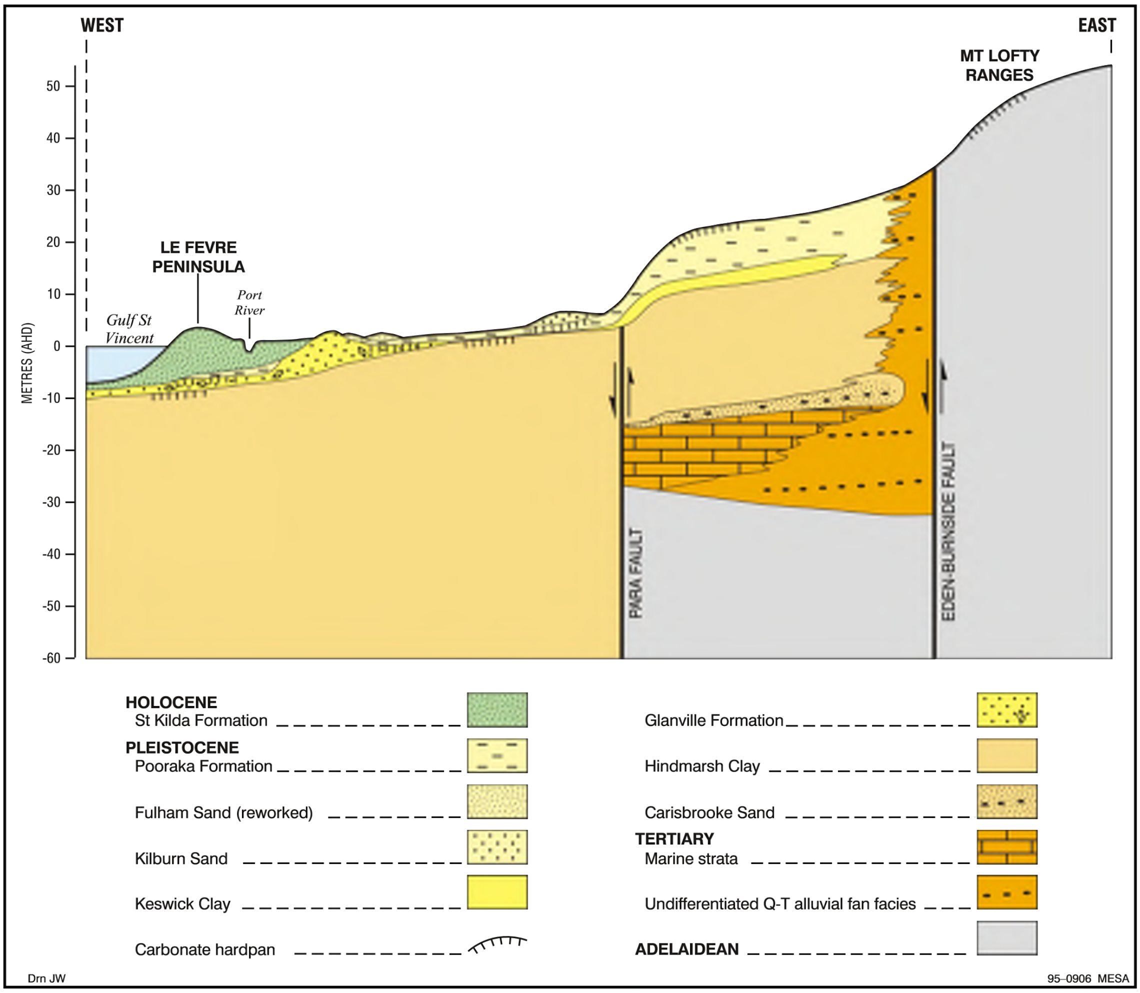


Figure 2 **Schematic cross-section from Le Fevre Peninsula to the Mount Lofty Ranges, showing relationships between Quaternary coastal marine and continental facies of the St Vincent Basin**

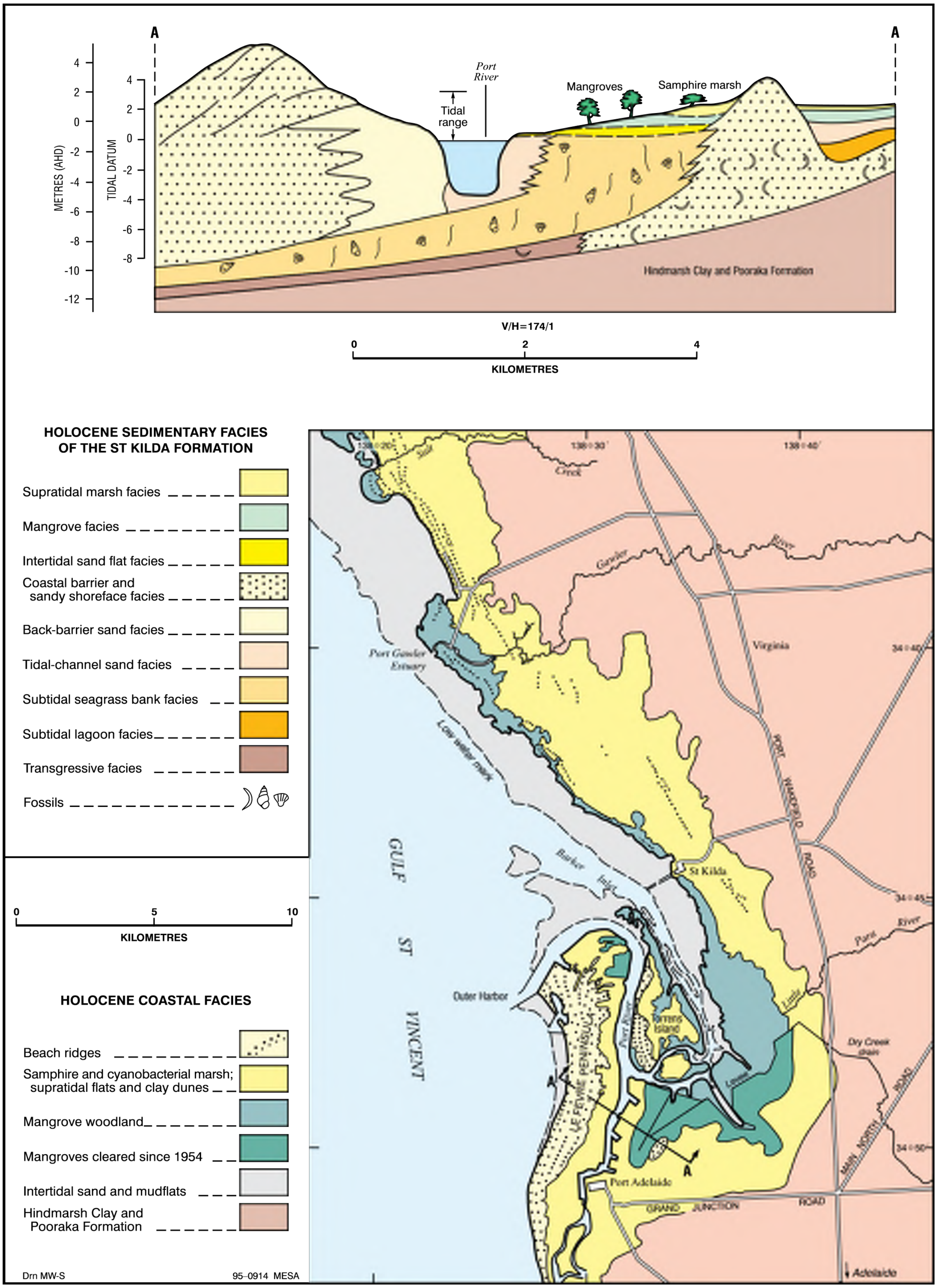


Figure 3 Morphology of the coastal zone north of Adelaide. Much of this area has been reclaimed for industrial and residential uses. Section A-A illustrates the inter-relationship of Holocene coastal marine facies

Discussion

Vibrocore samples from the study area penetrated coastal sediments from the Holocene St Kilda Formation and late Pleistocene Glanville Formation. The target penetration for the vibrocores was 6m, but due to the presence of calcrete horizons at the top of the Glanville Formation most of the cores met refusal after less than 1m. Two cores penetrated over a metre into the Glanville Formation recovering stiff sandy carbonate clay.

The St Kilda Formation is generally from 0.2 – 0.6m thick at the study location and is very soft with little to no internal strength. On several occasions the vibrocoring guide tower fell over as the stabilising legs sank into the soft mud. This was rectified by supporting the tower with the spare crane winch.

The surface of the Glanville Formation was stiff calcareous clay in cores BH-01-B, BH-11 , BH-03, and BH-06. Core BH-09 penetrated a thin fractured calcrete layer above variably cemented, sandy calcareous clay. The remainder of the cores met refusal on heavily cemented calcrete. The thickness of the calcrete layer and potential interlayering of cemented and non-cemented Glanville Formation below refusal is unknown.

Conclusions and Recommendations

The vibrocoring program intersected a thin St Kilda Formation coastal deposit sequence overlying variably cemented Glanville Formation marine carbonates. The majority of the cores met refusal at the top of the Glanville Formation. Rotary drilling and / or CPT investigation could be used to penetrate the calcrete layer(s) and provide addition information regarding the geotechnical properties of the underlying sediments.

Further geophysical and targeted geotechnical investigation are required to fully assess the Glanville Formation sediments to the required piling depth. It is recommended to conduct a detailed high resolution electro-resistivity survey (Aquares) to determine the sub-surface structure and lithological distribution to well below the proposed infrastructure foundation depth. Targeted rotary boreholes and /or CPT should also be acquired to validate the geophysical model and provide engineering data throughout the profile.

Vibrocore Acquisition Log

Client: Origin

Client	Origin Energy
Vessel	Barge :"Jake" and Tug "Lewis"
Location	Port Adelaide River, Adelaide, SA

Total sites cored 15 Total positions provided 13

Site ID	Target Location Lat (S)	Target Location Long (E)	Actual Location Lat (S)	Actual Location Long (E)	Time	DATE dd/mm	Vib Time sec	Core completed	Core ID VC-…	Barrel length m	Penetration m	Penetration %	Recovery m	Recovery %	NOTES / COMMENTS N/D = No Data
BH01A	-34.7783633	138.5180112	-34.778365	138.518007	10:00	15 Nov	93	Y	BH01A	6.00	0.82	14	0.60	73.2	Hard at .75, soft top 70 Hz, Base gravelly clay
BH01B	-34.7783633	138.5180112	-34.778365	138.518007	10:48	15 Nov	350	Y	BH01B	6.00	0.90	15	0.65	72.2	Re-core site to confirm first result, Hard same as BH01A
BH02	-34.7780859	138.5178828	-34.778083	138.517882	11:40	15 Nov	25	Y	BH02	6.00	0.70	12	0.50	71.4	Very Hard, Bounce, Cutter Damaged
BH03	-34.7778428	138.5179466	-34.777843	138.517952	13:01	15 Nov	495	Y	BH03	6.00	1.44	24	1.25	86.8	Very hard slow coring. Refusal at 1.44m, 'Yelllowish' clay at base and hard, Calcarinite rocks in sandy clay above Base
BH04	-34.777634	138.5182025	-34.777633	138.518200	08:58	16 Nov	34	Y	BH04	6.00	0.20	3	0.20	100.0	Very hard, corer bouncing, Cutter bruised, rocks in mud, Same as BH12
BH05	-34.7790678	138.5172396	-34.779065	138.517243	15:25	16 Nov	8	Y	BH05	6.00	0.82	14	0.58	70.7	Very hard base , soft on top
BH06	-34.7784832	138.517393	-34.778483	138.517392	14:35	16 Nov	223	Y	BH06	6.00	0.32	5	0.25	78.1	Hard Clay 'plug' with 50mm shelly mud above
BH07	-34.7778986	138.5175464	-34.777898	138.517543	09:45	16 Nov	70	Y	BH07	6.00	0.40	7	0.14	35.0	Let Vibe longer to try to 'punch' through hard layer same as 04 & 12
BH08A	-34.777314	138.5176998	-34.777317	138.517700	10:55	16 Nov	15	Y	BH08A	6.00	0.65	11	0.20	30.8	Core Loss from Barrel, Smashed cutter, 2 attempts at site same result at both for both
BH08B	-34.777314	138.5176998	-34.777313	138.517688	11:15	16 Nov	10	Y	BH08B	6.00	0.78	13	0.15	19.2	
BH09	-34.7767293	138.5178532	-34.776730	138.517853	12:36	16 Nov	300	Y	BH09	6.00	1.83	31	1.83	0.0	Very Slow coring
BH10	-34.778697	138.5175884	-34.778700	138.517592	13:40	16 Nov	62	Y	BH10	6.00	1.62	27	1.00	61.7	very hard base sogt above
BH11	-34.7781933	138.5177205	-34.778192	138.517722	12:20	15 Nov	55	Y	BH11	6.00	0.65	11	0.58	89.2	Very hard slow coring refusal at 0.65 / 55 seconds
BH12	-34.7776896	138.5178527	-34.777693	138.517857	08:19	16 Nov	12	Y	BH12	6.00	0.21	4	0.21	100.0	Very hard, corer bouncing, Cutter bruised, rocks in mud
BH13	-34.777186	138.5179849	-34.777190	138.517980	11:48	16 Nov	10	Y	BH13	6.00	0.64	11	0.35	54.7	Very Hard bounced from start

Vibrocore Description Sheets

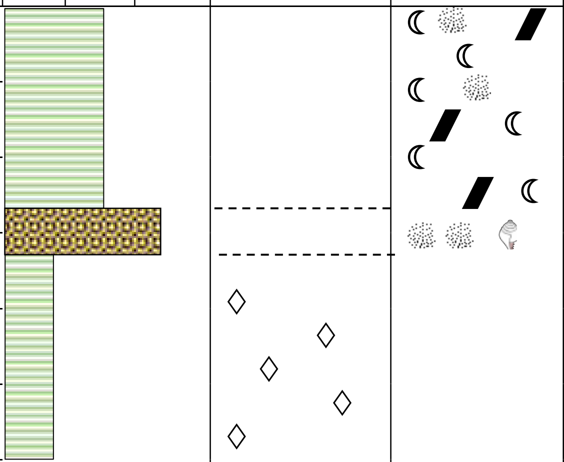
Vibrocore Description Sheet

Client:	Origin	Date:	15-Nov-2017
Location:	Torrens River, Adelaide, SA	Core Number:	BH-01-A
Latitude / Longitude	-34.778365 / 138.518007		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.90
		Core Recovery:	0.65
Operational Comments:			

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9				0.0– 0.30m: Sandy Shelly **MUD**; Dark greenish grey to olive grey, soft, silt to fine sand with abundant clay matrix, common to abundant very fine to coarse shell fragments, common organic matter. 0.30 – 0.60m: **CLAY**: Dark greenish grey to olive grey, firm to moderately stiff (180kPa) minor to common calcite cemented angular nodules up to 5mm, possibly fractures calcrete layer. .

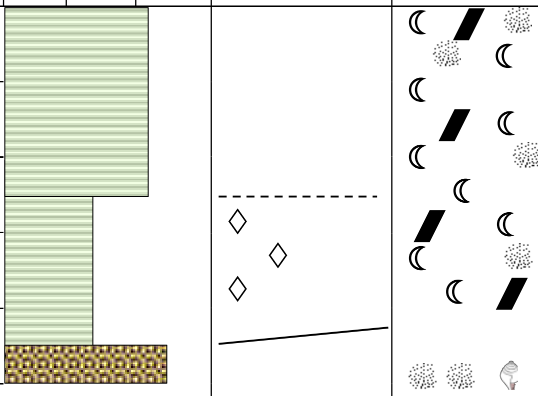
Vibrocore Description Sheet

Client:	Origin		Date:	15-Nov-2017
Location:	Torrens River, Adelaide, SA		Core Number:	BH-01-B
Latitude / Longitude	-34.778365	138.518007		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.70
			Core Recovery:	0.60
Operational Comments:				

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9				0.0– 0.27m: Sandy **MUD**; Dark greenish grey to olive grey, soft, silt to fine sand with abundant clay matrix, common to abundant very fine to coarse shell fragments, common organic matter. 0.27 – 0.32m **COQUINA**: Brown to yellowish brown, unconsolidated shells to 25m, dominantly bivalves with occasional gastropods 0.32 – 0.45m: **CLAY**, Dark greenish grey, very stiff (250kPa), moderate to high plasticity 0.45 – 0.65 **CLAY**: Dark greenish grey to olive grey, firm to moderately stiff (180kPa) minor to common calcite cemented angular nodules up to 5mm, possibly fractures calcrete layer.

Vibrocore Description Sheet

Client:	Origin		Date:	15-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-02
Latitude / Longitude	-34.778083	138.517882		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.71
			Core Recovery:	0.50
Operational Comments:				

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9				0.0 – 0.25m: Sandy Shelly **MUD**; Dark grey to greenish grey, soft (<50kPa), common to abundant very fine to coarse shell fragments to 15mm, common organic matter (tube worms, seaweed) 0.20 - 0.45m: Sandy **MUD**; Dark greenish grey, soft (<50kPa), silt to fine sand with abundant clay matrix, minor to common very fine to coarse shell fragments, common organic matter, occasional coarse calcite cemented angular nodules. 0.45 – 0.50 **COQUINA**: Brown to yellowish brown, unconsolidated shells to 25m, dominantly bivalves with occasional gastropods.

Vibrocore Description Sheet

Client:	Origin		Date:	15-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-11
Latitude / Longitude	-34.778192	138.517722		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.65
			Core Recovery:	0.58
Operational Comments:				

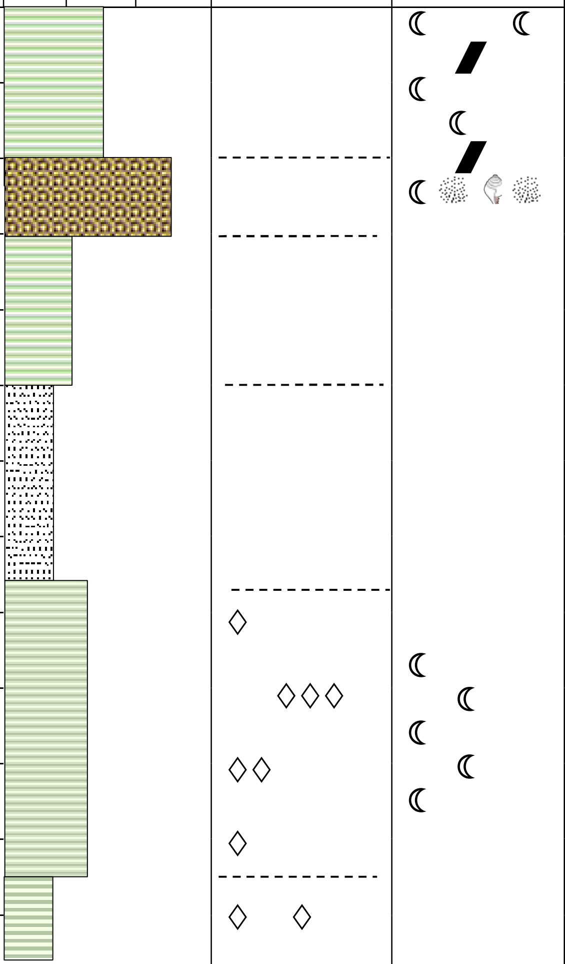
Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.25m: Sandy Shelly **<u>MUD</u>**; Dark greenish grey to greenish grey, soft (<50kPa), silt to fine sand with abundant clay matrix, common to abundant very fine to coarse shell fragments, common organic matter. 0.25 – 0.30m **<u>COQUINA</u>**: Brownish grey to dark olive grey, unconsolidated shells to 25m, dominantly bivalves with occasional gastropods, common muddy matrix. 0.30 – 0.58m: **<u>CLAY</u>**, Dark greenish grey to greenish black, very stiff (200 - 230kPa), moderate to high plasticity, trace angular calcite cemented nodules to 5mm.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin		Date:	15-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-03
Latitude / Longitude	-34.777843	138.517952		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.90
			Core Recovery:	0.65
Operational Comments:				

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description

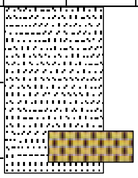
Depth: 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9



0.0 – 0.20m:
Sandy **MUD**; Dark greenish grey to olive grey, soft, silt to fine sand with abundant clay matrix, common to abundant very fine to coarse shell fragments, common organic matter.
0.20 – 0.30m:
COQUINA: Brown to yellowish brown, unconsolidated shells to 25m, dominantly bivalves with occasional gastropods
0.30 – 0.50m:
Sandy **CLAY**: Dark grey to brownish grey, firm, moderate plasticity, common very fine to fine angular to sub-angular sand.
0.50 – 0.75m:
Sandy **CLAY**: Brownish grey to dark yellowish brown, firm, moderate plasticity, common very fine to fine angular to sub-angular sand.
0.75 – 1.15m:
Sandy **CLAY**: Dark yellowish brown to yellowish brown, very stiff (250 - 330kPa), common calcite cemented / calcrete bands up to 5mm thick, common very fine to fine angular to sub-angular calcareous sand, abundant coarse shell fragments.
1.15 – 1.25m:
CLAY: Dark yellowish brown to yellowish brown, very stiff (250 - 330kPa), friable, common calcite cement.

Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-12
Latitude / Longitude	-34.777693 138.517857		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.21
		Core Recovery:	0.21
Operational Comments:	Refusal on rock at 0.21m.		

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0		◊◊◊ Fe		0.0 – 0.21m: Sandy Shelly **MUD**: Dark greenish grey to greenish black, soft, abundant silt to coarse sand, common to abundant very fine to very coarse shell fragments, common organic matter, common tube worms, 75mm calcarenite coble at base; **CALCARENITE**: dark brown to greyish brown, hard, sub-angular fine to coarse, poorly sorted, common very fine to coarse shell fragments and whole gastropod shells to 5mm, iron stained.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

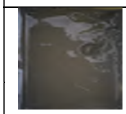
Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-04
Latitude / Longitude	-34.777633 / 138.518200		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.20
		Core Recovery:	0.20
Operational Comments:	Refusal on rock at 0.20m.		

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0		◇ ◇ ◇ ◇ ◇ ◇		Sandy Shelly **<u>MUD</u>**: Dark greenish grey to greenish black, soft, abundant silt to coarse sand, common to abundant very fine to very coarse shell fragments, common organic matter, common tube worms, common calcarenite pebbles to 30mm; **<u>CALCARENITE</u>**: dark brown to greyish brown, hard, sub-angular fine to coarse, poorly sorted, common very fine to coarse shell fragments and whole gastropod shells to 5mm, iron stained.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin		Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-07
Latitude / Longitude	-34.777898	138.517543		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.40
			Core Recovery:	0.14
Operational Comments:	Refusal on rock. Core cutter damaged			

Photo	Depth	Lithology / Grainsize (Mud / Sand / Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.14 Sandy Shelly **MUD**: Dark greenish grey to greenish black, very soft, soupy, abundant silt to coarse sand, common to abundant very fine to very coarse shell fragments, common organic matter, occasional tube worms.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin		Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-08-B
Latitude / Longitude	-34.777313	138.517688		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	0.78
			Core Recovery:	0.15
Operational Comments:	Guide tower fell over on sloping seabed. Re-cored with tower supported by crane. Refusal on rock at 0.78m. Core cutter damaged. Core retainer inverted allowing some sediment loss.			

Photo	Depth	Lithology / Grainsize (Mud / Sand / Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.15 Sandy Shelly **MUD**: Dark greenish grey, very soft, soupy, abundant silt to coarse sand, common to abundant very fine to very coarse shell fragments, common organic matter.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-13
Latitude / Longitude	-34.777190 / 138.517980		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.64
		Core Recovery:	0.35
Operational Comments:	Refusal on rock. Core cutter damaged.		

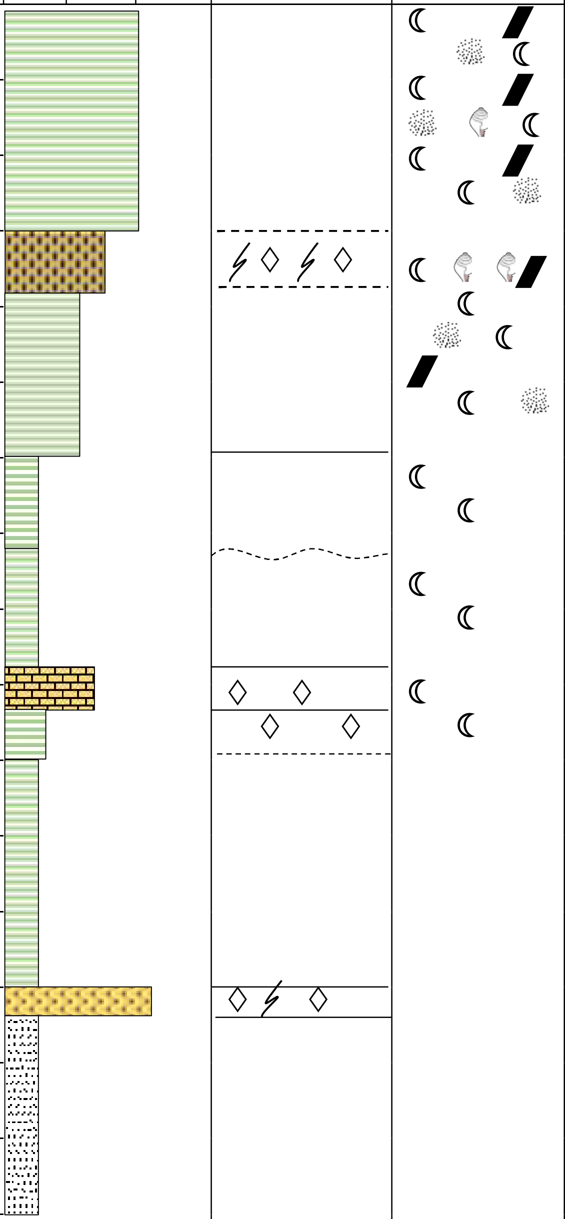
Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.25m Sandy Shelly **MUD**: Dark greenish grey, very soft, abundant silt to coarse sand, common to abundant very fine to very coarse shell fragments, common organic matter. 0.25 – 0.35m Sandy **MUD**: Dark greenish grey, very soft, soupy, abundant silt to coarse sand, common organic matter.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin		Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA		Core Number:	BH-09
Latitude / Longitude	-34.776730	138.517853		
Core Handling:	Core extruded into core tray and logged.			
			Total Penetration:	1.80
			Core Recovery:	1.60
Operational Comments:				

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description

Depth: 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9



0.0 – 0.30m:
Sandy Shelly **MUD**; Dark greenish grey to greenish black, very soft, abundant silt to coarse sand, common to abundant very fine to coarse shells and shell fragments, common organic matter.

0.30 – 0.38m:
CALCARENITE: Brown to yellowish brown, hard, abundant calcite cement, common very fine to fine angular to sub-angular calcareous sand, abundant shell fragments and whole gastropods to 5mm.

0.38 – 0.60m:
Sandy **CLAY**: Brown to yellowish brown, firm (120-140kPa), friable with low plasticity, common very fine to fine angular to sub-angular calcareous sand, abundant shell fragments

0.60 – 0.72m:
CLAY: Brownish, firm, moderate plasticity, calcareous, minor very fine to fine angular to sub-angular sand.

0.72 – 0.86m:
CLAY: Greyish brown to dark greyish brown, firm to moderately stiff (200-215 kPa), minor very fine to fine angular to sub-angular calcareous sand, abundant coarse shell fragments.

0.86 – 0.93m:
Muddy **CALCARENITE**: Yellowish brown, hard, slightly friable, calcite cement, common very fine to fine angular to sub-angular calcareous sand, common very fine to fine shell fragments

0.93 – 1.00m:
CLAY: Yellowish grey to yellowish brown, firm, moderate plasticity, sandy with occasional to common hard angular calcite cemented nodules to 5mm

1.00 – 1.30m:
CLAY: mottled brown and yellowish grey, stiff (190 – 210kPa).

1.30 – 1.34m:
Muddy **GRAVEL**: yellowish brown, friable, very fine sand to coarse quartz gravel, angular, abundant muddy matrix.

1.34 – 1.60m:
CLAY: mottled brown and yellowish grey, very stiff (300 – 450kPa), friable with low plasticity.

Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-10
Latitude / Longitude	-34.778700 / 138.517592		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	1.63
		Core Recovery:	1.00
Operational Comments:			

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.40m: **MUD**; Greenish black, very soft, soupy.
	0.1				
	0.2				
	0.3				
	0.4				0.4 – 0.95m: Sandy Shelly **MUD**; Dark greenish grey to greenish black, very soft, abundant silt to coarse sand, common to abundant very fine to coarse shells and shell fragments, common organic matter.
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				0.95 – 1.00m: **CALCARENITE**: Dark greyish brown, hard, abundant calcite cement, common very fine to fine angular to sub-angular calcareous sand, abundant shell fragments and whole gastropods to 5mm.
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-06
Latitude / Longitude	-34.778483 / 138.517392		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.32
		Core Recovery:	0.23
Operational Comments:	Refusal in stiff clay		

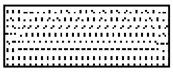
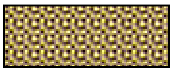
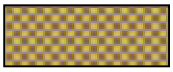
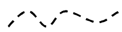
Photo	Depth	Lithology / Grainsize (Mud / Sand / Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.06m: Sandy Shelly **MUD**; Dark greenish grey to greenish black, very soft, abundant silt to coarse sand, common to abundant coarse shells and shell fragments, common organic matter. 0.06 – 0.23m: **CLAY**: Mottled orange brown and yellowish grey, stiff (250kPa), moderate plasticity, common silt to very fine sand.
	0.1				
	0.2				
	0.3				
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Vibrocore Description Sheet

Client:	Origin	Date:	16-Nov-2017
Location:	Port Adelaide River, Adelaide, SA	Core Number:	BH-05
Latitude / Longitude	-34.779065 138.517243		
Core Handling:	Core extruded into core tray and logged.		
		Total Penetration:	0.82
		Core Recovery:	0.58
Operational Comments:			

Photo	Depth	Lithology / Grainsize (Mud, Sand, Gravel)	Structure, texture & accessories	Fossils & Disturbance	Description
	0.0				0.0 – 0.25m: Sandy Shelly **MUD**; Dark greenish grey to greenish black, very soft, abundant silt to coarse sand, common to abundant coarse shells and shell fragments, common organic matter.
	0.1				
	0.2				
	0.3				0.25 – 0.58: Sandy Shelly **MUD**; Greenish grey to olive grey, very soft, abundant silt to coarse sand, common to abundant coarse shells and shell fragments, common organic matter.
	0.4				
	0.5				
	0.6				
	0.7				
	0.8				
	0.9				
	1.0				
	1.1				
	1.2				
	1.3				
	1.4				
	1.5				
	1.6				
	1.7				
	1.8				
	1.9				

Core Log Legend

Lithology		Structures, Texture and Accessories		Fossils and Disturbance	
CLAY / MUD		Calcite cementation	◊	Shell fragments	☾
SAND / GRAVEL		Iron staining	Fe	Bivalves	
CALCARENITE / CALCRETE		Boundary Distinct Indistinct Irregular	 ——————— - - - - - - - - - 	Gastropods	
				Organic matter	
		Soupy / disturbed			
		Fractured			

References

Belperio, A.P., 2012, The Geology of South Australia, Volume 2, Chapter 11: Quaternary; Geological Survey of South Australia, Bul 54 pp 219-280

APPENDIX C

Sediment characterisation

25 August 2017

ORIGIN ENERGY QUARANTINE POWER STATION

Project LISA Sediment Characterisation

Submitted to:
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LPG Supply Negotiator
Origin Energy
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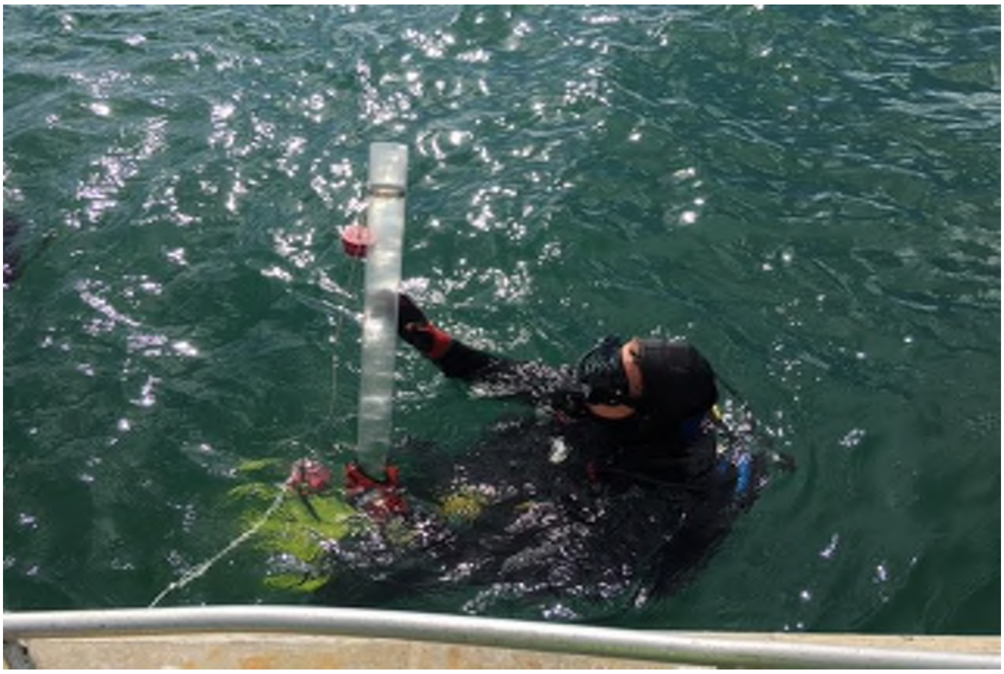

Report Number. 1783241-006-R-Rev0

Distribution:

1 eCopy - Origin Energy
1 eCopy - Golder Associates Pty Ltd

REPORT

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1.0 INTRODUCTION

1.1 Background

To assist South Australia in meeting its peek energy needs, Origin Energy (Origin) is proposing to provide dual fuel at the Quarantine Power Station (QPS), which is currently the largest peaking power station in South Australia with almost 225 MW capacity. Origin proposes to upgrade QPS Unit 5 to have dual fuel capabilities (LPG and natural gas). The proposal is named Project “LISA” – LPG in South Australia.

Origin proposes to supply LPG from a small gas carrier (Replenishment Ship) to a Storage Barge that is moored in Port River. LPG will be transferred via secure ship-to-barge pipes/hoses.

The QPS Unit 5 would use LPG supplied from the Storage Barge to the unit through a combination of submerged flexible hose and trenched and above ground pipes, providing rapid response to South Australia’s peaking power needs (i.e. QPS unit 5 has a start-up time of 24 minutes).

The proposed storage barge will hold 3000 tonnes of LPG which is sufficient for 4.5 days of continuous operation of the 128 MW gas turbine (or 13,000 MWh of fuel storage).

To enable the Replenishment Ship to access the Storage Barge, Project LISA requires a small area of the Port River to be dredged.

1.2 Purpose of this report

This report provides a contamination assessment of the sediments that are designated for dredging and disposal to allow a LPG ship to access the floating barge at QPS.

These results and interpretation of data will be used by Origin in discussions with the EPA on the most appropriate and pragmatic disposal option for sediments excavated from the Port River.

2.0 SEDIMENT SAMPLING

2.1 Sampling locations

Sampling in the Port River was undertaken on 19 and 20 July 2017. The locations were based on a random grid-based sample design, in accordance with National Assessment Guidelines for Dredging (NAGD) requirements. The sampling locations are presented in (Table 1 and Figure 1). All coordinates are in UTM Zone 54 H.

Table 1: Sampling locations

Sample ID	Easting (m)	Northing (m)
Core Samples		
3	272843	6148646
7	272830.7	6148665
13	272849.7	6148677
16	272821.7	6148700
23	272856.3	6148709
31	272831.7	6148747
32	272847.3	6148743
38	272866.3	6148756
40	272897.6	6148749
42	272854	6148775
52	272860.6	6148806
56	272848.3	6148825
58	272879.6	6148818
60	272910.9	6148812
66	272854.9	6148856
72	272873.9	6148869
74	272905.2	6148862
77	272877.2	6148884
80	272924.2	6148874
102	272945.6	6148872
Ponar Dredge Samples		
6	272815.1	6148668
8	272846.4	6148662
10	272877.7	6148655
26	272828.3	6148731
28	272859.6	6148724
48	272872.9	6148787
50	272904.2	6148780
66	272854.9	6148856
68	272886.2	6148850
70	272917.5	6148843

2.2 Sediment sampling

Sediment samples in the Swing Basin were collected using two methods. The main method was using SCUBA by Australian Diver Accreditation Scheme (ADAS) qualified divers at 20 locations within the area to be dredged. The second method was via ponar dredge sampling at 10 locations.

The approach for the collection of samples was as follows:

- The vessel anchored on location.
- A shot line was deployed for divers to descend and ascend.
- The GPS coordinates were recorded. The time of sampling, weather and sea conditions were noted.
- For the core samples:
  - Divers descended to the seabed using the shot line and remained within a 2 m radius.
  - A 1.5 m long x 63.5 mm wide clear polycarbonate sediment corer was pushed into the sediment using the assistance of a small rubber mallet until the tube was submerged or refusal occurred.
  - Due to the size of the corers, only one tube was required to collect the samples, as such the corer with the largest profile was used for sampling.
  - Once the samples were collected, divers ascended using the shot line and transferred the samples to the boat for logging by a Golder Environmental Scientist.
  - The sample depth was measured with a dive computer.
  - Where <0.5 m of sediment was recovered, the sediment was released from the corer into a clean stainless steel mixing bowl using a clean stainless steel scoop (with the sampler wearing powder-free nitrile gloves).
  - Where >0.5 m of sediment was recovered, two samples were taken, one from 0.0 to 0.5 m and a second from 0.5 to the end of the core, and placed into two separate, labelled bowls.
  - Each sample was thoroughly mixed in their respective bowls until the sample was uniform in colour and texture before a sub sample was taken for laboratory analysis.
- For the dredge samples the tethered ponar dredged was “dropped” from the boat at the desired location. The dredge snapped shut when it hit the bottom grabbing a sediment sample that was then lifted to the surface in the sampler.
- Samples (core and dredge sampled) were transferred to pre-labelled sample containers. A description of the sediment was also recorded including:
  - Physical appearance (e.g., clayey silt, silty sand, coarse sands).
  - Presence of foreign material.
  - Presence of shell fragments, biota (e.g., seagrass, polychaetes) and/or terrestrial organic material.
  - Colour.
- Sampling equipment was thoroughly cleaned between sampling sites, using a brush and seawater for initial cleaning and rinsed with clean water.

Sediment photographs are included in APPENDIX A.

2.3 Sampling analysis

All samples were analysed by a National Association of Testing Authorities (NATA) accredited laboratory. Selected samples were tested for a range of contaminants of potential concern, the analytes for each sample as well as the sample depths and are presented in Table 2.

Table 2: Environmental Laboratory Analysis Program – Sediment Sampling

Site ID	Sample Depth (m)	SA EPA Waste Screen	12 metals	PAH/TRH /BTEXN	PFAS	TBT	Potential Acid Sulfate Soils (S_{CR})	TOC
S3	0 – 0.5	✓			✓	✓	✓	✓
S7	0 – 0.5		✓	✓				
S13	0 – 0.5		✓	✓	✓	✓		
S15	0 – 0.5		✓		✓	✓		
S15 Dup 1/Dup 2	0 – 0.5		✓					
S15	0.5-1.0		✓					
S23	0 – 0.5	✓						
S23	0.5-1.0		✓					
S31	0 – 0.5		✓	✓				
S32	0 – 0.5		✓	✓				
S38	0 – 0.5		✓	✓			✓	✓
S40	0 – 0.5		✓	✓				
S42	0 – 0.5		✓		✓	✓		
S52	0 – 0.5		✓	✓				
S56	0 – 0.5		✓		✓	✓		
S58	0 – 0.5		✓	✓				
S60	0 – 0.5		✓	✓			✓	✓
S66	0 – 0.5		✓	✓				
S66 Dup1/Dup2	0 – 0.5		✓	✓				
S72	0 – 0.5	✓					✓	✓
S74	0 – 0.5		✓	✓	✓	✓		
S77	0 – 0.5		✓	✓				
S80	0 – 0.5	✓						
S102	0 – 0.5		✓	✓			✓	✓

Site ID	Sample Depth (m)	SA EPA Waste Screen	12 metals	PAH/TRH /BTEXN	PFAS	TBT	Potential Acid Sulfate Soils (S_{CR})	TOC
PS6	0 – 0.5		✓	✓				
PS8	0 – 0.5		✓	✓				
PS10	0 – 0.5		✓	✓				
PS26	0 – 0.5	✓						
PS28	0 – 0.5		✓	✓	✓	✓		
PS28 Dup1/Dup2	0 – 0.5		✓					
PS48	0 – 0.5		✓	✓	✓	✓		
PS50	0 – 0.5	✓			✓	✓		
PS66	0 – 0.5		✓		✓	✓		
PS66 Dup1/Dup2	0 – 0.5		✓					
PS68	0 – 0.5		✓	✓				
PS70	0 – 0.5		✓	✓				
Rinsate1	-		✓					
Rinsate2	-		✓	✓				

Abbreviations
SA EPA Waste Screen: South Australian Environment Protection Authority
12 metals: Arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel and zine
PAH/TRHBTEXN: Polycyclic Aromatic Hydrocarbons/Total Recoverable Hydrocarbons/Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
PFAS: Per- and Polyfluoroaklyl Substances
TBT: Tributyltin
TOC: Total Organic Carbon

2.4 Quality assurance

Quality assurance/quality control (QA/QC) samples were collected to assess the reliability of the results reported by the analytical laboratories, and to assess the potential for cross-contamination of the samples. Tabulated results from the field QA/QC program are presented in APPENDIX B. The QA/QC program included:

- Field inter-laboratory and intra-laboratory duplicates.
- Field rinsate samples taken each day.
- Laboratory QA/QC Program.

The results for each of these QA/QC categories are discussed in the following sections.

2.4.1 Sampling density

Thirty one samples were collected from an area of approximately 20,000 m^2. In accordance with AS4482.1 the recommended number of samples for this size area is 30, which was met. The proposed volume of material to be dredged is estimated as 70,000 m^3, for this volume of soil the recommended number of samples for collection (based on one sample for each 250 m^3) is 280. However given the depth of dredging (up to 2 m), the limited number of lithologies, the homogeneity of the sediment types including the presence of natural material, and the low standard deviation between each chemical concentration's data set, the number is considered adequate to provide an indication of the sediment quality.

2.4.2 Field inter-laboratory and intra-laboratory duplicates

Four primary duplicate and four secondary duplicate samples (for inter- and intra-lab comparison) were collected during the sampling program (a rate of one per eight samples which meets the requirements of AS4482.1). The primary samples and blind field duplicate samples (Dup1) were sent to the primary laboratory (ALS Environmental) for intra-laboratory duplicate analysis whilst the split field duplicate samples (Dup2) was sent to the secondary laboratory (Eurofins/MGT) for inter-laboratory duplicate analysis. Samples were analysed according to the information in Table 2. Replicate samples were taken from the same bowl containing the mixed sample. Sufficient sample was obtained from one 1 m core for the replicates.

Duplicate analysis results were assessed by calculation of their relative percent difference (RPD). These results are provided in APPENDIX B. Acceptable RPD results should be less than 30%, except if concentrations are less than five times the laboratory limit of reporting (LOR), or close to limits of reporting in which case greater variation may occur.

2.4.2.1 Inter-laboratory duplicates

Inter-laboratory field duplicate sample results reported RPDs within acceptable limits for the parameters analyses.

2.4.2.2 Intra-laboratory duplicates

Intra-laboratory field duplicate sample results reported RPDs within acceptable limits for the parameters analysed.

2.4.3 Field rinsate samples

A field rinsate sample was taken at the end of each day from the coring equipment. Equipment was rinsed following the same procedure used during the collection of primary samples, before de-ionised water supplied by the laboratory was poured over the utilised equipment and emptied into a rinsed stainless steel bowl. Samples were poured into the appropriate lab provided bottles and analysed for the analysis indicated in Table 2. Field rinsate analysis results are presented in APPENDIX B.

Results for the rinsate samples were below LOR for the parameters (metals) analysed.

2.4.4 Laboratory QA/QC program

ALS Environmental also conducted intra-laboratory duplicate tests on randomly selected samples. The laboratory duplicates were prepared by splitting a field sample and analysing it as two independent samples. The analysis of laboratory duplicate samples provides an indication of analytical precision. Quality control samples are also prepared by the laboratory by spiking a sample with a known concentration of the analyte being tested and determining the amount recovered. Laboratory method blanks are also run to check for sample contamination.

Laboratory issued quality control reports are provided in APPENDIX C. Review of the laboratory QA/QC reports indicate that the duplicate sample RPDs, matrix spike recoveries and blank results were generally within the laboratory acceptance criteria. Exceptions were:

- Matrix spike recovery for hexavalent chromium in soil (47.7%), which returned a recovery below the lower control limit of 58%.
- Matrix spike recoveries for perfluoroalkyl sulfonic acids (PFOS and PFHxS) in soil were not determined as the background levels were greater than or equal to 4x spike level.
- Matrix spike recoveries for manganese in water were not determined as the background levels were greater than or equal to 4 x spike level.
- Laboratory control spike for hexavalent chromium (5%) in soil was below the expected rate of recovery (10%).

All samples were received by the laboratory within holding times.

Data provided by ALS Environmental is deemed acceptable for use.

2.4.5 Summary

Overall, results from the QA/QC program give confidence in the quality of the data obtained from the sediment sampling program undertaken by Golder.

3.0 RESULTS

Results from analyses of sediment samples are provided in APPENDIX B. Laboratory issued reports are included in APPENDIX C.

3.1 Guidelines and criteria

The results have been compared to relevant available guidelines and criteria. Four guidelines have been used for these comparisons which include:

- The *National Assessment Guidelines for Dredging (*NADG) 2009 sediment screening levels.
- The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* recommended sediment quality guidelines.
- Environmental Protection Authority *Standard for the Production and Use of Waste Derived Fill* maximum concentrations of chemical substance to meet waste fill criteria.
- The South Australian Environmental Protection Authority *Acid Sulfate Soil Material Guideline November 2007* (Appendix C), EPA 638/07, criteria for acid sulfate material.
- New South Wales Department of Environment and Heritage. 2017. Draft PFAS Screening Criteria.

These guidelines have been selected as the most appropriate to help understand the sediment quality of the Port River where dredging would occur.

3.2 Sediment descriptions

The sediments collected from the proposed dredged area were generally a dark grey / black silty clay / mud with shell inclusions and plant roots. During sampling razor clams (*Pinna bicolor*) and invasive green algae species *Caulerpa taxifolia* and *C. racemosa* and the European fan worm, *Sabella spallanzani* were observed.

3.3 Metals

The samples collected were analysed for the presence of total trace metals. Beryllium, cadmium, chromium (hexavalent), and silver were present below the LOR in the analysed samples.

Concentrations of total metals in the samples analysed were below the SA EPA Waste Fill criteria for land disposal. Metal concentrations were also below the ANZECC and NADG Sediment Screening Levels with the exception of mercury in 26 of the 31 samples analysed.

3.4 Tributyltin

Tributyltin (TBT) was historically used as an antifouling agent in paint applied to hulls of ships and is a common contaminant for sediments in port areas. It has a high toxicity, especially to filter feeders. It becomes unstable when oxidised (to become tin) when the sediment is placed on land and dries. Its use has been prohibited since September 2008 (Department of Environment 2013).

Total organic carbon was analysed to enable normalisation of TBT results. Total organic carbon ranged from 0.58 to 0.88%. Normalisation was calculated by dividing TBT by TOC concentrations.

The TBT levels in the sediment analysed were below both the NAGD and ANZECC guidelines. No waste disposal criteria are available for TBT.

3.5 Per- and Polyfluoroalkyl Substances (PFAS)

PFAS's have been used globally since the 1960's for a range of industrial, commercial and domestic purposes including for firefighting. They are chemically and biologically stable being resistant to typical environmental degradation processes including hydrolysis, photolysis, biodegradation and metabolism. PFAS's have been used historically in the ports area for firefighting purposes. Additional inputs to the River could include surface run-off or via waste waters released from the waste water treatment plant at Bolivar. PFAS's, in particular PFOS (perfluorooctane sulfonate), are highly toxic to aquatic organisms.

PFOS was reported in five of the nine sediment samples analysed at concentrations ranging from 0.0002 to 0.0008 mg/kg. Currently there are no sediment guidelines available for PFAS compounds in Australian or internationally. However, given that the material will potentially be disposed of on land, the results were compared to available soil guidelines. The chemical concentrations in the sediment analysed did not exceed the available human health or ecological soil guidelines or criteria for residential and parkland / public open space and commercial / industrial settings.

3.6 Other organics

A selection of samples were also analysed for additional organic chemicals which included the following:

- Monocyclic aromatic hydrocarbons (MAHs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Total petroleum hydrocarbons (TPHs)
- Phenolics
- Polychlorinated biphenyls (PCBs)
- Organophosporous Pesticides (OPPs).

Sample concentrations in sediments at the locations sampled were below the LOR. The LORs were also below the NAGD screening levels, ANZECC guidelines and WDF criteria, therefore the results show that for the organic chemicals listed above, the concentrations were acceptable. A full list of these results is presented in APPENDIX B.

3.7 Acid sulfate soil analyses

Potential acid sulfate soils (PASS) contain iron pyrite which is stable in an un-oxidised state but, if exposed to air, may produce sulfuric acid due to oxidation of sulfides. These oxidised soils are commonly referred to as actual acid sulfate soils (AASS).

The sulfuric acid production from the oxidation of PASS can release iron, aluminium and other heavy metals from mineral soils. The sulfuric acid and dissolved metals can be released into the marine environment. In some cases, this acidity can result in significant physical and environmental degradation (e.g. corrosion and visual damage to engineering structures, toxicity to aquatic flora and fauna, impediment to growth or health of terrestrial plants and animals).

Chromium reducible sulfur (CRS) suite analyses were undertaken on a selection of sediment samples to assess ASS risks if dredged material is placed on land. Results are presented in APPENDIX B.

The EPA provides criteria for the classification of acid sulphate soil material in the *Acid Sulfate Soil Material Guideline November 2007.* Using the soil guidelines for sandy loams to light clay, soils with moles of H^+/tonne exceeding 36 or the percentage oxidisable sulfur (%S) above 0.03 are classified as acid sulfate material. As shown in Table 2 in APPENDIX B, the acidity of the five samples analysed, were less than 0.02% S and 10 mol H^+/tonne. The chromium reducible sulfur was greater than 0.03 (% S) and therefore the soils are potential acid sulphate soils (PASS). However, there is sufficient neutralising capacity in the soils and therefore the soils do not need treatment or management.

3.8 Porewater analyses

Three porewater samples were also collected and analysed for metals and PFAS concentrations. The PFAS concentrations were below the LOR and therefore the draft marine guideline concentrations for the three samples collected and analysed. For metals the concentration of copper, lead and zinc in at least one sample analysed was above the marine guideline for protection of 80% of species. The 80% protection level is considered appropriate as the environment is highly modified.

4.0 INTERPRETING THE RESULTS

4.1 Sediment quality risks and implications

Chemical concentrations in the samples tested had contaminants that were below the EPA waste derived fill criteria. The chemical concentrations were also below the NAGD sediment screening levels and the ANZECC sediment quality guidelines, with the exception of mercury.

Prior to and after normalisation of the results with TOC, the concentration of TBT in the sediment was an order of magnitude lower than the ANZECC and NAGD guidelines.

Concentrations of PFOS were above the LOR in five of the nine samples analysed but no criteria currently exist for sediment for disposal to land or water. The concentrations were below the soil guidelines and criteria for both human and ecological health in both residential and parkland / public open space and commercial and industrial settings.

ASS testing in five sediment samples found that it was classified as an acid sulfate soil, however it has enough buffering capacity and therefore does not require management measures to avoid adverse environmental impacts if exposed to air following disposal to land.

Porewater concentrations were elevated above the guideline concentrations for copper, lead and zinc for protection of marine species (80%). This should be considered in selecting dredging options to reduce movement of contamination within the river system. It is also relevant to dewatering of the dredge during land disposal, as it indicates that the excess water from the settling process may have concentrations of metals which could preclude direct return of water to the Port River.

There are no apparent metals or organics that would prevent disposal of the spoil to land, on the basis of environmental harm. The concentrations of mercury however, presents a risk to disposal of the spoil at sea.

5.0 CLOSURE

Testing of sediments by Golder indicates that there were no reported levels of contamination that exceeded the waste fill disposal criteria for land disposal. Concentrations assessed also did not exceed the ANZECC and NADG sediment guidelines for sea disposal, with the exception of mercury in the majority of samples. Based on these results, the dredged spoil should be disposed of to land and not sea.

6.0 IMPORTANT INFORMATION

Your attention is drawn to the document – "Important Information", which is included in Appendix E of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

7.0 REFERENCE

ANZECC/ARCMANZ 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council Agriculture and Resource Management Council of Australia and New Zealand. National Water Quality Management Strategy. Canberra, Australia. March.

Commonwealth of Australia (2009). *National Assessment Guidelines for Dredging (*NADG). Canberra.

Department of the Environment (2013). Antifouling Program. [ONLINE] Available at: http://secure.environment.gov.au/coasts/pollution/antifouling/index.html. [Accessed 01 March 16].

Environmental Protection Authority (2013). Standards for the production and use of Waste Derived Fill. South Australia.

Environmental Protection Authority (2007). EPA Guidelines: Site contamination – acid sulfate soil materials. EPA 638/07. South Australia. November.

Golder (2013). 137663005-001-M-Rev0. Diver Reconnaissance Survey of Berth 8 and the Caulerpa Trench, Outer Harbor, South Australia.

NSW Department of Environment and Heritage (2017). Draft PFAS Screening Criteria. May 2017.

Report Signature Page

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LOCATION MAP

LEGEND

- Core Samples
- Ponar Dredge Samples
- Dredging Area
- Minimum Channel Clearance
- Mooring Chain
- Storage Barge
- Submerged Flexible Pipeline
- Pipeline - Above Ground
- Pipeline - Below Ground
- Vapourizer

NOTES

1. Imagery supplied by client and georeferenced based on ESRI online basemaps.
2. Location map sourced from Esri online basemaps.

0 40 80 120 160
METRES

REFERENCE SCALE: 1:2,500 (at A3)

PROJECTION: GDA 1994 MGA Zone 54

CLIENT
ORIGIN

PROJECT
PROJECT LISA

TITLE
SAMPLING LOCATION PLAN

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-08-21
PREPARED	AFE
DESIGN	-
REVIEW	THH
APPROVED	THH

PROJECT No.	CONTROL	Rev.	FIGURE
1783241	006-R	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3

25mm

Path: I:\1. Active\3. Project\1783241 Origin Energy Quarantine Power Station DA\Project Doc\Deliverables\006-R\1783241-006-R-F0001-Rev0.mxd

APPENDIX A

Sediment Photographs

APPENDIX A
Sediment Sample Photos

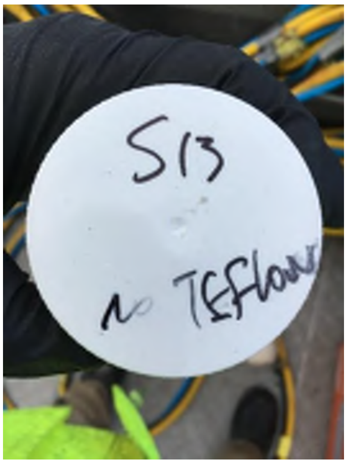

Plate 1: S13 Sediment Core

Plate 2: S31 Sediment Core

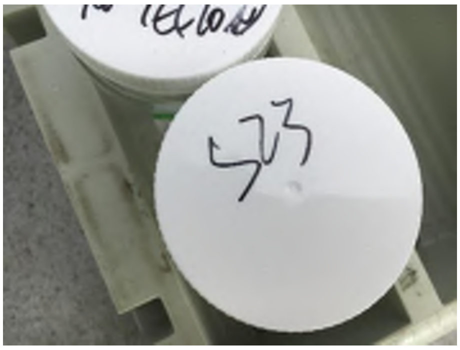

Plate 3: S23 Sediment Core

Plate 4: S42 Sediment Core

Plate 5: PS8 Ponar Grab Sample

Plate 6: PS50 Ponar Grab Sample

APPENDIX B

Tabulated Laboratory Results

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results

		Moisture	Metals															SQP	TBT
		Moisture Content	Arsenic	Barium	Beryllium	Cadmium	Chromium III + VI	Chromium (hexavalent)	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc	Cyanide (total)	Tributyltin
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg Sn/kg
EQL		1	5	10	1	1	2	0.5	2	5	50	5	5	0.1	2	2	5	1	0.5
SA EPA Waste Fill			20	300	20	3	400	1	170	60		300	500	1	60		200	500	
SA EPA Intermediate Soil			200		40	30	120000	200	170	2000		1200	6000	30	600		14000	1000	
SA EPA Low Level Contaminated Soil			**750**		**150**	**60**	**300000**	**750**	**1000**	**7500**		**5000**	**10000**	**110**	**3000**		**50000**	**3500**	
ANZECC Sediment Quality Guidelines ISQG-Low (Trigger values)			20			1.5	80			65		50		0.15	21	1	200		5
ANZECC Sediment Quality Guidelines - ISQG-High			70			10	370			270		220		1	52	3.7	410		70
NADG Screening Levels (ISQG Screening Levels)			20			1.5	80			65		50		0.15	21	1	200		9
NADG Maximum Levels			**70**			**10**	**370**			**270**		**220**		**1**	**52**	**3.7**	**410**		**70**
SA EPA Acid Sulfate Soil Materials - Silty clays																			
Human Health screening Levels- Residential, low density																			
Human Health screening Levels- Residential, high density																			
Human Health screening Levels- Commercial industrial																			
Indirct Soil Criteria/ Ecological Screening Criteria - Residential and Parkland																			
Indirct Soil Criteria/ Ecological Screening Criteria - Commercial / Industrial																			
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Urban Residential and Open Space																			
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Commercial / Industrial																			
Sample ID	**Sampled Date**																		
PS08/20/20170719	19/07/2017	49.9	9	30	<1	<1	29	-	6	42	-	34	303	0.2	11	-	100	-	
PS10/20/20170719	19/07/2017	46.9	8	20	<1	<1	25	-	5	36	-	30	244	0.2	10	-	92	-	
PS26/20/20170719	19/07/2017	43.6	10	20	<1	<1	25	<0.5	5	40	17,800	30	232	0.2	10	<2	90	<1	
PS28/20/20170720	20/07/2017	42.3	9	30	<1	<1	29	-	6	40	-	33	267	0.2	12	-	104	-	0.8
PS48/20/20170720	20/07/2017	49.9	9	30	<1	<1	31	-	6	42	-	35	284	0.2	12	-	109	-	0.6
PS50/20/20170720	20/07/2017	42.1	9	30	<1	<1	28	<0.5	6	40	18,900	32	246	0.2	11	<2	100	<1	<0.5
PS6/20/20170720	20/07/2017	44.8	9	30	<1	<1	24	-	5	32	-	30	235	0.2	10	-	88	-	
PS66/20/20170720	20/07/2017	41.4	8	30	<1	<1	27	-	5	36	-	30	258	0.2	11	-	88	-	<0.5
PS70/20/20170720	20/07/2017	26.5 - 52	9	30	<1	<1	32	-	6	43	-	34	274	0.2	12	-	105	-	
S102_S/20/20170720	20/07/2017	30.1	7	20	<1	<1	21	-	4	26	-	25	180	0.2	9	-	70	-	
S13_S/20/20170719	19/07/2017	40	7	20	<1	<1	20	-	4	28	-	25	200	0.2	8	-	72	-	<0.5
S15_M/20/20170719	19/07/2017	23.4	9	60	<1	<1	29	-	6	19	-	12	109	<0.1	13	-	31	-	
S15_S/20/20170719	19/07/2017	25.1	6	20	<1	<1	15	-	3	19	-	21	118	0.2	7	-	53	-	<0.5
S23_M/20/20170719	19/07/2017	26	5	20	<1	<1	15	-	3	19	-	24	126	0.2	7	-	54	-	
S23_S/20/20170719	19/07/2017	37.1	6	20	<1	<1	19	<0.5	4	25	12,400	24	184	0.2	8	<2	70	<1	
S3_S/20/20170719	19/07/2017	21 - 56	10	40	<1	<1	25	<0.5	6	43	16,400	39	432	0.2	11	<2	102	<1	0.9
S31_S/20/20170719	19/07/2017	32.4	7	30	<1	<1	23	-	5	24	-	21	189	0.1	10	-	58	-	
S32_S/20/20170719	19/07/2017	31.8	7	20	<1	<1	20	-	4	25	-	23	189	0.2	8	-	70	-	
S38_S/20/20170719	19/07/2017	37	9	30	<1	<1	22	-	5	30	-	28	288	0.2	10	-	78	-	
S40_S/20/20170719	19/07/2017	32.2	6	20	<1	<1	17	-	3	21	-	25	131	0.2	7	-	63	-	
S42_S/20/20170719	19/07/2017	21.9	6	20	<1	<1	19	-	4	22	-	23	170	0.1	8	-	63	-	<0.5
S52_S/20/20170720	20/07/2017	39.6	8	30	<1	<1	26	-	5	35	-	31	253	0.2	11	-	92	-	
S56_S/20/20170720	20/07/2017	29	7	30	<1	<1	23	-	5	31	-	31	240	0.2	11	-	76	-	
S58_S/20/20170720	20/07/2017	40.6	7	20	<1	<1	22	-	4	29	-	28	210	0.2	9	-	76	-	
S60_S/20/20170720	20/07/2017	32.3	7	20	<1	<1	23	-	4	30	-	27	206	0.2	9	-	81	-	
S66_S/20/20170720	20/07/2017	29.7	14	50	<1	<1	25	-	7	28	-	34	226	0.2	14	-	70	-	
S7_S/20/20170719	19/07/2017	46.3	10	40	<1	<1	30	-	6	42	-	41	391	0.2	13	-	105	-	
S72_S/20/20170720	20/07/2017	34.4	6	20	<1	<1	19	<0.5	4	25	12,000	25	186	0.2	8	<2	66	<1	
S74_S/20/20170720	20/07/2017	37.4	7	20	<1	<1	19	-	4	26	-	24	185	0.1	8	-	66	-	
S77_S/20/20170720	20/07/2017	36.3	9	30	<1	<1	28	-	6	33	-	30	238	0.2	12	-	87	-	
S80_S/20/20170720	20/07/2017	26.6	6	20	<1	<1	17	<0.5	3	21	10,100	21	150	0.1	7	<2	60	<1	

	Per- and Polyfluoroalkyl Subst														Nutrient	TRH						
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Perfluorobutane sulfonic acid (PFBS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoate (PFOA)	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS	Total Organic Carbon	C6-C10 less BTEX (F1)	+C10 - C40 (Sum of total)	F2-NAPHTHALENE	C6-C10	C10-C16	C16-C34	C34-C40
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.0005	0.0005	0.0005	0.0005	0.0002	0.0002	0.0002	0.001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.02	10	50	50	10	50	100	100
SA EPA Waste Fill																	1000					
SA EPA Intermediate Soil																	1000					
SA EPA Low Level Contaminated Soil																	**10000**					
ANZECC Sediment Quality Guidelines ISQG-Low (Trigger values)																						
ANZECC Sediment Quality Guidelines - ISQG-High																						
NADG Screening Levels (ISQG Screening Levels)																	550					
NADG Maximum Levels																						
SA EPA Acid Sulfate Soil Materials - Silty clays																						
Human Health screening Levels- Residential, low density												0.1		0.009								
Human Health screening Levels- Residential, high density												*20*		*2*								
Human Health screening Levels- Commercial industrial												***100***		***20***								
Indirct Soil Criteria/ Ecological Screening Criteria - Residential and Parkland							0.01															
Indirct Soil Criteria/ Ecological Screening Criteria - Commercial / Industrial							0.14															
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Urban Residential and Open Space							32					*17*										
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Commercial / Industrial							60					*48*										
Sample ID																						
PS08/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
PS10/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
PS26/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
PS28/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
PS48/20/20170720	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	0.0005	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	0.0005	-	<10	<50	<50	<10	<50	<100	<100
PS50/20/20170720	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	0.0005	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	0.0005	-	<10	<50	<50	<10	<50	<100	<100
PS6/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
PS66/20/20170720	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	0.0008	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	0.0008	-	-	-	-	-	-	-	-
PS70/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S102_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.58	<10	<50	<50	<10	<50	<100	<100
S13_S/20/20170719	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<10	<50	<50	<10	<50	<100	<100
S15_M/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S15_S/20/20170719	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-	-	-	-	-	-
S23_M/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S23_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S3_S/20/20170719	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.88	<10	<50	<50	<10	<50	<100	<100
S31_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S32_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S38_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.66	<10	<50	<50	<10	<50	<100	<100
S40_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S42_S/20/20170719	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-	-	-	-	-	-
S52_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S56_S/20/20170720	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-	-	-	-	-	-
S58_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S60_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.69	<10	<50	<50	<10	<50	<100	<100
S66_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S7_S/20/20170719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S72_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.61	<10	<50	<50	<10	<50	<100	<100
S74_S/20/20170720	<0.0005	<0.0005	<0.0005	<0.0005	<0.0002	<0.0002	0.0002	<0.001	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.0002	-	<10	<50	<50	<10	<50	<100	<100
S77_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100
S80_S/20/20170720	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<10	<50	<50	<10	<50	<100	<100

Waste Fill, Intermediate Soil and Low Level Contaminated Soil criteria from" Current criteria for the classification of waste – including Industrial and Commercial Waste (Listed) and Waste Soil" (SA EPA, March 2010).

NADG-

mg/kg - milligrams per kilogram
Criteria for total chromium (chromium III and VI) is based on chromium (III)
< - less than laboratory limit of reporting

Abbreviations:

EQL - Effective Quantitative Limit	PASS- Potential Acid Sulfate Soils
TPH - Total Petroleum Hydrocarbons	OCP - Organochlorine Pesticides
TRH - Total Recoverable Hydrocarbons	PCB - Polychlorinated Biphenyls
PAH - Polycyclic Aromatic Hydrocarbons	MAH - Monocyclic Aromatic Hydrocarbons
SQP - Sample Quality Parameters	SA - South Australia
OPP - Organophosphorous Pesticides	EPA - Environment Protection Authority

Prepared by: HK	Date: 4/08/2017
Checked by: NC	Date: 7/08/2017

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results

		TPH					PCB	OCP																									Phenols												
		C 6 - C 9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29-C36 Fraction	C10 - C36 Total	PCB Total	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane (Sum of total)	cis-Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	trans-Chlordane	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,6-Dichlorophenol	2-Chlorophenol	2-Methylphenol	2-Nitrophenol	3- & 4- Methylphenol	4-Chloro-3-methylphenol	Pentachlorophenol	Phenol	Total Phenols
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL		10	50	100	100	50	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.2	0.05	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	2	0.5	0.5
SA EPA Waste Fill		65				1000	2				2		2				2											2																	
SA EPA Intermediate Soil		100				1000	2				2		2				2											2																	
SA EPA Low Level Contaminated Soil		**1000**				**10000**	**50**				**50**		**50**				**50**											**50**																	
ANZECC Sediment Quality Guidelines ISQG-Low (Trigger values)							23						0.5			2	1.6		0.02					0.02																					
ANZECC Sediment Quality Guidelines - ISQG-High													6			20	46		8					8																					
NADG Screening Levels (ISQG Screening Levels)						550	23						0.5			2	1.6		280					10																					
NADG Maximum Levels																**20**	**46**		**620**					**220**																					
SA EPA Acid Sulfate Soil Materials - Silty clays																																													
Human Health screening Levels- Residential, low density																																													
Human Health screening Levels- Residential, high density																																													
Human Health screening Levels- Commercial industrial																																													
Indirct Soil Criteria/ Ecological Screening Criteria - Residential and Parkland																																													
Indirct Soil Criteria/ Ecological Screening Criteria - Commercial / Industrial																																													
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Urban Residential and Open Space																																													
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Commercial / Industrial																																													
Sample ID	**Sampled Date**																																												
PS08/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS10/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS26/20/20170719	19/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5
PS28/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS48/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS50/20/20170720	20/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5
PS6/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS66/20/20170720	20/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS70/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S102_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S13_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S15_M/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S15_S/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S23_M/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S23_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5
S3_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5
S31_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S32_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S38_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S40_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S42_S/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S52_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S56_S/20/20170720	20/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S58_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S60_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S66_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S7_S/20/20170719	19/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S72_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5
S74_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S77_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S80_S/20/20170720	20/07/2017	<10	<50	<100	<100	<50	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<2	<0.5	<0.5

Waste Fill, Intermediate Soil and Low Level Contaminated Soil criteria from" Current criteria for the classification of waste – including Industrial and Commercial Waste (Listed) and Waste Soil" (SA EPA, March 2010).

NADG-

mg/kg - milligrams per kilogram
Criteria for total chromium (chromium III and VI) is based on chromium (III)
< - less than laboratory limit of reporting

Abbreviations:

EQL - Effective Quantitative Limit	PASS- Potential Acid Sulfate Soils
TPH - Total Petroleum Hydrocarbons	OCP - Organochlorine Pesticides
TRH - Total Recoverable Hydrocarbons	PCB - Polychlorinated Biphenyls
PAH - Polycyclic Aromatic Hydrocarbons	MAH - Monocyclic Aromatic Hydrocarbons
SQP - Sample Quality Parameters	SA - South Australia
OPP - Organophosphorous Pesticides	EPA - Environment Protection Authority

Prepared by: HK	Date: 4/08/2017
Checked by: NC	Date: 7/08/2017

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results

		PAH																	MAH							Other		
		Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo[b+j]fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	PAH Total	Benzene	Ethylbenzene	Toluene	Xylene (o)	Xylenes (m & p)	Xylenes Total	Total BTEX (QLD EPA 1999 Draft)	Benzo(a)pyrene (TEQs)	Benzo(a)pyrene TEQ (half LOR)	Benzo(a)pyrene TEQ (LOR)
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.5	0.5	0.5	0.5	0.5	0.2	0.5	0.5	0.5
SA EPA Waste Fill						1												5	1	3.1	1.4			14				
SA EPA Intermediate Soil						2												40	5	100	50			180				
SA EPA Low Level Contaminated Soil						**5**												**200**	**15**	**1000**	**500**			**1800**				
ANZECC Sediment Quality Guidelines ISQG-Low (Trigger values)		16	44	85	261	430				384	63	600	19		160	240	665	4000										
ANZECC Sediment Quality Guidelines - ISQG-High		500	640	1100	1600	1600				2800	260	5100	540		2100	1500	2600	45,000										
NADG Screening Levels (ISQG Screening Levels)																		10,000										
NADG Maximum Levels																		**50,000**										
SA EPA Acid Sulfate Soil Materials - Silty clays																												
Human Health screening Levels- Residential, low density																												
Human Health screening Levels- Residential, high density																												
Human Health screening Levels- Commercial industrial																												
Indirct Soil Criteria/ Ecological Screening Criteria - Residential and Parkland																												
Indirct Soil Criteria/ Ecological Screening Criteria - Commercial / Industrial																												
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Urban Residential and Open Space																												
Direct Toxicity Criteria / Ecological Screening Levels Terrestrial - Commercial / Industrial																												
Sample ID	**Sampled Date**																											
PS08/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS10/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS26/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS28/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS48/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS50/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS6/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
PS66/20/20170720	20/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PS70/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S102_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S13_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S15_M/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S15_S/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S23_M/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S23_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S3_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S31_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S32_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S38_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S40_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S42_S/20/20170719	19/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S52_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S56_S/20/20170720	20/07/2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S58_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S60_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S66_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S7_S/20/20170719	19/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S72_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S74_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S77_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2
S80_S/20/20170720	20/07/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.5	0.6	1.2

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Prepared by: HK	Date: 4/08/2017
Checked by: NC	Date: 7/08/2017

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results- RPDs

			Lab Report Number	EM1709792	EM1709792		EM1709792	EM1709792		EM1709792	EM1709792		EM1709792	EM1709792	
			Field ID	S15_S/20/20170719	S15_S/29/20170719	RPD	S66_S/20/20170720	S66_S/29/20170720	RPD	PS28/20/20170720	PS28/29/20170720	RPD	PS66/20/20170720	PS66/29/20170720	RPD
			Sampled Date/Time	19/07/2017 14:30	19/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30	
Chem_Group	**ChemName**	**Units**	**EQL**												
Moisture Content	Moisture Content	%	1	25.1	29.7	17	29.7	25.8	14	42.3	48.8	14	41.4	35.5	15
Metals	Arsenic	mg/kg	5 (Primary): 2 (Interlab)	6.0	5.0	18	14.0	6.0	80	9.0	9.0	0	8.0	6.0	29
	Barium	mg/kg	10	20.0	10.0	67	50.0	20.0	86	30.0	30.0	0	30.0	20.0	40
	Beryllium	mg/kg	1 (Primary): 2 (Interlab)	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	NA
	Cadmium	mg/kg	1 (Primary): 0.4 (Interlab)	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	NA	<1.0	<1.0	NA
	Chromium III + VI	mg/kg	2 (Primary): 5 (Interlab)	15.0	14.0	7	25.0	22.0	13	29.0	31.0	7	27.0	22.0	20
	Cobalt	mg/kg	2 (Primary): 5 (Interlab)	3.0	3.0	0	7.0	5.0	33	6.0	6.0	0	5.0	4.0	22
	Copper	mg/kg	5	19.0	17.0	11	28.0	28.0	0	40.0	42.0	5	36.0	29.0	22
	Lead	mg/kg	5	21.0	20.0	5	34.0	29.0	16	33.0	35.0	6	30.0	25.0	18
	Manganese	mg/kg	5	118.0	115.0	3	226.0	198.0	13	267.0	287.0	7	258.0	220.0	16
	Mercury	mg/kg	0.1	0.2	0.1	67	0.2	0.2	0	0.2	0.2	0	0.2	0.1	67
	Nickel	mg/kg	2 (Primary): 5 (Interlab)	7.0	6.0	15	14.0	10.0	33	12.0	12.0	0	11.0	9.0	20
	Zinc	mg/kg	5	53.0	50.0	6	70.0	71.0	1	104.0	110.0	6	88.0	74.0	17
TRH	C6-C10 less BTEX (F1)	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<10.0	NA						
	+C10 - C40 (Sum of total)	mg/kg	50				<50.0	<50.0	NA						
	F2-NAPHTHALENE	mg/kg	50				<50.0	<50.0	NA						
	C6-C10	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<10.0	NA						
	C10-C16	mg/kg	50				<50.0	<50.0	NA						
	C16-C34	mg/kg	100				<100.0	<100.0	NA						
	C34-C40	mg/kg	100				<100.0	<100.0	NA						
TPH	C 6 - C 9 Fraction	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<10.0	NA						
	C10 - C14 Fraction	mg/kg	50 (Primary): 20 (Interlab)				<50.0	<50.0	NA						
	C15 - C28 Fraction	mg/kg	100 (Primary): 50 (Interlab)				<100.0	<100.0	NA						
	C29-C36 Fraction	mg/kg	100 (Primary): 50 (Interlab)				<100.0	<100.0	NA						
	C10 - C36 Total	mg/kg	50				<50.0	<50.0	NA						
PAH	Acenaphthene	mg/kg	0.5				<0.5	<0.5	NA						
	Acenaphthylene	mg/kg	0.5				<0.5	<0.5	NA						
	Anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Benz(a)anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(a)pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo[b+j]fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(g,h,i)perylene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(k)fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Chrysene	mg/kg	0.5				<0.5	<0.5	NA						
	Dibenz(a,h)anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Fluorene	mg/kg	0.5				<0.5	<0.5	NA						
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	Naphthalene	mg/kg	1 (Primary): 0.5 (Interlab)				<1.0	<1.0	NA						
	Naphthalene	mg/kg	0.5				<0.5	<0.5	NA						
	Phenanthrene	mg/kg	0.5				<0.5	<0.5	NA						
	Pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	PAH Total	mg/kg	0.5				<0.5	<0.5	NA						
MAH	Benzene	mg/kg	0.2 (Primary): 0.1 (Interlab)				<0.2	<0.2	NA						
	Ethylbenzene	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.5	NA						
	Toluene	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.5	NA						
	Xylene (o)	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.5	NA						
	Xylenes (m & p)	mg/kg	0.5 (Primary): 0.2 (Interlab)				<0.5	<0.5	NA						
	Xylenes Total	mg/kg	0.5 (Primary): 0.3 (Interlab)				<0.5	<0.5	NA						
	Total BTEX (QLD EPA 1999 Draft)	mg/kg	0.2				<0.2	<0.2	NA						
Other	Benzo(a)pyrene (TEQs)	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(a)pyrene TEQ (half LOR)	mg/kg	0.5				0.6	0.6	0						
	Benzo(a)pyrene TEQ (LOR)	mg/kg	0.5				1.2	1.2	0						

			Lab Report Number	EM1709792	556033		EM1709792	556033		EM1709792	556033		EM1709792	556033	
			Field ID	S15_S/20/20170719	S15_S/28/2017-719	RPD	S66_S/20/20170720	S66_S/28/20170720	RPD	PS28/20/20170720	PS28/28/20170720	RPD	PS66/20/20170720	PS66/28/20170720	RPD
			Sampled Date/Time	19/07/2017 14:30	19/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30		20/07/2017 14:30	20/07/2017 14:30	
Chem_Group	**ChemName**	**Units**	**EQL**												
Moisture Content	Moisture Content	%	1	25.1			29.7			42.3			41.4		
Metals	Arsenic	mg/kg	5 (Primary): 2 (Interlab)	6.0	11.0	59	14.0	13.0	7	9.0	9.9	10	8.0	14.0	55
	Barium	mg/kg	10	20.0	21.0	5	50.0	31.0	47	30.0	28.0	7	30.0	29.0	3
	Beryllium	mg/kg	1 (Primary): 2 (Interlab)	<1.0	<2.0	NA	<1.0	<2.0	NA	<1.0	<2.0	NA	<1.0	<2.0	NA
	Cadmium	mg/kg	1 (Primary): 0.4 (Interlab)	<1.0	<0.4	NA	<1.0	<0.4	NA	<1.0	<0.4	NA	<1.0	<0.4	NA
	Chromium III + VI	mg/kg	2 (Primary): 5 (Interlab)	15.0	22.0	38	25.0	29.0	15	29.0	27.0	7	27.0	28.0	4
	Cobalt	mg/kg	2 (Primary): 5 (Interlab)	3.0	<5.0	0	7.0	<5.0	NA	6.0	<5.0	18	5.0	<5.0	0
	Copper	mg/kg	5	19.0	28.0	38	28.0	43.0	42	40.0	43.0	7	36.0	39.0	8
	Lead	mg/kg	5	21.0	25.0	17	34.0	35.0	3	33.0	27.0	20	30.0	33.0	10
	Manganese	mg/kg	5	118.0	130.0	10	226.0	240.0	6	267.0	240.0	11	258.0	220.0	16
	Mercury	mg/kg	0.1	0.2	0.2	0	0.2	0.2	0	0.2	0.2	0	0.2	0.3	40
	Nickel	mg/kg	2 (Primary): 5 (Interlab)	7.0	9.4	29	14.0	12.0	15	12.0	11.0	9	11.0	12.0	9
	Zinc	mg/kg	5	53.0	70.0	28	70.0	99.0	34	104.0	96.0	8	88.0	94.0	7
TRH	C6-C10 less BTEX (F1)	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<20.0	NA						
	+C10 - C40 (Sum of total)	mg/kg	50				<50.0								
	F2-NAPHTHALENE	mg/kg	50				<50.0	<50.0	NA						
	C6-C10	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<20.0	NA						
	C10-C16	mg/kg	50				<50.0	<50.0	NA						
	C16-C34	mg/kg	100				<100.0	<100.0	NA						
	C34-C40	mg/kg	100				<100.0	<100.0	NA						
TPH	C 6 - C 9 Fraction	mg/kg	10 (Primary): 20 (Interlab)				<10.0	<20.0	NA						
	C10 - C14 Fraction	mg/kg	50 (Primary): 20 (Interlab)				<50.0	<20.0	NA						
	C15 - C28 Fraction	mg/kg	100 (Primary): 50 (Interlab)				<100.0	<50.0	NA						
	C29-C36 Fraction	mg/kg	100 (Primary): 50 (Interlab)				<100.0	<50.0	NA						
	C10 - C36 Total	mg/kg	50				<50.0	<50.0	NA						
PAH	Acenaphthene	mg/kg	0.5				<0.5	<0.5	NA						
	Acenaphthylene	mg/kg	0.5				<0.5	<0.5	NA						
	Anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Benz(a)anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(a)pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo[b+j]fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(g,h,i)perylene	mg/kg	0.5				<0.5	<0.5	NA						
	Benzo(k)fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Chrysene	mg/kg	0.5				<0.5	<0.5	NA						
	Dibenz(a,h)anthracene	mg/kg	0.5				<0.5	<0.5	NA						
	Fluoranthene	mg/kg	0.5				<0.5	<0.5	NA						
	Fluorene	mg/kg	0.5				<0.5	<0.5	NA						
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	Naphthalene	mg/kg	1 (Primary): 0.5 (Interlab)				<1.0	<0.5	NA						
	Naphthalene	mg/kg	0.5				<0.5	<0.5	NA						
	Phenanthrene	mg/kg	0.5				<0.5	<0.5	NA						
	Pyrene	mg/kg	0.5				<0.5	<0.5	NA						
	PAH Total	mg/kg	0.5				<0.5	<0.5	NA						
MAH	Benzene	mg/kg	0.2 (Primary): 0.1 (Interlab)				<0.2	<0.1	NA						
	Ethylbenzene	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.1	NA						
	Toluene	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.1	NA						
	Xylene (o)	mg/kg	0.5 (Primary): 0.1 (Interlab)				<0.5	<0.1	NA						
	Xylenes (m & p)	mg/kg	0.5 (Primary): 0.2 (Interlab)				<0.5	<0.2	NA						
	Xylenes Total	mg/kg	0.5 (Primary): 0.3 (Interlab)				<0.5	<0.3	NA						
	Total BTEX (QLD EPA 1999 Draft)	mg/kg	0.2				<0.2								
Other	Benzo(a)pyrene (TEQs)	mg/kg	0.5				<0.5								
	Benzo(a)pyrene TEQ (half LOR)	mg/kg	0.5				0.6	0.6	0						
	Benzo(a)pyrene TEQ (LOR)	mg/kg	0.5				1.2	1.2	0						

*RPDs have only been considered where a concentration is greater than 5 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier rane are: 30 (5-10 x EQL); 30 (10-30 x EQL); 30 (>30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories.
NA denotes Not Available as RPD can only be calculated when both concentrations are above the limit of reporting
< - less than laboratory limit of reporting
mg/kg - milligrams per kilogram

Prepared by:	HK	Date:	4/08/2017
Checked by:	NC	Date:	7/08/2017

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results- Rinsate

Field Blanks (WATER)
Filter: Lab_Report_Number in('EM1709792')

			Lab Report Number	EM1709792	EM1709792
			Field ID	RB01/67/20170719	RB02/67/20170720
			Sampled_Date/Time	19/07/2017 14:30	20/07/2017 14:30
			Sample Type	Rinsate	Rinsate
Chem_Group	**ChemName**	**Units**	**EQL**		
03-Metals	Arsenic (Filtered)	mg/l	0.001	<0.001	<0.001
	Barium (Filtered)	mg/l	0.001	<0.001	<0.001
	Beryllium (Filtered)	mg/l	0.001	<0.001	<0.001
	Cadmium (Filtered)	mg/l	0.0001	<0.0001	<0.0001
	Chromium III + VI (Filtered)	mg/l	0.001	<0.001	<0.001
	Cobalt (Filtered)	mg/l	0.001	<0.001	<0.001
	Copper (Filtered)	mg/l	0.001	<0.001	<0.001
	Lead (Filtered)	mg/l	0.001	<0.001	<0.001
	Manganese (Filtered)	mg/l	0.001	<0.001	<0.001
	Mercury (Filtered)	mg/l	0.0001	<0.0001	<0.0001
	Nickel (Filtered)	mg/l	0.001	<0.001	<0.001
	Zinc (Filtered)	mg/l	0.005	<0.005	<0.005

mg/L - milligrams per litre

Abbreviations:
EQL - Effective Quantitative Limit

Prepared by:	HK	Date:	4/08/2017
Checked by:	NC	Date:	7/08/2017

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results- Porewater

		Moisture Content	Per- and Polyfluoroalkyl Substances														Metals											
		Moisture Content	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer sulfonic acid (6:2 FTS)	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Perfluorobutane sulfonic acid (PFBS)	Perfluorohexane sulfonic acid (PFHxS)	Perfluorooctane sulfonic acid (PFOS)	Perfluorobutanoic acid (PFBA)	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorooctanoic acid (PFOA)	Sum of PFAS (WA DER List)	Sum of PFHxS and PFOS	Arsenic (Filtered)	Barium (Filtered)	Beryllium (Filtered)	Cadmium (Filtered)	Chromium III + VI (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)
		%	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		1	0.05	0.05	0.05	0.05	0.02	0.02	0.01	0.1	0.02	0.02	0.02	0.01	0.01	0.01	0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.0001	0.001	0.005
ANZECC 2000 Marine 80%																				0.036	0.09	0.15	0.008	0.012		0.0014	0.56	0.043
ANZECC 2000 Marine 90%																				*0.014*	*0.05*	*0.014*	*0.003*	*0.0066*		*0.0007*	*0.2*	*0.023*
ANZECC 2000 Marine 95%																				**0.0055**	**0.027**	**0.001**	**0.0013**	**0.0044**		**0.0004**	**0.07**	**0.015**
DoEE Draft PFAS guidelines 95% species protection									***0.13***					***220***														
DoEE Draft PFAS guidelines 90% species protection									***2***					***632***														
Field_ID	**Sampled_Date-Time**																											
PS50/20/20170720	20/07/2017	42.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.045	0.016	<0.005	<0.0005	<0.005	<0.005	<0.005	**0.005**	0.995	<0.0001	<0.005	<0.025
PS28/29/20170720	20/07/2017	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.024	0.02	<0.005	<0.0005	0.01	<0.005	***0.017***	0.017	0.936	<0.0001	<0.005	***0.049***
S74_S/20/20170720	20/07/2017	37.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.015	0.029	<0.005	<0.0005	0.007	<0.005	***0.009***	***0.013***	0.424	<0.0001	<0.005	***0.037***

Abbreviations:
% - percent
µg/L - micrograms per litre
mg/L - milligrams per litre
EQL - Effective Quantitative Limit

Prepared by:	HK	Date:	4/08/2017
Checked by:	NC	Date:	7/08/2017

Golder Associates

Origin Energy Quarantine Power Station- Port River Sediment Waste Classification

Project no: 1783241

Chemical Data Results- Acid Sulfate Soils

Test Location	Depth Range (m - BGL)		Depth Range (m AD)		Material Description	pH_{FIELD}	pH_{KCl}	TAA (moles H+/t)	sTAA (% pyrite S)	S_{NAS} (if pH less than 4.5)	Existing Acidity % S (sTAA + 0.75 x S_{NAS})	Chromium Reducible Sulfur (S_{CR}) % S	Acid Neutralising Capacity % CaCO3 (if pH more than 6.5)	Net Acidity (%S) (S_{CR}+Existing Acidity-ANC/FF)	Is This AASS	Is This PASS	Liming Rate (kg $CaCO_3$/t)
S3	0.00	0.50	2.96	2.46	sandy clay	-	9	<2	<0.02	-	0.00	0.346	36.3	-23.85	No	YES	<1
S38	0.00	0.50	2.96	2.46	silty clay	-	9.1	<2	<0.02	-	0.00	0.209	35.4	0.21	No	YES	<1
S72	0.00	0.50	2.96	2.46	silty clay	-	9.1	<2	<0.02	-	0.00	0.175	35.9	-23.76	No	YES	<1
S102	0.00	0.50	2.96	2.46	silty clay	-	9.1	<2	<0.02	-	0.00	0.382	22.2	-14.42	No	YES	<1
S60	0.00	0.50	2.96	2.46	silty clay	-	9.1	<2	<0.02	-	0.00	0.222	23	-15.11	No	YES	<1

APPENDIX C

Laboratory Reports and Chain of Custody Documentation

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 2.

Golder Associates Pty Ltd
118 Franklin Street,
Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Port River Sampling	**DATE RESULTS REQUIRED:**	
PROJ No.:	1783241	**E-MAIL RESULTS:**	Asavaglia@golder.com
SAMPLED BY:	AS	**CC RESULTS:**	mel-envdata@golder.com.au
CONTACT:	Alex Savaglia - 0433 743 730	**LABORATORY:**	ALS
		QUOTE No:	MSA

FREIGHT

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Sample Jars: Hold	250g Jar	250g Jar (No Teflon Lid)	60ml non-preserved metals	Analysis Required						Comments
	S3_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S7_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S13_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S31_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S15_S/20/2017-719	19/07/2017	Natural	Surface		x	x								
	S15_S/29/2017-719	19/07/2017	Natural	Surface		x	x								
	S15_S/28/2017-719	19/07/2017	Natural	Surface		x	x								Please forward to MGT Eurofins
	S15_M/20/2017-719	19/07/2017	Natural	Mid		x	x								
	S23_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S23_M/20/20170719	19/07/2017	Natural	Mid		x	x								
	S32_S/20/2-170719	19/07/2017	Natural	Surface		x	x								
	S38_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S40_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	S42_S/20/20170719	19/07/2017	Natural	Surface		x	x								
	PS08/20/20170719	19/07/2017	Natural	Surface		x	x								
	PS10/20/20170719	19/07/2017	Natural	Surface		x	x								
	PS26/20/20170719	19/07/2017	Natural	Surface		x	x								
	S52_S/20/20170720	20/07/2017	Natural	Surface		x	x								
	S58_S/20/20170720	20/07/2017	Natural	Surface		x	x								
	S66_S/20/20170720	20/07/2017	Natural	Surface		x	x								
	S72_S/20/20170720	20/07/2017	Natural	Surface		x	x								
				Totals :											

Environmental Division
Melbourne
Work Order Reference
EM1709792

Telephone : +61-3-8549 9600

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Savaglia	Golder Associates	Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	Bharathi	ALS	Yes / No	Yes / No	25/7/17	11am	
RELEASED BY:			Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:			Yes / No	Yes / No			

Forwarded to Secondary Lab MGT
Initials TL Date 25/7

Updated COC 24/07/17 15.05 - BN

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 2.

Golder Associates Pty Ltd
118 Franklin Street,
Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Port River Sampling	**DATE RESULTS REQUIRED:**	
PROJ No.:	1783241	**E-MAIL RESULTS:**	nacooper@golder.com
SAMPLED BY:	AS	**CC RESULTS:**	hkeynes@golder.com
CONTACT:	Naomi Cooper	**LABORATORY:**	ALS
		QUOTE No:	MSA

FREIG

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Sample Jars: Hold	Sample Jars: 250g Jar	Sample Jars: 250g Jar (No Teflon Lid)	Analysis Required: SA EPA Waste Screen Basic	As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn	PAH/TRH/BTEX	PFAS	TBT	Acid Sulphate Soils	TOC	Comments
1	S3_S/20/20170719	19/07/2017	Natural	Surface		x	x	x			x	x	x	x	
2	S7_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
3	S13_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x	x	x			
4	S31_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
5	S15_S/20/2017-719	19/07/2017	Natural	Surface		x	x		x		x	x			
6	S15_S/29/2017-719	19/07/2017	Natural	Surface		x	x		x						
	S15_S/28/2017-719	19/07/2017	Natural	Surface		x	x		x						Please forward to MGT Eurofins
7	S15_M/20/2017-719	19/07/2017	Natural	Mid		x	x		x						
8	S23_S/20/20170719	19/07/2017	Natural	Surface		x	x	x							
9	S23_M/20/20170719	19/07/2017	Natural	Mid		x	x		x						
10	S32_S/20/2-170719	19/07/2017	Natural	Surface		x	x		x	x					
11	S38_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x			x	x	
12	S40_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
13	S42_S/20/20170719	19/07/2017	Natural	Surface		x	x		x		x	x			
14	PS08/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
15	PS10/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
16	PS26/20/20170719	19/07/2017	Natural	Surface		x	x	x							
17	S52_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
18	S58_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
19	S66_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
20	S72_S/20/20170720	20/07/2017	Natural	Surface		x	x	x					x	x	
				Totals :				4	17	11	4	4	3	3	

Any samples heavily contaminated?

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Savaglia	Golder Associates	*Yes / No*	*Yes / No*			
			Esky Intact	***Security Seals Intact***			
RECEIVED BY:	Bharathi	ALS	*Yes / No*	*Yes / No*	25/7/17	11am	
RELEASED BY:			*Yes / No*	*Yes / No*			
			Esky Intact	***Security Seals Intact***			
RECEIVED BY:			*Yes / No*	*Yes / No*			

Chain of Custody Record - Soil/Sediment Samples

Sheet 2 of 2

Golder Associates Pty Ltd
118 Franklin Street,
Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Port River Sampling	**DATE RESULTS REQUIRED:**	
PROJ No.:	1783241	**E-MAIL RESULTS:**	nacooper@golder.com
SAMPLED BY:	AS	**CC RESULTS:**	hkeynes@golder.com
CONTACT:	Naomi Cooper	**LABORATORY:**	ALS
		QUOTE No:	MSA

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Sample Jars: Hold	Sample Jars: 250g Jar	Sample Jars: 250g Jar (No Teflon Lid)	Sample Jars: 60ml non-preserved metals	Analysis Required: SA EPA Waste Screen Basic	Analysis Required: As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn	Analysis Required: PAH/TRH/BTEX	Analysis Required: PFAS	Analysis Required: TBT	Analysis Required: Acid Sulphate Soils	Analysis Required: TOC	Comments
21	S74_S/20/2017072	20/07/2017	Natural	Surface		x	x			x	x	x	x			
22	S80_S/20/2017072	20/07/2017	Natural	Surface		x	x		x							
23	S66_S/29/2017072	20/07/2017	Natural	Surface		x	x			x	x					
→	S66_S/28/2017072	20/07/2017	Natural	Surface		x	x			x	x					Please forward to MGT Eurofins
24	S56_S/20/2017072	20/07/2017	Natural	Surface		x	x			x		x	x			
25	S102_S/20/2017072	20/07/2017	Natural	Surface		x	x			x	x			x	x	
26	S60_S/20/2017072	20/07/2017	Natural	Surface		x	x			x	x			x	x	
27	S77_S/20/2017072	20/07/2017	Natural	Surface		x	x			x	x					
28	PS28/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
29	PS28/29/20170720	20/07/2017	Natural	Surface		x	x			x		x	x			
→	PS28/28/20170720	20/07/2017	Natural	Surface		x	x			x						Please forward to MGT Eurofins
30	PS48/20/20170720	20/07/2017	Natural	Surface		x	x			x	x	x	x			
31	PS50/20/20170720	20/07/2017	Natural	Surface		x	x		x			x	x			
32	PS66/20/20170720	20/07/2017	Natural	Surface		x	x			x		x	x			
33	PS66/29/20170720	20/07/2017	Natural	Surface		x	x			x						
→	PS66/28/20170720	20/07/2017	Natural	Surface		x	x			x						Please forward to MGT Eurofins
(broken)	PS68/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
34	PS70/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
35	PS6/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
36	RB01/67/20170719	19/07/2017						x		x						
37	RB02/67/20170720	20/07/2017						x		x	x					
				Totals :					2	19	12	7	7	2	2	

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Savaglia	Golder Associates	*Yes / No*	*Yes / No*			
RECEIVED BY:	Bharathi	ALS	***Esky Intact*** *Yes / No*	***Security Seals Intact*** *Yes / No*	25/7/17	11 am	
RELEASED BY:			*Yes / No*	*Yes / No*			
RECEIVED BY:			***Esky Intact*** *Yes / No*	***Security Seals Intact*** *Yes / No*			

Bharathi Narayanan

From: Cooper, Naomi <NACooper@golder.com.au>
Sent: Monday, 24 July 2017 7:05 PM
To: Bronwyn Sheen
Subject: RE: 1783241
Attachments: Port River Assessment - COC.xls

Hi Bronwyn
Another change to the COC – sorry this is the most updated one.
Cheers,
Naomi

From: Cooper, Naomi
Sent: Monday, 24 July 2017 6:25 PM
To: Bronwyn Sheen (bronwyn.sheen@alsglobal.com) <bronwyn.sheen@alsglobal.com>
Subject: 1783241

Hi Bronwyn

Please find attached the COC for this job.

It is slightly different than the other one as I had to fix a few of the sample numbers up.

We were also supposed to do 3 porewater screens. Can you please see if there would be enough porewater from the samples to do those screens. Is it possible to mix porewater from various samples? Can you please look into that when the samples get there and let me know.

It would be very much appreciated.

Thanks,
Naomi

Naomi Cooper (BEnvlTox (Hons), MS Natural Science) CEnvP | Environmental Toxicologist | **Golder Associates Pty Ltd**
118 Franklin Street, Adelaide, South Australia 5000, Australia
T: +61 8 8213 2100 | **D:** +61 (8) 8213 2217 | **F:** +61 8 8213 2101 | **M:** 0427 222 110 | **E:** NACooper@golder.com.au | **www.golder.com**

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Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EM1709792**		
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Contact	: Bronwyn Sheen
Address	: 118 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: gcontact@golder.com.au	E-mail	: bronwyn.sheen@alsglobal.com
Telephone	: +61 03 8862 3500	Telephone	: +61-3-8549 9636
Facsimile	: +61 03 8862 3501	Facsimile	: +61-3-8549 9601
Project	: 1783241	Page	: 1 of 5
Order number	: ----	Quote number	: ES2016GOLASS0005 (EN/002/16 v2)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Port River		
Sampler	: AS		

Dates

Date Samples Received	: 25-Jul-2017 11:00	Issue Date	: 25-Jul-2017
Client Requested Due Date	: 01-Aug-2017	Scheduled Reporting Date	: **02-Aug-2017**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 6	Temperature	: 3.2°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 37 / 36

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **The scheduled reporting date has been extended due to analytical testing conducted by ALS interstate laboratories. Please refer to your quotation for further information.**
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
- **Analytical work for this work order will be conducted at ALS Springvale, ALS Brisbane & ALS Sydney.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA033 Chromium Suite for Acid Sulphate Soils	SOIL - EA055-103 Moisture Content	SOIL - EP003 Total Organic Carbon (TOC) in Soil	SOIL - EP090 (solids) Organotins	SOIL - EP231 (solids) PFAS - Short Suite (12 analytes)	SOIL - P-15/1 SA EPA Waste Classification-Basic	SOIL - S-02 8 Metals (incl. Digestion)
EM1709792-001	19-Jul-2017 00:00	S3_S/20/20170719	✓	✓	✓	✓	✓	✓	
EM1709792-002	19-Jul-2017 00:00	S7_S/20/20170719		✓					✓
EM1709792-003	19-Jul-2017 00:00	S13_S/20/20170719		✓		✓	✓		✓
EM1709792-004	19-Jul-2017 00:00	S31_S/20/20170719		✓					✓
EM1709792-005	19-Jul-2017 00:00	S15_S/20/20170719		✓		✓	✓		✓
EM1709792-006	19-Jul-2017 00:00	S15_S/29/20170719		✓					✓
EM1709792-007	19-Jul-2017 00:00	S15_M/20/20170719		✓					✓
EM1709792-008	19-Jul-2017 00:00	S23_S/20/20170719		✓				✓	
EM1709792-009	19-Jul-2017 00:00	S23_M/20/20170719		✓					✓
EM1709792-010	19-Jul-2017 00:00	S32_S/20/20170719		✓					✓
EM1709792-011	19-Jul-2017 00:00	S38_S/20/20170719	✓	✓	✓				✓
EM1709792-012	19-Jul-2017 00:00	S40_S/20/20170719		✓					✓
EM1709792-013	19-Jul-2017 00:00	S42_S/20/20170719		✓		✓	✓		✓
EM1709792-014	19-Jul-2017 00:00	PS08/20/20170719		✓					✓
EM1709792-015	19-Jul-2017 00:00	PS10/20/20170719		✓					✓
EM1709792-016	19-Jul-2017 00:00	PS26/20/20170719		✓				✓	
EM1709792-017	20-Jul-2017 00:00	S52_S/20/20170720		✓					✓
EM1709792-018	20-Jul-2017 00:00	S58_S/20/20170720		✓					✓
EM1709792-019	20-Jul-2017 00:00	S66_S/20/20170720		✓					✓
EM1709792-020	20-Jul-2017 00:00	S72_S/20/20170720	✓	✓	✓			✓	
EM1709792-021	20-Jul-2017 00:00	S74_S/20/20170720		✓		✓	✓		✓
EM1709792-022	20-Jul-2017 00:00	S80_S/20/20170720		✓				✓	
EM1709792-023	20-Jul-2017 00:00	S66_S/29/20170720		✓					✓
EM1709792-024	20-Jul-2017 00:00	S56_S/20/20170720		✓		✓	✓		✓
EM1709792-025	20-Jul-2017 00:00	S102_S/20/20170720	✓	✓	✓				✓
EM1709792-026	20-Jul-2017 00:00	S60_S/20/20170720	✓	✓	✓				✓
EM1709792-027	20-Jul-2017 00:00	S77_S/20/20170720		✓					✓
EM1709792-028	20-Jul-2017 00:00	PS28/20/20170720		✓					✓
EM1709792-029	20-Jul-2017 00:00	PS28/29/20170720		✓		✓	✓		✓
EM1709792-030	20-Jul-2017 00:00	PS48/20/20170720		✓		✓	✓		✓
EM1709792-031	20-Jul-2017 00:00	PS50/20/20170720		✓		✓	✓	✓	
EM1709792-032	20-Jul-2017 00:00	PS66/20/20170720		✓		✓	✓		✓
EM1709792-033	20-Jul-2017 00:00	PS66/29/20170720		✓					✓
EM1709792-034	20-Jul-2017 00:00	PS70/20/20170720		✓					✓
EM1709792-035	20-Jul-2017 00:00	PS6/20/20170720		✓					✓

Matrix: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EG005T (solids) Total Metals by ICP-AES	SOIL - EG020T Total Recoverable Metals by ICPMS (including	SOIL - EN82 Porewater Extraction	SOIL - EP231 PFAS - Short Suite (12 analytes)	SOIL - S-07 TRH/BTEXN/PAH (SIM)	SOIL - W-02T 8 metals (Total)
EM1709792-002	19-Jul-2017 00:00	S7_S/20/20170719	✓				✓	
EM1709792-003	19-Jul-2017 00:00	S13_S/20/20170719	✓				✓	
EM1709792-004	19-Jul-2017 00:00	S31_S/20/20170719	✓				✓	
EM1709792-005	19-Jul-2017 00:00	S15_S/20/20170719	✓					
EM1709792-006	19-Jul-2017 00:00	S15_S/29/20170719	✓					
EM1709792-007	19-Jul-2017 00:00	S15_M/20/20170719	✓					
EM1709792-009	19-Jul-2017 00:00	S23_M/20/20170719	✓					
EM1709792-010	19-Jul-2017 00:00	S32_S/20/20170719	✓				✓	
EM1709792-011	19-Jul-2017 00:00	S38_S/20/20170719	✓				✓	
EM1709792-012	19-Jul-2017 00:00	S40_S/20/20170719	✓				✓	
EM1709792-013	19-Jul-2017 00:00	S42_S/20/20170719	✓					
EM1709792-014	19-Jul-2017 00:00	PS08/20/20170719	✓				✓	
EM1709792-015	19-Jul-2017 00:00	PS10/20/20170719	✓				✓	
EM1709792-017	20-Jul-2017 00:00	S52_S/20/20170720	✓				✓	
EM1709792-018	20-Jul-2017 00:00	S58_S/20/20170720	✓				✓	
EM1709792-019	20-Jul-2017 00:00	S66_S/20/20170720	✓				✓	
EM1709792-021	20-Jul-2017 00:00	S74_S/20/20170720	✓	✓	✓	✓	✓	✓
EM1709792-023	20-Jul-2017 00:00	S66_S/29/20170720	✓				✓	
EM1709792-024	20-Jul-2017 00:00	S56_S/20/20170720	✓					
EM1709792-025	20-Jul-2017 00:00	S102_S/20/20170720	✓				✓	
EM1709792-026	20-Jul-2017 00:00	S60_S/20/20170720	✓				✓	
EM1709792-027	20-Jul-2017 00:00	S77_S/20/20170720	✓				✓	
EM1709792-028	20-Jul-2017 00:00	PS28/20/20170720	✓				✓	
EM1709792-029	20-Jul-2017 00:00	PS28/29/20170720	✓	✓	✓	✓		✓
EM1709792-030	20-Jul-2017 00:00	PS48/20/20170720	✓				✓	
EM1709792-031	20-Jul-2017 00:00	PS50/20/20170720		✓	✓	✓		✓
EM1709792-032	20-Jul-2017 00:00	PS66/20/20170720	✓					
EM1709792-033	20-Jul-2017 00:00	PS66/29/20170720	✓					
EM1709792-034	20-Jul-2017 00:00	PS70/20/20170720	✓				✓	
EM1709792-035	20-Jul-2017 00:00	PS6/20/20170720	✓				✓	

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - W-02 8 Metals
EM1709792-036	19-Jul-2017 00:00	RB01/67/20170719	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	(On Hold) WATER No analysis requested	WATER - EG020F Dissolved Metals by ICPMS
EM1709792-036	19-Jul-2017 00:00	RB01/67/20170719		✓
EM1709792-037	20-Jul-2017 00:00	RB02/67/20170720	✓	

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **SOIL**

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

Method Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received Date	Samples Received Evaluation	Instructions Received Date	Instructions Received Evaluation
EA033: Chromium Suite for Acid Sulphate Soils							
S102_S/20/20170720	Soil Glass Jar - Unpreserved	21-Jul-2017	19-Oct-2017	25-Jul-2017	✘	----	----
S3_S/20/20170719	Soil Glass Jar - Unpreserved	20-Jul-2017	18-Oct-2017	25-Jul-2017	✘	----	----
S38_S/20/20170719	Soil Glass Jar - Unpreserved	20-Jul-2017	18-Oct-2017	25-Jul-2017	✘	----	----
S60_S/20/20170720	Soil Glass Jar - Unpreserved	21-Jul-2017	19-Oct-2017	25-Jul-2017	✘	----	----
S72_S/20/20170720	Soil Glass Jar - Unpreserved	21-Jul-2017	19-Oct-2017	25-Jul-2017	✘	----	----

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	au_accountspayable@golder.com.au
ACCOUNTS PAYABLE (au)		
- A4 - AU Tax Invoice (INV)	Email	auaccountspayable@golder.com.au
HANNAH KEYNES		
- *AU Certificate of Analysis - NATA (COA)	Email	hkeynes@golder.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	hkeynes@golder.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	hkeynes@golder.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	hkeynes@golder.com.au
- Chain of Custody (CoC) (COC)	Email	hkeynes@golder.com.au
- Chromatogram (CHROM)	Email	hkeynes@golder.com.au
- EDI Format - ESDAT (ESDAT)	Email	hkeynes@golder.com.au
NAOMI COOPER		
- *AU Certificate of Analysis - NATA (COA)	Email	nacooper@golder.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	nacooper@golder.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	nacooper@golder.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	nacooper@golder.com
- Chain of Custody (CoC) (COC)	Email	nacooper@golder.com
- Chromatogram (CHROM)	Email	nacooper@golder.com
- EDI Format - ESDAT (ESDAT)	Email	nacooper@golder.com
RESULTS ADELAIDE		
- *AU Certificate of Analysis - NATA (COA)	Email	adelaide@golder.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	adelaide@golder.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	adelaide@golder.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	adelaide@golder.com.au
- Chain of Custody (CoC) (COC)	Email	adelaide@golder.com.au
- Chromatogram (CHROM)	Email	adelaide@golder.com.au
- EDI Format - ESDAT (ESDAT)	Email	adelaide@golder.com.au

CERTIFICATE OF ANALYSIS

Work Order	: **EM1709792**	Page	: 1 of 41
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Contact	: Bronwyn Sheen
Address	: 118 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 8862 3500	Telephone	: +61-3-8549 9636
Project	: 1783241	Date Samples Received	: 25-Jul-2017 11:00
Order number	: 1783241	Date Analysis Commenced	: 26-Jul-2017
C-O-C number	: ----	Issue Date	: 02-Aug-2017 17:18
Sampler	: AS		
Site	: Port River		
Quote number	: EN/002/16 v2		
No. of samples received	: 39		
No. of samples analysed	: 39		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

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

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

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

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

When no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

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

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

- EG048G: EM1709784 #2, matrix spike failed due to sample matrix interferences.
- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for samples EM1709792-021 S74_S/20/20170720), EM1709792-029 (PS28/29/20170720) and EM1709792-031 (PS50/20/20170720) due to matrix interference.
- EP231X: Samples required dilution prior to extraction due to high conductivity. LOR values have been adjusted accordingly.
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Analytical Results

Sub-Matrix: PORE WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	S74_S/20/20170720	PS28/29/20170720	PS50/20/20170720	----	----
Client sampling date / time				20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	----	----
				EM1709792-021	EM1709792-029	EM1709792-031	--------	--------
				Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.015**	**0.024**	**0.045**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.005	<0.005	<0.005	----	----
Barium	7440-39-3	0.001	mg/L	**0.029**	**0.020**	**0.016**	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	----	----
Chromium	7440-47-3	0.001	mg/L	**0.007**	**0.010**	<0.005	----	----
Copper	7440-50-8	0.001	mg/L	**0.009**	**0.017**	<0.005	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	----	----
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	----	----
Lead	7439-92-1	0.001	mg/L	**0.013**	**0.017**	**0.005**	----	----
Zinc	7440-66-6	0.005	mg/L	**0.037**	**0.049**	<0.025	----	----
Manganese	7439-96-5	0.001	mg/L	**0.424**	**0.936**	**0.995**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.02	µg/L	<0.05	<0.05	<0.05	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.02	µg/L	<0.05	<0.05	<0.05	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.01	µg/L	<0.05	<0.05	<0.05	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.1	µg/L	<0.2	<0.2	<0.2	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.02	µg/L	<0.05	<0.05	<0.05	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.02	µg/L	<0.05	<0.05	<0.05	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02	µg/L	<0.05	<0.05	<0.05	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.01	µg/L	<0.05	<0.05	<0.05	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.05	µg/L	<0.05	<0.05	<0.05	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.05	µg/L	<0.05	<0.05	<0.05	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.05	µg/L	<0.05	<0.05	<0.05	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.05	µg/L	<0.05	<0.05	<0.05	----	----

Analytical Results

Sub-Matrix: **PORE WATER** (Matrix: **WATER**)			Client sample ID	**S74_S/20/20170720**	**PS28/29/20170720**	**PS50/20/20170720**	**----**	**----**
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM1709792-021**	**EM1709792-029**	**EM1709792-031**	**--------**	**--------**
				Result	Result	Result	----	----
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.01	µg/L	<0.05	<0.05	<0.05	----	----
Sum of PFAS (WA DER List)	----	0.01	µg/L	<0.05	<0.05	<0.05	----	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.02	%	**80.7**	**81.8**	**80.8**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.0	----	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.346	----	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	216	----	----	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	36.3	----	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	7250	----	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	11.6	----	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.35	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	216	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	16	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	21.0	46.3	40.0	32.4	25.1
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	10	10	7	7	6
Barium	7440-39-3	10	mg/kg	40	40	20	30	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	25	30	20	23	15
Cobalt	7440-48-4	2	mg/kg	6	6	4	5	3
Copper	7440-50-8	5	mg/kg	43	42	28	24	19
Iron	7439-89-6	50	mg/kg	16400	----	----	----	----
Lead	7439-92-1	5	mg/kg	39	41	25	21	21
Manganese	7439-96-5	5	mg/kg	432	391	200	189	118

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	**11**	**13**	**8**	**10**	**7**
Silver	7440-22-4	2	mg/kg	<2	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**102**	**105**	**72**	**58**	**53**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.2**	**0.2**	**0.2**	**0.1**	**0.2**
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.88**	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	----
^ Sum of Phenols	----	0.5	mg/kg	<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	----	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	----	<10	<10	<10	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	----	<10	<10	<10	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
Toluene	108-88-3	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
^ Sum of BTEX	----	0.2	mg/kg	----	<0.2	<0.2	<0.2	----
^ Total Xylenes	1330-20-7	0.5	mg/kg	----	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	1	mg/kg	----	<1	<1	<1	----
EP090: Organotin Compounds								
Tributyltin	56573-85-4	0.5	µgSn/kg	**0.9**	----	<0.5	----	<0.5
EP231A: Perfluoroalkyl Sulfonic Acids								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EP231A: Perfluoroalkyl Sulfonic Acids - Continued								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	----	<0.001	----	<0.001
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	----	<0.0005	----	<0.0005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	----	<0.0005	----	<0.0005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	----	<0.0005	----	<0.0005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	----	<0.0005	----	<0.0005
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	<0.0002	----	<0.0002	----	<0.0002
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**85.7**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**85.1**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**75.0**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**94.0**	**95.6**	**100**	**93.6**	----
2-Chlorophenol-D4	93951-73-6	0.5	%	**88.8**	**93.8**	**98.4**	**91.8**	----
2.4.6-Tribromophenol	118-79-6	0.5	%	**84.4**	**84.3**	**89.0**	**83.3**	----

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	S3_S/20/20170719	S7_S/20/20170719	S13_S/20/20170719	S31_S/20/20170719	S15_S/20/20170719
Client sampling date / time				19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
				EM1709792-001	EM1709792-002	EM1709792-003	EM1709792-004	EM1709792-005
				Result	Result	Result	Result	Result
EP075(SIM)S: Phenolic Compound Surrogates - Continued								
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	97.9	104	109	101	----
Anthracene-d10	1719-06-8	0.5	%	109	118	124	118	----
4-Terphenyl-d14	1718-51-0	0.5	%	107	116	123	114	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	71.7	73.3	71.4	----
Toluene-D8	2037-26-5	0.2	%	----	74.2	74.2	71.7	----
4-Bromofluorobenzene	460-00-4	0.2	%	----	80.9	79.8	83.6	----
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	85.5	----	93.3	----	95.9
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	103	----	109	----	110

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	S15_S/29/20170719	S15_M/20/20170719	S23_S/20/20170719	S23_M/20/20170719	S32_S/20/20170719
Client sampling date / time				19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
				EM1709792-006	EM1709792-007	EM1709792-008	EM1709792-009	EM1709792-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	29.7	23.4	37.1	26.0	31.8
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	5	9	6	5	7
Barium	7440-39-3	10	mg/kg	10	60	20	20	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	14	29	19	15	20
Cobalt	7440-48-4	2	mg/kg	3	6	4	3	4
Copper	7440-50-8	5	mg/kg	17	19	25	19	25
Iron	7439-89-6	50	mg/kg	----	----	12400	----	----
Lead	7439-92-1	5	mg/kg	20	12	24	24	23
Manganese	7439-96-5	5	mg/kg	115	109	184	126	189
Nickel	7440-02-0	2	mg/kg	6	13	8	7	8
Silver	7440-22-4	2	mg/kg	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	50	31	70	54	70
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.1	<0.1	0.2	0.2	0.2
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	----	----	<0.5	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	----	<1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg	----	----	<0.05	----	----
gamma-BHC	58-89-9	0.05	mg/kg	----	----	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg	----	----	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg	----	----	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg	----	----	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		S15_S/29/20170719	S15_M/20/20170719	S23_S/20/20170719	S23_M/20/20170719	S32_S/20/20170719
		Client sampling date / time		19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-006	EM1709792-007	EM1709792-008	EM1709792-009	EM1709792-010
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg	----	----	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg	----	----	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	<0.05	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	----	----	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	----	----	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg	----	----	<0.2	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	----	<0.05	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	----	----	<0.05	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	----	----	<0.5	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	----	----	<0.5	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	----	----	<0.5	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	----	----	<1	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	----	----	<0.5	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	----	----	<0.5	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	----	----	<0.5	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	----	----	<0.5	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	----	----	<0.5	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	----	----	<0.5	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	----	----	<0.5	----	----
Pentachlorophenol	87-86-5	2	mg/kg	----	----	<2	----	----
^ Sum of Phenols	----	0.5	mg/kg	----	----	<0.5	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	----	----	<0.5	----	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	----	----	<0.5	----	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	----	----	<0.5	----	<0.5
Fluorene	86-73-7	0.5	mg/kg	----	----	<0.5	----	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S15_S/29/20170719	S15_M/20/20170719	S23_S/20/20170719	S23_M/20/20170719	S32_S/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-006	EM1709792-007	EM1709792-008	EM1709792-009	EM1709792-010
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Phenanthrene	85-01-8	0.5	mg/kg	----	----	<0.5	----	<0.5
Anthracene	120-12-7	0.5	mg/kg	----	----	<0.5	----	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	----	----	<0.5	----	<0.5
Pyrene	129-00-0	0.5	mg/kg	----	----	<0.5	----	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	----	----	<0.5	----	<0.5
Chrysene	218-01-9	0.5	mg/kg	----	----	<0.5	----	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	----	----	<0.5	----	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	----	----	<0.5	----	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	----	----	<0.5	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	----	----	<0.5	----	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	----	----	<0.5	----	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	----	----	<0.5	----	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	----	----	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	----	----	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	----	----	**0.6**	----	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	----	----	**1.2**	----	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	----	----	<10	----	<10
C10 - C14 Fraction	----	50	mg/kg	----	----	<50	----	<50
C15 - C28 Fraction	----	100	mg/kg	----	----	<100	----	<100
C29 - C36 Fraction	----	100	mg/kg	----	----	<100	----	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	----	----	<50	----	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	----	----	<10	----	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	----	----	<10	----	<10
>C10 - C16 Fraction	----	50	mg/kg	----	----	<50	----	<50
>C16 - C34 Fraction	----	100	mg/kg	----	----	<100	----	<100
>C34 - C40 Fraction	----	100	mg/kg	----	----	<100	----	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	----	----	<50	----	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	----	----	<50	----	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	----	----	<0.2	----	<0.2

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	S15_S/29/20170719	S15_M/20/20170719	S23_S/20/20170719	S23_M/20/20170719	S32_S/20/20170719
Client sampling date / time				19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
				EM1709792-006	EM1709792-007	EM1709792-008	EM1709792-009	EM1709792-010
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
Toluene	108-88-3	0.5	mg/kg	----	----	<0.5	----	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	----	----	<0.5	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	----	----	<0.5	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	----	----	<0.5	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	----	----	<0.2	----	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	----	----	<0.5	----	<0.5
Naphthalene	91-20-3	1	mg/kg	----	----	<1	----	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	----	----	106	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	----	----	86.9	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	----	----	89.9	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	----	----	97.3	----	98.4
2-Chlorophenol-D4	93951-73-6	0.5	%	----	----	94.1	----	95.9
2.4.6-Tribromophenol	118-79-6	0.5	%	----	----	84.7	----	88.7
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	----	----	105	----	106
Anthracene-d10	1719-06-8	0.5	%	----	----	124	----	124
4-Terphenyl-d14	1718-51-0	0.5	%	----	----	120	----	122
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	----	68.4	----	77.5
Toluene-D8	2037-26-5	0.2	%	----	----	67.8	----	79.3
4-Bromofluorobenzene	460-00-4	0.2	%	----	----	79.0	----	87.9

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S38_S/20/20170719	S40_S/20/20170719	S42_S/20/20170719	PS08/20/20170719	PS10/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-011	EM1709792-012	EM1709792-013	EM1709792-014	EM1709792-015
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.1	----	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.209	----	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	130	----	----	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	35.4	----	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	7070	----	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	11.3	----	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.21	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	130	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	10	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	37.0	32.2	21.9	49.9	46.9
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	9	6	6	9	8
Barium	7440-39-3	10	mg/kg	30	20	20	30	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	22	17	19	29	25
Cobalt	7440-48-4	2	mg/kg	5	3	4	6	5
Copper	7440-50-8	5	mg/kg	30	21	22	42	36
Lead	7439-92-1	5	mg/kg	28	25	23	34	30
Manganese	7439-96-5	5	mg/kg	288	131	170	303	244
Nickel	7440-02-0	2	mg/kg	10	7	8	11	10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S38_S/20/20170719	S40_S/20/20170719	S42_S/20/20170719	PS08/20/20170719	PS10/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-011	EM1709792-012	EM1709792-013	EM1709792-014	EM1709792-015
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	78	63	63	100	92
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.2	0.2	0.1	0.2	0.2
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.66	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	0.6	0.6	----	0.6	0.6
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	1.2	1.2	----	1.2	1.2
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	----	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	----	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	----	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	----	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	----	<10	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S38_S/20/20170719	S40_S/20/20170719	S42_S/20/20170719	PS08/20/20170719	PS10/20/20170719
			Client sampling date / time	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-011	EM1709792-012	EM1709792-013	EM1709792-014	EM1709792-015
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	----	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	----	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	----	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	----	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	----	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	----	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	----	<0.2	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	----	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	----	<1	<1
EP090: Organotin Compounds								
Tributyltin	56573-85-4	0.5	µgSn/kg	----	----	<0.5	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	----	----	<0.0002	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	----	----	<0.001	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	----	----	<0.0002	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	----	----	<0.0002	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	----	----	<0.0005	----	----

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	S38_S/20/20170719	S40_S/20/20170719	S42_S/20/20170719	PS08/20/20170719	PS10/20/20170719
Client sampling date / time				19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00	19-Jul-2017 00:00
				EM1709792-011	EM1709792-012	EM1709792-013	EM1709792-014	EM1709792-015
				Result	Result	Result	Result	Result
EP231D: (n:2) Fluorotelomer Sulfonic Acids - Continued								
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	----	----	<0.0005	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	----	----	<0.0005	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	----	----	<0.0005	----	----
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	----	----	<0.0002	----	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	----	----	<0.0002	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	92.4	97.4	----	95.8	89.6
2-Chlorophenol-D4	93951-73-6	0.5	%	88.9	93.7	----	91.9	87.0
2.4.6-Tribromophenol	118-79-6	0.5	%	84.4	93.5	----	89.4	80.8
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	104	108	----	99.3	96.4
Anthracene-d10	1719-06-8	0.5	%	118	125	----	120	112
4-Terphenyl-d14	1718-51-0	0.5	%	116	123	----	118	108
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	67.3	75.2	----	85.4	66.8
Toluene-D8	2037-26-5	0.2	%	69.8	79.7	----	89.4	66.1
4-Bromofluorobenzene	460-00-4	0.2	%	74.3	83.6	----	97.0	70.5
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	----	----	94.4	----	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	----	----	104	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS26/20/20170719	S52_S/20/20170720	S58_S/20/20170720	S66_S/20/20170720	S72_S/20/20170720
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-016	EM1709792-017	EM1709792-018	EM1709792-019	EM1709792-020
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	----	9.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	----	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	----	----	----	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	----	----	----	0.175
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	----	----	----	109
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	----	35.9
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	----	7180
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	----	11.5
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	----	1.5
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	----	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	----	<10
Liming Rate	----	1	kg CaCO3/t	----	----	----	----	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	----	0.18
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	----	109
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	----	8
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	43.6	39.6	40.6	29.7	34.4
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	10	8	7	14	6
Barium	7440-39-3	10	mg/kg	20	30	20	50	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	25	26	22	25	19
Cobalt	7440-48-4	2	mg/kg	5	5	4	7	4
Copper	7440-50-8	5	mg/kg	40	35	29	28	25
Iron	7439-89-6	50	mg/kg	17800	----	----	----	12000
Lead	7439-92-1	5	mg/kg	30	31	28	34	25
Manganese	7439-96-5	5	mg/kg	232	253	210	226	186

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS26/20/20170719	S52_S/20/20170720	S58_S/20/20170720	S66_S/20/20170720	S72_S/20/20170720
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-016	EM1709792-017	EM1709792-018	EM1709792-019	EM1709792-020
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	**10**	**11**	**9**	**14**	**8**
Silver	7440-22-4	2	mg/kg	<2	----	----	----	<2
Zinc	7440-66-6	5	mg/kg	**90**	**92**	**76**	**70**	**66**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	----	----	----	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	<1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	----	**0.61**
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS26/20/20170719	S52_S/20/20170720	S58_S/20/20170720	S66_S/20/20170720	S72_S/20/20170720
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-016	EM1709792-017	EM1709792-018	EM1709792-019	EM1709792-020
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	<0.05
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	<0.2
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	<0.05
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	<0.05
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	<1
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	<0.5
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	<0.5
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	<0.5
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	<0.5
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	<0.5
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	<0.5
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	<2
^ Sum of Phenols	----	0.5	mg/kg	<0.5	----	----	----	<0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS26/20/20170719	S52_S/20/20170720	S58_S/20/20170720	S66_S/20/20170720	S72_S/20/20170720
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-016	EM1709792-017	EM1709792-018	EM1709792-019	EM1709792-020
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	**99.3**	----	----	----	**101**
EP068S: Organochlorine Pesticide Surrogate								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS26/20/20170719	S52_S/20/20170720	S58_S/20/20170720	S66_S/20/20170720	S72_S/20/20170720
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-016	EM1709792-017	EM1709792-018	EM1709792-019	EM1709792-020
				Result	Result	Result	Result	Result
EP068S: Organochlorine Pesticide Surrogate - Continued								
Dibromo-DDE	21655-73-2	0.05	%	84.4	----	----	----	82.2
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	85.4	----	----	----	83.2
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	98.7	91.6	93.3	92.7	94.1
2-Chlorophenol-D4	93951-73-6	0.5	%	95.9	87.3	89.0	91.3	89.9
2.4.6-Tribromophenol	118-79-6	0.5	%	89.6	85.5	84.2	82.9	82.4
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	106	102	101	102	102
Anthracene-d10	1719-06-8	0.5	%	122	116	117	122	123
4-Terphenyl-d14	1718-51-0	0.5	%	120	113	115	118	117
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	64.7	55.2	58.8	64.5	56.4
Toluene-D8	2037-26-5	0.2	%	71.2	59.2	55.5	72.1	61.1
4-Bromofluorobenzene	460-00-4	0.2	%	74.3	63.2	57.2	75.1	68.2

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
Client sampling date / time				20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
				EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	----	9.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	----	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	----	----	----	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	----	----	----	0.382
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	----	----	----	238
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	----	22.2
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	----	4430
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	----	7.10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	----	1.5
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	----	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	----	<10
Liming Rate	----	1	kg CaCO3/t	----	----	----	----	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	----	0.38
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	----	238
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	----	18
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	37.4	26.6	25.8	29.0	30.1
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	7	6	6	7	7
Barium	7440-39-3	10	mg/kg	20	20	20	30	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	19	17	22	23	21
Cobalt	7440-48-4	2	mg/kg	4	3	5	5	4
Copper	7440-50-8	5	mg/kg	26	21	28	31	26
Iron	7439-89-6	50	mg/kg	----	10100	----	----	----
Lead	7439-92-1	5	mg/kg	24	21	29	31	25
Manganese	7439-96-5	5	mg/kg	185	150	198	240	180

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	8	7	10	11	9
Silver	7440-22-4	2	mg/kg	----	<2	----	----	----
Zinc	7440-66-6	5	mg/kg	66	60	71	76	70
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.1	0.1	0.2	0.2	0.2
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	----	<0.5	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	----	<1	----	----	----
EN82: Porewater Extraction								
Volume	----	1	mL	26	----	----	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	----	0.58
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	<0.1	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	<0.05	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	<0.05	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	----	<0.05	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	----	<0.05	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	----	<0.05	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	----	<0.05	----	----	----
Aldrin	309-00-2	0.05	mg/kg	----	<0.05	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	<0.05	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	<0.05	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	<0.05	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	<0.05	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	<0.05	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	----	<0.05	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	<0.05	----	----	----
Endrin	72-20-8	0.05	mg/kg	----	<0.05	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	<0.05	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	<0.05	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	<0.05	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	<0.05	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	<0.05	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	----	<0.2	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	----	<0.05	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	----	<0.2	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	----	<0.05	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	----	<0.05	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	----	<0.5	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	----	<0.5	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	----	<0.5	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	----	<1	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	----	<0.5	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	----	<0.5	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	----	<0.5	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	----	<0.5	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	----	<0.5	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	----	<0.5	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	----	<0.5	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	----	<2	----	----	----
^ Sum of Phenols	----	0.5	mg/kg	----	<0.5	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	----	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	----	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	----	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	----	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	----	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	----	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	----	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	----	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	----	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	----	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	----	<1
EP090: Organotin Compounds								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EP090: Organotin Compounds - Continued								
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	----	----	**0.9**	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	**0.0002**	----	----	<0.0002	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	----	----	<0.001	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	----	----	<0.0002	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	----	----	<0.0005	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	----	----	<0.0005	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	----	----	<0.0005	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	----	----	<0.0005	----
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	**0.0002**	----	----	<0.0002	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	**0.0002**	----	----	<0.0002	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	----	**101**	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	----	**80.0**	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	----	**82.3**	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S74_S/20/20170720	S80_S/20/20170720	S66_S/29/20170720	S56_S/20/20170720	S102_S/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-021	EM1709792-022	EM1709792-023	EM1709792-024	EM1709792-025
				Result	Result	Result	Result	Result
EP075(SIM)S: Phenolic Compound Surrogates - Continued								
Phenol-d6	13127-88-3	0.5	%	92.6	93.4	92.5	----	94.9
2-Chlorophenol-D4	93951-73-6	0.5	%	88.0	90.0	84.5	----	91.5
2.4.6-Tribromophenol	118-79-6	0.5	%	85.7	83.0	80.1	----	85.7
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	101	102	100	----	103
Anthracene-d10	1719-06-8	0.5	%	123	122	120	----	120
4-Terphenyl-d14	1718-51-0	0.5	%	118	117	115	----	116
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	81.1	53.5	55.2	----	57.6
Toluene-D8	2037-26-5	0.2	%	94.3	56.9	62.2	----	60.1
4-Bromofluorobenzene	460-00-4	0.2	%	94.6	60.1	58.9	----	65.8
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	69.9	----	----	78.3	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	96.9	----	----	97.2	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S60_S/20/20170720	S77_S/20/20170720	PS28/20/20170720	PS28/29/20170720	PS48/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-026	EM1709792-027	EM1709792-028	EM1709792-029	EM1709792-030
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.1	----	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.222	----	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	138	----	----	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	23.0	----	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	4600	----	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	7.38	----	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.22	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	138	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	10	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	32.3	36.3	42.3	48.8	49.9
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	7	9	9	9	9
Barium	7440-39-3	10	mg/kg	20	30	30	30	30
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	23	28	29	31	31
Cobalt	7440-48-4	2	mg/kg	4	6	6	6	6
Copper	7440-50-8	5	mg/kg	30	33	40	42	42
Lead	7439-92-1	5	mg/kg	27	30	33	35	35
Manganese	7439-96-5	5	mg/kg	206	238	267	287	284
Nickel	7440-02-0	2	mg/kg	9	12	12	12	12

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S60_S/20/20170720	S77_S/20/20170720	PS28/20/20170720	PS28/29/20170720	PS48/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-026	EM1709792-027	EM1709792-028	EM1709792-029	EM1709792-030
				Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued								
Zinc	7440-66-6	5	mg/kg	**81**	**87**	**104**	**110**	**109**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
EN82: Porewater Extraction								
Volume	----	1	mL	----	----	----	**50**	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.69**	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	**0.6**	**0.6**	----	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	**1.2**	**1.2**	----	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	----	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	----	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S60_S/20/20170720	S77_S/20/20170720	PS28/20/20170720	PS28/29/20170720	PS48/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-026	EM1709792-027	EM1709792-028	EM1709792-029	EM1709792-030
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	----	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	----	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	----	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	----	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	----	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	----	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	----	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	----	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	----	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	----	<1
EP090: Organotin Compounds								
Tributyltin	56573-85-4	0.5	µgSn/kg	----	----	----	**0.8**	**0.6**
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	----	----	----	**0.0003**	**0.0005**
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	----	----	----	<0.001	<0.001
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	----	----	----	<0.0002	<0.0002
EP231D: (n:2) Fluorotelomer Sulfonic Acids								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S60_S/20/20170720	S77_S/20/20170720	PS28/20/20170720	PS28/29/20170720	PS48/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-026	EM1709792-027	EM1709792-028	EM1709792-029	EM1709792-030
				Result	Result	Result	Result	Result
EP231D: (n:2) Fluorotelomer Sulfonic Acids - Continued								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	----	----	----	<0.0005	<0.0005
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	----	----	----	<0.0005	<0.0005
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	----	----	----	<0.0005	<0.0005
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	----	----	----	<0.0005	<0.0005
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	----	----	----	**0.0003**	**0.0005**
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	----	----	----	**0.0003**	**0.0005**
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	**89.2**	**92.2**	**89.7**	----	**92.4**
2-Chlorophenol-D4	93951-73-6	0.5	%	**109**	**101**	**110**	----	**108**
2.4.6-Tribromophenol	118-79-6	0.5	%	**66.2**	**63.2**	**60.5**	----	**60.2**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	**112**	**114**	**113**	----	**117**
Anthracene-d10	1719-06-8	0.5	%	**113**	**114**	**112**	----	**115**
4-Terphenyl-d14	1718-51-0	0.5	%	**120**	**127**	**122**	----	**127**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**65.3**	**52.5**	**59.3**	----	**52.4**
Toluene-D8	2037-26-5	0.2	%	**79.1**	**62.0**	**67.9**	----	**55.7**
4-Bromofluorobenzene	460-00-4	0.2	%	**74.0**	**61.0**	**65.5**	----	**60.6**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	----	----	----	**90.3**	**80.3**
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	----	----	----	**107**	**111**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS50/20/20170720	PS66/20/20170720	PS66/29/20170720	PS70/20/20170720	PS6/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-031	EM1709792-032	EM1709792-033	EM1709792-034	EM1709792-035
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	42.1	41.4	35.5	26.5	44.8
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	9	8	6	9	9
Barium	7440-39-3	10	mg/kg	30	30	20	30	30
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	28	27	22	32	24
Cobalt	7440-48-4	2	mg/kg	6	5	4	6	5
Copper	7440-50-8	5	mg/kg	40	36	29	43	32
Iron	7439-89-6	50	mg/kg	18900	----	----	----	----
Lead	7439-92-1	5	mg/kg	32	30	25	34	30
Manganese	7439-96-5	5	mg/kg	246	258	220	274	235
Nickel	7440-02-0	2	mg/kg	11	11	9	12	10
Silver	7440-22-4	2	mg/kg	<2	----	----	----	----
Zinc	7440-66-6	5	mg/kg	100	88	74	105	88
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.2	0.2	0.1	0.2	0.2
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	----	----	----	----
EN82: Porewater Extraction								
Volume	----	1	mL	54	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		PS50/20/20170720	PS66/20/20170720	PS66/29/20170720	PS70/20/20170720	PS6/20/20170720
		Client sampling date / time		20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-031	EM1709792-032	EM1709792-033	EM1709792-034	EM1709792-035
				Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued								
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	----
^ Sum of Phenols	----	0.5	mg/kg	<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS50/20/20170720	PS66/20/20170720	PS66/29/20170720	PS70/20/20170720	PS6/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-031	EM1709792-032	EM1709792-033	EM1709792-034	EM1709792-035
				Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	----	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	**0.6**	----	----	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	**1.2**	----	----	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	----	----	----	<10
C10 - C14 Fraction	----	50	mg/kg	<50	----	----	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	----	----	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	----	----	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	----	----	----	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	----	----	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	----	----	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	----	----	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	----	----	<50	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS50/20/20170720	PS66/20/20170720	PS66/29/20170720	PS70/20/20170720	PS6/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-031	EM1709792-032	EM1709792-033	EM1709792-034	EM1709792-035
				Result	Result	Result	Result	Result
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	----	----	----	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	----	----	----	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	----	----	----	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	----	----	----	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	----	----	----	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	----	----	----	<0.2
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	----	----	----	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	----	----	----	<1
EP090: Organotin Compounds								
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	----	----	----
EP231A: Perfluoroalkyl Sulfonic Acids								
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	**0.0005**	**0.0008**	----	----	----
EP231B: Perfluoroalkyl Carboxylic Acids								
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	----	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	----	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	----	----	----
EP231P: PFAS Sums								
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg	**0.0005**	**0.0008**	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PS50/20/20170720	PS66/20/20170720	PS66/29/20170720	PS70/20/20170720	PS6/20/20170720
			Client sampling date / time	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00	20-Jul-2017 00:00
Compound	CAS Number	LOR	Unit	EM1709792-031	EM1709792-032	EM1709792-033	EM1709792-034	EM1709792-035
				Result	Result	Result	Result	Result
EP231P: PFAS Sums - Continued								
Sum of PFAS (WA DER List)	----	0.0002	mg/kg	0.0005	0.0008	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	99.3	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	79.1	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	79.4	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	91.6	----	----	87.3	90.2
2-Chlorophenol-D4	93951-73-6	0.5	%	108	----	----	106	106
2.4.6-Tribromophenol	118-79-6	0.5	%	75.5	----	----	62.8	67.0
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	113	----	----	112	112
Anthracene-d10	1719-06-8	0.5	%	115	----	----	113	113
4-Terphenyl-d14	1718-51-0	0.5	%	127	----	----	121	124
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	85.5	----	----	----	104
Toluene-D8	2037-26-5	0.2	%	93.2	----	----	----	113
4-Bromofluorobenzene	460-00-4	0.2	%	91.2	----	----	----	114
EP090S: Organotin Surrogate								
Tripropyltin	----	0.5	%	87.7	46.2	----	----	----
EP231S: PFAS Surrogate								
13C4-PFOS	----	0.0002	%	93.3	113	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S3_S/20/20170719 Volatiles	PS70/20/20170720 Volatiles	----	----	----
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1709792-038	EM1709792-039	--------	--------	--------
				Result	Result	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**56.0**	**52.0**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	----	----
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	----	----	----
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**68.1**	**67.0**	----	----	----
Toluene-D8	2037-26-5	0.2	%	**74.4**	**73.5**	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	**78.9**	**77.8**	----	----	----

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	RB01/67/20170719	RB02/67/20170720	----	----	----
			Client sampling date / time	19-Jul-2017 00:00	20-Jul-2017 00:00	----	----	----
				EM1709792-036	EM1709792-037	--------	--------	--------
				Result	Result	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----

Surrogate Control Limits

Sub-Matrix: **PORE WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP231S: PFAS Surrogate			
13C4-PFOS	----	60	130

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	36	140
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	38	128
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	33	139
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	54	125
2-Chlorophenol-D4	93951-73-6	65	123
2.4.6-Tribromophenol	118-79-6	34	122
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	61	125
Anthracene-d10	1719-06-8	62	130
4-Terphenyl-d14	1718-51-0	67	133
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	51	125
Toluene-D8	2037-26-5	55	125
4-Bromofluorobenzene	460-00-4	56	124
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP231S: PFAS Surrogate			
13C4-PFOS	----	70	130

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1709792**	Page	: 1 of 28
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Contact	: Bronwyn Sheen
Address	: 118 FRANKLIN ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 8862 3500	Telephone	: +61-3-8549 9636
Project	: 1783241	Date Samples Received	: 25-Jul-2017
Order number	: 1783241	Date Analysis Commenced	: 26-Jul-2017
C-O-C number	: ----	Issue Date	: 02-Aug-2017
Sampler	: AS		
Site	: Port River		
Quote number	: EN/002/16 v2		
No. of samples received	: 39		
No. of samples analysed	: 39		

NATA

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD
Xing Lin	Senior Organic Chemist	Melbourne Organics, Springvale, VIC

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates 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%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA033-A: Actual Acidity (QC Lot: 1025678)									
EB1715167-001	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	8.4	8.5	1.18	0% - 20%
EB1715511-001	Anonymous	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	8.9	9.0	1.12	0% - 20%
EA033-B: Potential Acidity (QC Lot: 1025678)									
EB1715167-001	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.005	<0.005	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EB1715511-001	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.007	0.008	22.2	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 1025678)									
EB1715167-001	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	1.46	1.42	2.79	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.47	0.46	2.79	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	292	284	2.79	0% - 20%
EB1715511-001	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	7.45	7.44	0.00	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	2.38	2.38	0.00	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	1490	1490	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1017636)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1017636) - continued									
EM1709792-001	S3_S/20/20170719	EA055: Moisture Content	----	1	%	21.0	21.0	0.00	0% - 20%
EM1709792-011	S38_S/20/20170719	EA055: Moisture Content	----	1	%	37.0	37.4	1.32	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1017637)									
EM1709792-021	S74_S/20/20170720	EA055: Moisture Content	----	1	%	37.4	37.8	0.954	0% - 20%
EM1709792-031	PS50/20/20170720	EA055: Moisture Content	----	1	%	42.1	42.1	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1026028)									
EM1709792-038	S3_S/20/20170719 Volatiles	EA055: Moisture Content	----	1	%	56.0	56.0	0.00	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 1020728)									
EM1709792-001	S3_S/20/20170719	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	40	40	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	25	30	20.4	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	6	6	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	11	13	20.0	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	10	10	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	43	47	8.29	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	39	40	4.60	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	432	484	11.3	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	102	111	8.50	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	16400	16400	0.149	0% - 20%
EM1709792-010	S32_S/20/20170719	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	20	20	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	20	20	0.00	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	4	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	8	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	7	8	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	25	26	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	23	23	0.00	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	189	185	2.34	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	70	68	3.21	0% - 50%
		EG005T: Iron	7439-89-6	50	mg/kg	13700	15900	14.6	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 1020729)									
EM1709792-021	S74_S/20/20170720	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	20	20	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005T: Total Metals by ICP-AES (QC Lot: 1020729) - continued									
EM1709792-021	S74_S/20/20170720	EG005T: Chromium	7440-47-3	2	mg/kg	19	19	0.00	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	4	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	8	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	7	7	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	26	25	4.98	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	24	24	0.00	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	185	177	4.72	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	66	66	0.00	0% - 50%
		EG005T: Iron	7439-89-6	50	mg/kg	12500	12000	3.87	0% - 20%
EM1709792-030	PS48/20/20170720	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	30	30	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	31	32	6.03	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	6	6	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	12	13	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	9	10	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	42	45	5.78	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	35	37	6.50	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	284	306	7.52	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	109	117	7.18	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	21000	22400	6.10	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1020727)									
EM1709792-001	S3_S/20/20170719	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.2	0.2	0.00	No Limit
EM1709792-010	S32_S/20/20170719	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.2	0.1	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1020730)									
EM1709792-021	S74_S/20/20170720	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.1	0.2	0.00	No Limit
EM1709792-030	PS48/20/20170720	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.2	0.2	0.00	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 1023617)									
EM1709784-001	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1709884-001	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1025874)									
EM1709784-001	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EM1709884-001	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 1025815)									
EB1714696-001	Anonymous	EP003: Total Organic Carbon	----	0.02	%	2.48	2.40	3.28	0% - 20%
EB1715424-002	Anonymous	EP003: Total Organic Carbon	----	0.02	%	5.34	5.32	0.505	0% - 20%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 1025816)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 1025816) - continued									
EM1709792-011	S38_S/20/20170719	EP003: Total Organic Carbon	----	0.02	%	0.66	0.67	1.73	0% - 20%
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 1020686)									
EM1709792-001	S3_S/20/20170719	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 1022382)									
EM1709792-031	PS50/20/20170720	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 1020689)									
EM1709792-001	S3_S/20/20170719	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 1022383)									
EM1709792-031	PS50/20/20170720	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP068A: Organochlorine Pesticides (OC) (QC Lot: 1022383) - continued									
EM1709792-031	PS50/20/20170720	EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 1020688)									
EM1709792-016	PS26/20/20170719	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EM1709792-001	S3_S/20/20170719	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 1022380)									
EM1709793-042	Anonymous	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075(SIM)A: Phenolic Compounds (QC Lot: 1022380) - continued									
EM1709793-042	Anonymous	EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EM1709792-031	PS50/20/20170720	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1020688)									
EM1709792-016	PS26/20/20170719	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1709792-001	S3_S/20/20170719	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1020688) - continued									
EM1709792-001	S3_S/20/20170719	EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1022380)									
EM1709793-042	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1709792-031	PS50/20/20170720	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 1022380) - continued									
EM1709792-031	PS50/20/20170720	EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1017503)									
EM1709792-001	S3_S/20/20170719	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EM1709818-002	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1017506)									
EM1709792-016	PS26/20/20170719	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EM1709792-027	S77_S/20/20170720	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1020687)									
EM1709792-016	PS26/20/20170719	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1709792-001	S3_S/20/20170719	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1022381)									
EM1709793-042	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1709792-031	PS50/20/20170720	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 1026051)									
EM1709792-038	S3_S/20/20170719 Volatiles	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1017503)									
EM1709792-001	S3_S/20/20170719	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1017503) - continued									
EM1709818-002	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1017506)									
EM1709792-016	PS26/20/20170719	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EM1709792-027	S77_S/20/20170720	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1020687)									
EM1709792-016	PS26/20/20170719	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1709792-001	S3_S/20/20170719	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1022381)									
EM1709793-042	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EM1709792-031	PS50/20/20170720	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.00	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.00	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 1026051)									
EM1709792-038	S3_S/20/20170719 Volatiles	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.00	No Limit
EP080: BTEXN (QC Lot: 1017503)									
EM1709792-001	S3_S/20/20170719	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EM1709818-002	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP080: BTEXN (QC Lot: 1017503) - continued									
EM1709818-002	Anonymous	EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP080: BTEXN (QC Lot: 1017506)									
EM1709792-016	PS26/20/20170719	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EM1709792-027	S77_S/20/20170720	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP080: BTEXN (QC Lot: 1026051)									
EM1709792-038	S3_S/20/20170719 Volatiles	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.00	No Limit
EP090: Organotin Compounds (QC Lot: 1020236)									
EM1709792-001	S3_S/20/20170719	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	0.9	0.9	0.00	No Limit
EP090: Organotin Compounds (QC Lot: 1025346)									
EM1709792-029	PS28/29/20170720	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	0.8	0.8	0.00	No Limit
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 1022115)									
EB1715147-001	Anonymous	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	0.0004	0.0004	0.00	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	0.0068	0.0067	0.00	0% - 20%
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	0.267	0.243	9.20	0% - 20%
EM1709792-021	S74_S/20/20170720	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	0.0002	0.0003	0.00	No Limit
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 1022115)									
EB1715147-001	Anonymous	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	0.0007	0.0008	0.00	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	0.0019	0.0019	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 1022115) - continued									
EB1715147-001	Anonymous	EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	0.0005	0.0006	0.00	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	0.0036	0.0034	5.81	0% - 50%
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.00	No Limit
EM1709792-021	S74_S/20/20170720	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	0.00	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.00	No Limit
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QC Lot: 1022115)									
EB1715147-001	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
EM1709792-021	S74_S/20/20170720	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1017102)									
EM1709775-005	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.002	0.003	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
EM1709792-036	RB01/67/20170719	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1017102) - continued									
EM1709792-036	RB01/67/20170719	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.002	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1019803)									
EM1709830-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.021	0.022	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.100	0.099	1.34	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.037	0.037	0.00	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.095	0.099	3.78	0% - 50%
EM1709830-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.077	0.079	3.08	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.003	0.004	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.007	0.007	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.319	0.328	2.73	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.014	0.014	0.00	0% - 50%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.035	0.034	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1022090)									
EB1715388-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	3.57	3.74	4.56	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.002	0.003	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1022090) - continued									
EB1715388-003	Anonymous	EG020A-F: Copper	7440-50-8	0.001	mg/L	0.004	0.005	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	2.43	2.54	4.50	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.014	0.015	0.00	0% - 50%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.020	0.017	14.8	No Limit
EM1709792-029	PS28/29/20170720	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.024	0.023	7.94	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.020	0.019	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.010	0.008	21.4	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.017	0.015	15.1	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.017	0.016	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.936	0.925	1.20	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.049	0.048	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1017100)									
EM1709775-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1709755-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1019802)									
EM1709845-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1709830-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1022088)									
EM1709792-021	S74_S/20/20170720	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1715281-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.1 µg/L	<0.0001	0.00	No Limit
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 1024877)									
EB1715257-003	Anonymous	EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.02	µg/L	<0.02	<0.02	0.00	No Limit
ES1718711-003	Anonymous	EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.02	µg/L	<0.02	<0.02	0.00	No Limit
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 1024877)									
EB1715257-003	Anonymous	EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.01	µg/L	<0.01	<0.01	0.00	No Limit
		EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.1	µg/L	<0.1	<0.1	0.00	No Limit
ES1718711-003	Anonymous	EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.01	µg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 1024877) - continued									
ES1718711-003	Anonymous	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02	µg/L	<0.02	<0.02	0.00	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.1	µg/L	<0.1	<0.1	0.00	No Limit
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QC Lot: 1024877)									
EB1715257-003	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.05	µg/L	<0.05	<0.05	0.00	No Limit
ES1718711-003	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.05	µg/L	<0.05	<0.05	0.00	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.05	µg/L	<0.05	<0.05	0.00	No Limit

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

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 parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA033-A: Actual Acidity (QCLot: 1025678)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.2 pH Unit	97.6	70	130
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	56 mole H+ / t	102	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 1025678)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.25483 % S	95.4	70	130
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 1025678)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	99.8	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EG005T: Total Metals by ICP-AES (QCLot: 1020728)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	96.2	79	113
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	94.4	79	110
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	105	85	120
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	92.0	85	109
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	95.4	83	109
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	102	78	112
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	94.2	78	108
EG005T: Iron	7439-89-6	50	mg/kg	<50	8400 mg/kg	93.0	90	110
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	92.9	78	106
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	99.9	82	107
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	95.3	82	111
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	93.7	80	108
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	96.0	82	111
EG005T: Total Metals by ICP-AES (QCLot: 1020729)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	98.6	79	113
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	99.2	79	110
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	109	85	120
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	95.6	85	109
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	100.0	83	109
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	107	78	112
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	97.8	78	108
EG005T: Iron	7439-89-6	50	mg/kg	<50	8400 mg/kg	98.7	90	110
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	96.0	78	106

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EG005T: Total Metals by ICP-AES (QCLot: 1020729) - continued								
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	104	82	107
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	99.2	82	111
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	80.3	80	108
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	99.6	82	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1020727)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	85.3	77	104
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1020730)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	86.2	77	104
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1023617)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	91.8	80	120
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1025874)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	94.8	80	110
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 1025815)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	100 %	100	70	130
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 1025816)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	100 %	101	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1020686)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	92.3	55	135
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1022382)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	80.9	55	135
EP068A: Organochlorine Pesticides (OC) (QCLot: 1020689)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	95.4	45	131
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	96.3	45	125
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	87.6	46	134
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	101	49	133
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	97.4	52	128
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	93.4	48	128
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	100	52	128
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	103	52	130
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	101	51	131
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	57	135
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	104	51	131
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	99.7	51	131
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	103	51	131
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	95.3	41	131
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	101	52	132
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	92.7	50	134

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 1020689) - continued								
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	96.1	49	130
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	97.3	50	132
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	90.2	38	140
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	95.6	64	132
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	85.2	41	141
EP068A: Organochlorine Pesticides (OC) (QCLot: 1022383)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	88.6	45	131
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	85.2	45	125
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	108	46	134
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	108	49	133
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	96.0	52	128
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	99.5	48	128
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	92.1	52	128
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	92.4	52	130
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	92.1	51	131
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	57	135
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	91.5	51	131
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	93.4	51	131
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	98.7	51	131
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	91.5	41	131
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	99.9	52	132
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	105	50	134
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	100	49	130
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	110	50	132
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	60.7	38	140
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	97.0	64	132
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	68.1	41	141
EP075(SIM)A: Phenolic Compounds (QCLot: 1020688)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	3 mg/kg	108	65	125
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	3 mg/kg	108	74	124
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	3 mg/kg	109	76	123
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	6 mg/kg	110	70	123
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	3 mg/kg	74.2	56	120
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	3 mg/kg	108	66	125
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	3 mg/kg	105	61	120
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	3 mg/kg	110	70	123
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	3 mg/kg	104	57	122
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	3 mg/kg	96.9	54	120
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	3 mg/kg	106	57	119

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075(SIM)A: Phenolic Compounds (QCLot: 1020688) - continued								
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	6 mg/kg	55.8	20	112
EP075(SIM)A: Phenolic Compounds (QCLot: 1022380)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	3 mg/kg	110	65	125
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	3 mg/kg	116	74	124
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	3 mg/kg	109	76	123
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	6 mg/kg	112	70	123
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	3 mg/kg	76.8	56	120
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	3 mg/kg	107	66	125
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	3 mg/kg	106	61	120
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	3 mg/kg	118	70	123
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	3 mg/kg	106	57	122
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	3 mg/kg	85.8	54	120
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	3 mg/kg	115	57	119
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	6 mg/kg	48.7	20	112
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1020688)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	3 mg/kg	108	80	121
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	3 mg/kg	108	70	130
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	3 mg/kg	110	80	120
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	3 mg/kg	106	70	124
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	3 mg/kg	112	80	122
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	3 mg/kg	120	80	126
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	3 mg/kg	114	70	128
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	3 mg/kg	116	80	125
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	3 mg/kg	111	70	130
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	3 mg/kg	118	80	126
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	3 mg/kg	99.8	70	124
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	3 mg/kg	110	75	125
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	3 mg/kg	96.6	65	125
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	3 mg/kg	76.3	65	128
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	3 mg/kg	74.7	65	126
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	3 mg/kg	75.1	65	127
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1022380)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	3 mg/kg	120	80	121
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	3 mg/kg	113	70	130
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	3 mg/kg	120	80	120
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	3 mg/kg	117	70	124
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	3 mg/kg	111	80	122

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1022380) - continued								
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	3 mg/kg	120	80	126
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	3 mg/kg	112	70	128
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	3 mg/kg	119	80	125
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	3 mg/kg	118	70	130
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	3 mg/kg	118	80	126
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	3 mg/kg	111	70	124
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	3 mg/kg	117	75	125
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	3 mg/kg	108	65	125
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	3 mg/kg	93.0	65	128
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	3 mg/kg	92.8	65	126
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	3 mg/kg	92.7	65	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1017503)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	101	70	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1017506)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	107	70	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1020687)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	837 mg/kg	97.0	65	131
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	3061 mg/kg	100	70	126
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	1592 mg/kg	102	70	122
EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1022381)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	837 mg/kg	96.1	65	131
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	3061 mg/kg	92.2	70	126
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	1592 mg/kg	90.6	70	122
EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1026051)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	101	70	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1017503)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	45 mg/kg	97.3	68	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1017506)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	45 mg/kg	102	68	125
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1020687)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1222 mg/kg	92.7	68	130
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	3919 mg/kg	101	72	116
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	316 mg/kg	98.1	38	132
EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1022381)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1222 mg/kg	94.0	68	130
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	3919 mg/kg	93.4	72	116
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	316 mg/kg	90.9	38	132
EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1026051)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	45 mg/kg	97.3	68	125
EP080: BTEXN (QCLot: 1017503)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	97.7	74	124
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	106	77	125
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	94.6	73	125
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	100	77	128
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	102	81	128
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	104	66	130
EP080: BTEXN (QCLot: 1017506)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	101	74	124
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	112	77	125
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	106	73	125
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	110	77	128
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	109	81	128
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	97.3	66	130
EP080: BTEXN (QCLot: 1026051)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	97.7	74	124
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	106	77	125
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	94.6	73	125
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	100	77	128
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	102	81	128
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	104	66	130
EP090: Organotin Compounds (QCLot: 1020236)								
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	101	52	139
EP090: Organotin Compounds (QCLot: 1025346)								
EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	1.25 µgSn/kg	98.0	52	139
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 1022115)								
EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	0.00125 mg/kg	69.1	57	121
EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	0.00125 mg/kg	72.5	52	126
EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	87.0	55	127

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 1022115)								
EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	0.00625 mg/kg	84.2	52	128
EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	0.00125 mg/kg	74.1	54	129
EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	0.00125 mg/kg	92.3	58	127
EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	0.00125 mg/kg	74.7	57	128
EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	104	60	134
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 1022115)								
EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	0.00125 mg/kg	65.4	54	130
EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	0.00125 mg/kg	121	61	130
EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	0.00125 mg/kg	87.7	62	130
EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	0.00125 mg/kg	118	60	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1017102)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.7	91	107
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	102	82	113
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	92.5	84	106
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	91.4	84	104
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	88.4	83	103
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	91.6	83	106
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	89.2	82	103
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	92.3	83	105
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.0	83	105
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	91.1	82	106
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	93.1	85	109
EG020F: Dissolved Metals by ICP-MS (QCLot: 1019803)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	95.2	91	107
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	104	82	113
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	95.5	84	106
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	91.0	84	104
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	88.2	83	103
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	92.0	83	106
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	91.1	82	103
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.0	83	105
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	91.3	83	105
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	90.4	82	106
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	95.4	85	109
EG020F: Dissolved Metals by ICP-MS (QCLot: 1022090)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1022090) - continued								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	93.7	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.4	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	96.6	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.0	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.5	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	96.6	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	96.3	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	101	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	92.3	89	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	92.8	89	113
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	94.4	87	113
EG035F: Dissolved Mercury by FIMS (QCLot: 1017100)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	88.5	81	114
EG035F: Dissolved Mercury by FIMS (QCLot: 1019802)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	92.6	81	114
EG035F: Dissolved Mercury by FIMS (QCLot: 1022088)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	109	84	118
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 1024877)								
EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.02	µg/L	<0.02	0.5 µg/L	70.2	70	130
EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.02	µg/L	<0.02	0.5 µg/L	71.0	70	130
EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.01	µg/L	<0.01	0.5 µg/L	81.8	70	130
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 1024877)								
EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.1	µg/L	<0.1	2.5 µg/L	107	70	130
EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.02	µg/L	<0.02	0.5 µg/L	89.0	70	130
EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.02	µg/L	<0.02	0.5 µg/L	84.2	70	130
EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02	µg/L	<0.02	0.5 µg/L	105	70	130
EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.01	µg/L	<0.01	0.5 µg/L	91.8	70	130
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 1024877)								
EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.05	µg/L	<0.05	0.5 µg/L	98.6	70	130
EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.05	µg/L	<0.05	0.5 µg/L	86.2	70	130
EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.05	µg/L	<0.05	0.5 µg/L	81.0	70	130
EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.05	µg/L	<0.05	0.5 µg/L	77.2	70	130

Matrix Spike (MS) Report

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 parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Matrix Spike (MS) Report

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1020728)							
EM1709792-002	S7_S/20/20170719	EG005T: Arsenic	7440-38-2	50 mg/kg	107	78	124
		EG005T: Barium	7440-39-3	50 mg/kg	103	71	135
		EG005T: Beryllium	7440-41-7	50 mg/kg	109	85	125
		EG005T: Cadmium	7440-43-9	50 mg/kg	102	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	105	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	114	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	103	76	124
		EG005T: Manganese	7439-96-5	50 mg/kg	73.7	68	136
		EG005T: Nickel	7440-02-0	50 mg/kg	99.4	78	120
		EG005T: Zinc	7440-66-6	50 mg/kg	99.2	74	128
EG005T: Total Metals by ICP-AES (QCLot: 1020729)							
EM1709792-022	S80_S/20/20170720	EG005T: Arsenic	7440-38-2	50 mg/kg	106	78	124
		EG005T: Barium	7440-39-3	50 mg/kg	106	71	135
		EG005T: Beryllium	7440-41-7	50 mg/kg	110	85	125
		EG005T: Cadmium	7440-43-9	50 mg/kg	102	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	105	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	112	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	102	76	124
		EG005T: Manganese	7439-96-5	50 mg/kg	107	68	136
		EG005T: Nickel	7440-02-0	50 mg/kg	99.8	78	120
		EG005T: Zinc	7440-66-6	50 mg/kg	96.9	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1020727)							
EM1709792-002	S7_S/20/20170719	EG035T: Mercury	7439-97-6	5 mg/kg	85.1	76	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1020730)							
EM1709792-022	S80_S/20/20170720	EG035T: Mercury	7439-97-6	5 mg/kg	87.8	76	116
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 1023617)							
EM1709784-002	Anonymous	EG048G: Hexavalent Chromium	18540-29-9	40 mg/kg	# 47.7	58	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1025874)							
EM1709784-002	Anonymous	EK026SF: Total Cyanide	57-12-5	20 mg/kg	96.6	77	113
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 1020686)							
EM1709792-008	S23_S/20/20170719	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	82.4	44	144
EP068A: Organochlorine Pesticides (OC) (QCLot: 1020689)							
EM1709792-008	S23_S/20/20170719	EP068: gamma-BHC	58-89-9	0.5 mg/kg	80.1	22	139
		EP068: Heptachlor	76-44-8	0.5 mg/kg	42.8	18	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	30.6	23	136
		EP068: Dieldrin	60-57-1	0.5 mg/kg	105	42	136
		EP068: Endrin	72-20-8	0.5 mg/kg	71.1	23	146

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 1020689) - continued							
EM1709792-008	S23_S/20/20170719	EP068: 4.4`-DDT	50-29-3	0.5 mg/kg	29.8	20	133
EP075(SIM)A: Phenolic Compounds (QCLot: 1020688)							
EM1709792-002	S7_S/20/20170719	EP075(SIM): Phenol	108-95-2	3 mg/kg	97.9	63	117
		EP075(SIM): 2-Chlorophenol	95-57-8	3 mg/kg	94.0	65	123
		EP075(SIM): 2-Nitrophenol	88-75-5	3 mg/kg	55.7	40	134
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	3 mg/kg	89.2	56	122
		EP075(SIM): Pentachlorophenol	87-86-5	3 mg/kg	68.7	15	139
EP075(SIM)A: Phenolic Compounds (QCLot: 1022380)							
EM1709792-027	S77_S/20/20170720	EP075(SIM): Phenol	108-95-2	3 mg/kg	93.4	63	117
		EP075(SIM): 2-Chlorophenol	95-57-8	3 mg/kg	96.2	65	123
		EP075(SIM): 2-Nitrophenol	88-75-5	3 mg/kg	71.7	40	134
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	3 mg/kg	69.5	56	122
		EP075(SIM): Pentachlorophenol	87-86-5	3 mg/kg	39.3	15	139
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1020688)							
EM1709792-002	S7_S/20/20170719	EP075(SIM): Acenaphthene	83-32-9	3 mg/kg	95.4	67	117
		EP075(SIM): Pyrene	129-00-0	3 mg/kg	103	52	148
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 1022380)							
EM1709792-027	S77_S/20/20170720	EP075(SIM): Acenaphthene	83-32-9	3 mg/kg	91.8	67	117
		EP075(SIM): Pyrene	129-00-0	3 mg/kg	113	52	148
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1017503)							
EM1709792-002	S7_S/20/20170719	EP080: C6 - C9 Fraction	----	28 mg/kg	77.5	42	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1017506)							
EM1709792-017	S52_S/20/20170720	EP080: C6 - C9 Fraction	----	28 mg/kg	66.6	42	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1020687)							
EM1709792-003	S13_S/20/20170719	EP071: C10 - C14 Fraction	----	837 mg/kg	94.2	53	123
		EP071: C15 - C28 Fraction	----	3061 mg/kg	98.1	70	124
		EP071: C29 - C36 Fraction	----	1592 mg/kg	100	64	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 1022381)							
EM1709792-028	PS28/20/20170720	EP071: C10 - C14 Fraction	----	837 mg/kg	97.8	53	123
		EP071: C15 - C28 Fraction	----	3061 mg/kg	94.0	70	124
		EP071: C29 - C36 Fraction	----	1592 mg/kg	92.5	64	118
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1017503)							
EM1709792-002	S7_S/20/20170719	EP080: C6 - C10 Fraction	C6_C10	33 mg/kg	74.8	39	129
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1017506)							
EM1709792-017	S52_S/20/20170720	EP080: C6 - C10 Fraction	C6_C10	33 mg/kg	62.5	39	129

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1020687)							
EM1709792-003	S13_S/20/20170719	EP071: >C10 - C16 Fraction	----	1222 mg/kg	90.2	65	123
		EP071: >C16 - C34 Fraction	----	3919 mg/kg	99.3	67	121
		EP071: >C34 - C40 Fraction	----	316 mg/kg	98.0	44	126
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 1022381)							
EM1709792-028	PS28/20/20170720	EP071: >C10 - C16 Fraction	----	1222 mg/kg	95.9	65	123
		EP071: >C16 - C34 Fraction	----	3919 mg/kg	95.3	67	121
		EP071: >C34 - C40 Fraction	----	316 mg/kg	90.9	44	126
EP080: BTEXN (QCLot: 1017503)							
EM1709792-002	S7_S/20/20170719	EP080: Benzene	71-43-2	2 mg/kg	89.0	50	136
		EP080: Toluene	108-88-3	2 mg/kg	89.6	56	139
EP080: BTEXN (QCLot: 1017506)							
EM1709792-017	S52_S/20/20170720	EP080: Benzene	71-43-2	2 mg/kg	74.6	50	136
		EP080: Toluene	108-88-3	2 mg/kg	84.0	56	139
EP090: Organotin Compounds (QCLot: 1020236)							
EM1709792-003	S13_S/20/20170719	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	57.6	20	130
EP090: Organotin Compounds (QCLot: 1025346)							
EM1709792-031	PS50/20/20170720	EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	117	20	130
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 1022115)							
EB1715147-001	Anonymous	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.00125 mg/kg	53.5	50	130
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.00125 mg/kg	# Not Determined	50	130
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.00125 mg/kg	# Not Determined	50	130
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 1022115)							
EB1715147-001	Anonymous	EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.00625 mg/kg	70.6	30	130
		EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.00125 mg/kg	102	50	130
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.00125 mg/kg	95.0	50	130
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.00125 mg/kg	69.1	50	130
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.00125 mg/kg	58.9	50	130
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 1022115)							
EB1715147-001	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.00125 mg/kg	58.6	50	130
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.00125 mg/kg	105	50	130
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.00125 mg/kg	108	50	130
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.00125 mg/kg	106	50	130

Matrix Spike (MS) Report

Sub-Matrix: **WATER**

Spike	SpikeRecovery(%)	Recovery Limits (%)

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1017102)							
EM1709775-005	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	85.8	85	131
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	102	73	141
		EG020A-F: Barium	7440-39-3	0.2 mg/L	87.3	75	127
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	86.8	81	133
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	86.1	71	135
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	87.1	78	132
		EG020A-F: Copper	7440-50-8	0.2 mg/L	84.2	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	88.7	75	133
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	87.3	64	134
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	85.4	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	87.3	75	131
EG020F: Dissolved Metals by ICP-MS (QCLot: 1019803)							
EM1709830-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	103	85	131
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	100	73	141
		EG020A-F: Barium	7440-39-3	0.2 mg/L	100	75	127
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	89.8	81	133
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	89.2	71	135
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	97.9	78	132
		EG020A-F: Copper	7440-50-8	0.2 mg/L	90.8	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	90.9	75	133
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	94.7	64	134
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	91.5	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	93.5	75	131
EG020F: Dissolved Metals by ICP-MS (QCLot: 1022090)							
EB1715388-004	Anonymous	EG020A-F: Arsenic	7440-38-2	0.1 mg/L	102	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	98.5	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	123	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	98.3	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	93.8	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	95.0	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	92.3	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	99.4	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	# Not Determined	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	91.9	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	99.4	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 1017100)							
EM1709755-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	82.4	70	120

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low	High
EG035F: Dissolved Mercury by FIMS (QCLot: 1019802)							
EM1709830-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	70.2	70	120
EG035F: Dissolved Mercury by FIMS (QCLot: 1022088)							
EB1715289-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	84.0	70	130
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 1024877)							
EB1715257-003	Anonymous	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.5 µg/L	69.0	50	130
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.5 µg/L	85.2	50	130
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.5 µg/L	91.2	50	130
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 1024877)							
EB1715257-003	Anonymous	EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	2.5 µg/L	84.0	50	130
		EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.5 µg/L	111	50	130
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.5 µg/L	87.0	50	130
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.5 µg/L	102	50	130
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.5 µg/L	87.2	50	130
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 1024877)							
EB1715257-003	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.5 µg/L	107	50	130
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.5 µg/L	94.8	50	130
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.5 µg/L	88.2	50	130
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.5 µg/L	76.8	50	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1709792**	Page	: 1 of 17
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Melbourne
Contact	: GOLDER CONTACT	Telephone	: +61-3-8549 9636
Project	: 1783241	Date Samples Received	: 25-Jul-2017
Site	: Port River	Issue Date	: 02-Aug-2017
Sampler	: AS	No. of samples received	: 39
Order number	: 1783241	No. of samples analysed	: 39

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

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

Summary of Outliers

Outliers : Quality Control Samples

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

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

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

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG048: Hexavalent Chromium (Alkaline Digest)	EM1709784--002	Anonymous	**Hexavalent Chromium**	18540-29-9	47.7 %	58-114%	**Recovery less than lower data quality objective**
EP231A: Perfluoroalkyl Sulfonic Acids	EB1715147--001	Anonymous	**Perfluorohexane sulfonic acid (PFHxS)**	355-46-4	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EP231A: Perfluoroalkyl Sulfonic Acids	EB1715147--001	Anonymous	**Perfluorooctane sulfonic acid (PFOS)**	1763-23-1	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG020F: Dissolved Metals by ICP-MS	EB1715388--004	Anonymous	**Manganese**	7439-96-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Control Samples (LCS)					
Hexavalent Chromium by Alkaline Digestion and DA Finish	1	20	5.00	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

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

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

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

Matrix: **SOIL**

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

Method		*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)			*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EA033-A: Actual Acidity								
Snap Lock Bag - frozen (EA033) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**01-Aug-2017**	19-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
Snap Lock Bag - frozen (EA033) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**01-Aug-2017**	20-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity								
Snap Lock Bag - frozen (EA033) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**01-Aug-2017**	19-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
Snap Lock Bag - frozen (EA033) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**01-Aug-2017**	20-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
EA033-C: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA033) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**01-Aug-2017**	19-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
Snap Lock Bag - frozen (EA033) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**01-Aug-2017**	20-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
EA033-D: Retained Acidity								
Snap Lock Bag - frozen (EA033) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**01-Aug-2017**	19-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
Snap Lock Bag - frozen (EA033) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**01-Aug-2017**	20-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**01-Aug-2017**	19-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓
Snap Lock Bag - frozen (EA033) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**01-Aug-2017**	20-Jul-2018	✓	**01-Aug-2017**	30-Oct-2017	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
S3_S/20/20170719,	S7_S/20/20170719,	**19-Jul-2017**	**----**	----	----	**26-Jul-2017**	02-Aug-2017	✓
S13_S/20/20170719,	S31_S/20/20170719,							
S15_S/20/20170719,	S15_S/29/20170719,							
S15_M/20/20170719,	S23_S/20/20170719,							
S23_M/20/20170719,	S32_S/20/20170719,							
S38_S/20/20170719,	S40_S/20/20170719,							
S42_S/20/20170719,	PS08/20/20170719,							
PS10/20/20170719,	PS26/20/20170719							
Soil Glass Jar - Unpreserved (EA055)								
S3_S/20/20170719 - Volatiles		**19-Jul-2017**	**----**	----	----	**31-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EA055)								
S52_S/20/20170720,	S58_S/20/20170720,	**20-Jul-2017**	**----**	----	----	**26-Jul-2017**	03-Aug-2017	✓
S66_S/20/20170720,	S72_S/20/20170720,							
S74_S/20/20170720,	S80_S/20/20170720,							
S66_S/29/20170720,	S56_S/20/20170720,							
S102_S/20/20170720,	S60_S/20/20170720,							
S77_S/20/20170720,	PS28/20/20170720,							
PS28/29/20170720,	PS48/20/20170720,							
PS50/20/20170720,	PS66/20/20170720,							
PS66/29/20170720,	PS70/20/20170720,							
PS6/20/20170720								
Soil Glass Jar - Unpreserved (EA055)								
PS70/20/20170720 - Volatiles		**20-Jul-2017**	**----**	----	----	**31-Jul-2017**	03-Aug-2017	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG005T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
S3_S/20/20170719,	S7_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	15-Jan-2018	✓	**31-Jul-2017**	15-Jan-2018	✓
S13_S/20/20170719,	S31_S/20/20170719,							
S15_S/20/20170719,	S15_S/29/20170719,							
S15_M/20/20170719,	S23_S/20/20170719,							
S23_M/20/20170719,	S32_S/20/20170719,							
S38_S/20/20170719,	S40_S/20/20170719,							
S42_S/20/20170719,	PS08/20/20170719,							
PS10/20/20170719,	PS26/20/20170719							
Soil Glass Jar - Unpreserved (EG005T)								
S52_S/20/20170720,	S58_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	16-Jan-2018	✓	**31-Jul-2017**	16-Jan-2018	✓
S66_S/20/20170720,	S72_S/20/20170720,							
S74_S/20/20170720,	S80_S/20/20170720,							
S66_S/29/20170720,	S56_S/20/20170720,							
S102_S/20/20170720,	S60_S/20/20170720,							
S77_S/20/20170720,	PS28/20/20170720,							
PS28/29/20170720,	PS48/20/20170720,							
PS50/20/20170720,	PS66/20/20170720,							
PS66/29/20170720,	PS70/20/20170720,							
PS6/20/20170720								
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
S3_S/20/20170719,	S7_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	16-Aug-2017	✓	**31-Jul-2017**	16-Aug-2017	✓
S13_S/20/20170719,	S31_S/20/20170719,							
S15_S/20/20170719,	S15_S/29/20170719,							
S15_M/20/20170719,	S23_S/20/20170719,							
S23_M/20/20170719,	S32_S/20/20170719,							
S38_S/20/20170719,	S40_S/20/20170719,							
S42_S/20/20170719,	PS08/20/20170719,							
PS10/20/20170719,	PS26/20/20170719							
Soil Glass Jar - Unpreserved (EG035T)								
S52_S/20/20170720,	S58_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	17-Aug-2017	✓	**31-Jul-2017**	17-Aug-2017	✓
S66_S/20/20170720,	S72_S/20/20170720,							
S74_S/20/20170720,	S80_S/20/20170720,							
S66_S/29/20170720,	S56_S/20/20170720,							
S102_S/20/20170720,	S60_S/20/20170720,							
S77_S/20/20170720,	PS28/20/20170720,							
PS28/29/20170720,	PS48/20/20170720,							
PS50/20/20170720,	PS66/20/20170720,							
PS66/29/20170720,	PS70/20/20170720,							
PS6/20/20170720								

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG048: Hexavalent Chromium (Alkaline Digest)								
Soil Glass Jar - Unpreserved (EG048G) S3_S/20/20170719, PS26/20/20170719	S23_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	16-Aug-2017	✓	**31-Jul-2017**	04-Aug-2017	✓
Soil Glass Jar - Unpreserved (EG048G) S72_S/20/20170720, PS50/20/20170720	S80_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	17-Aug-2017	✓	**31-Jul-2017**	04-Aug-2017	✓
EK026SF: Total CN by Segmented Flow Analyser								
Soil Glass Jar - Unpreserved (EK026SF) S3_S/20/20170719, PS26/20/20170719	S23_S/20/20170719,	**19-Jul-2017**	**31-Jul-2017**	02-Aug-2017	✓	**01-Aug-2017**	14-Aug-2017	✓
Soil Glass Jar - Unpreserved (EK026SF) S72_S/20/20170720, PS50/20/20170720	S80_S/20/20170720,	**20-Jul-2017**	**31-Jul-2017**	03-Aug-2017	✓	**01-Aug-2017**	14-Aug-2017	✓
EN82: Porewater Extraction								
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN82) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**20-Jul-2017**	**27-Jul-2017**	17-Aug-2017	✓	**----**	----	----
EP003: Total Organic Carbon (TOC) in Soil								
Pulp Bag (EP003) S3_S/20/20170719,	S38_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	16-Aug-2017	✓	**31-Jul-2017**	16-Aug-2017	✓
Pulp Bag (EP003) S72_S/20/20170720, S60_S/20/20170720	S102_S/20/20170720,	**20-Jul-2017**	**31-Jul-2017**	17-Aug-2017	✓	**31-Jul-2017**	17-Aug-2017	✓
EP066: Polychlorinated Biphenyls (PCB)								
Soil Glass Jar - Unpreserved (EP066) S3_S/20/20170719, PS26/20/20170719	S23_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP066) S72_S/20/20170720, PS50/20/20170720	S80_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
EP068A: Organochlorine Pesticides (OC)								
Soil Glass Jar - Unpreserved (EP068) S3_S/20/20170719, PS26/20/20170719	S23_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP068) S72_S/20/20170720, PS50/20/20170720	S80_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075(SIM)A: Phenolic Compounds								
Soil Glass Jar - Unpreserved (EP075(SIM))								
S3_S/20/20170719,	S23_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
PS26/20/20170719								
Soil Glass Jar - Unpreserved (EP075(SIM))								
S72_S/20/20170720,	S80_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
PS50/20/20170720								
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Soil Glass Jar - Unpreserved (EP075(SIM))								
S3_S/20/20170719,	S7_S/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
S13_S/20/20170719,	S31_S/20/20170719,							
S23_S/20/20170719,	S32_S/20/20170719,							
S38_S/20/20170719,	S40_S/20/20170719,							
PS08/20/20170719,	PS10/20/20170719,							
PS26/20/20170719								
Soil Glass Jar - Unpreserved (EP075(SIM))								
S52_S/20/20170720,	S58_S/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
S66_S/20/20170720,	S72_S/20/20170720,							
S74_S/20/20170720,	S80_S/20/20170720,							
S66_S/29/20170720,	S102_S/20/20170720,							
S60_S/20/20170720,	S77_S/20/20170720,							
PS28/20/20170720,	PS48/20/20170720,							
PS50/20/20170720,	PS70/20/20170720,							
PS6/20/20170720								

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

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP080) S3_S/20/20170719 - Volatiles		**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**01-Aug-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S7_S/20/20170719, S31_S/20/20170719, S32_S/20/20170719, S40_S/20/20170719, PS10/20/20170719	S13_S/20/20170719, S23_S/20/20170719, S38_S/20/20170719, PS08/20/20170719,	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**27-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS26/20/20170719		**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP071) S3_S/20/20170719, S13_S/20/20170719, S23_S/20/20170719, S38_S/20/20170719, PS08/20/20170719, PS26/20/20170719	S7_S/20/20170719, S31_S/20/20170719, S32_S/20/20170719, S40_S/20/20170719, PS10/20/20170719,	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS70/20/20170720 - Volatiles		**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**01-Aug-2017**	03-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S52_S/20/20170720, S66_S/20/20170720, S74_S/20/20170720, S66_S/29/20170720, S60_S/20/20170720, PS28/20/20170720, PS50/20/20170720,	S58_S/20/20170720, S72_S/20/20170720, S80_S/20/20170720, S102_S/20/20170720, S77_S/20/20170720, PS48/20/20170720, PS6/20/20170720	**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	03-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP071) S52_S/20/20170720, S66_S/20/20170720, S74_S/20/20170720, S66_S/29/20170720, S60_S/20/20170720, PS28/20/20170720, PS50/20/20170720, PS6/20/20170720	S58_S/20/20170720, S72_S/20/20170720, S80_S/20/20170720, S102_S/20/20170720, S77_S/20/20170720, PS48/20/20170720, PS70/20/20170720,	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) S3_S/20/20170719 - Volatiles	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**01-Aug-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S7_S/20/20170719, S13_S/20/20170719, S31_S/20/20170719, S23_S/20/20170719, S32_S/20/20170719, S38_S/20/20170719, S40_S/20/20170719, PS08/20/20170719, PS10/20/20170719	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**27-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS26/20/20170719	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP071) S3_S/20/20170719, S7_S/20/20170719, S13_S/20/20170719, S31_S/20/20170719, S23_S/20/20170719, S32_S/20/20170719, S38_S/20/20170719, S40_S/20/20170719, PS08/20/20170719, PS10/20/20170719, PS26/20/20170719	**19-Jul-2017**	**28-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS70/20/20170720 - Volatiles	**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**01-Aug-2017**	03-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S52_S/20/20170720, S58_S/20/20170720, S66_S/20/20170720, S72_S/20/20170720, S74_S/20/20170720, S80_S/20/20170720, S66_S/29/20170720, S102_S/20/20170720, S60_S/20/20170720, S77_S/20/20170720, PS28/20/20170720, PS48/20/20170720, PS50/20/20170720, PS6/20/20170720	**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	03-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP071) S52_S/20/20170720, S58_S/20/20170720, S66_S/20/20170720, S72_S/20/20170720, S74_S/20/20170720, S80_S/20/20170720, S66_S/29/20170720, S102_S/20/20170720, S60_S/20/20170720, S77_S/20/20170720, PS28/20/20170720, PS48/20/20170720, PS50/20/20170720, PS70/20/20170720, PS6/20/20170720	**20-Jul-2017**	**28-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	06-Sep-2017	✓

Matrix: **SOIL**

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

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) S3_S/20/20170719 - Volatiles	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**01-Aug-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S7_S/20/20170719, S13_S/20/20170719, S31_S/20/20170719, S23_S/20/20170719, S32_S/20/20170719, S38_S/20/20170719, S40_S/20/20170719, PS08/20/20170719, PS10/20/20170719	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**27-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS26/20/20170719	**19-Jul-2017**	**26-Jul-2017**	02-Aug-2017	✓	**28-Jul-2017**	02-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) PS70/20/20170720 - Volatiles	**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**01-Aug-2017**	03-Aug-2017	✓
Soil Glass Jar - Unpreserved (EP080) S52_S/20/20170720, S58_S/20/20170720, S66_S/20/20170720, S72_S/20/20170720, S74_S/20/20170720, S80_S/20/20170720, S66_S/29/20170720, S102_S/20/20170720, S60_S/20/20170720, S77_S/20/20170720, PS28/20/20170720, PS48/20/20170720, PS50/20/20170720, PS6/20/20170720	**20-Jul-2017**	**26-Jul-2017**	03-Aug-2017	✓	**28-Jul-2017**	03-Aug-2017	✓
EP090: Organotin Compounds							
Soil Glass Jar - Unpreserved (EP090) S3_S/20/20170719, S13_S/20/20170719, S15_S/20/20170719, S42_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	02-Aug-2017	✓	**01-Aug-2017**	09-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP090) PS28/29/20170720, PS50/20/20170720	**20-Jul-2017**	**01-Aug-2017**	03-Aug-2017	✓	**02-Aug-2017**	10-Sep-2017	✓
Soil Glass Jar - Unpreserved (EP090) S74_S/20/20170720, S56_S/20/20170720, PS48/20/20170720, PS66/20/20170720	**20-Jul-2017**	**31-Jul-2017**	03-Aug-2017	✓	**01-Aug-2017**	09-Sep-2017	✓
EP231A: Perfluoroalkyl Sulfonic Acids							
HDPE Soil Jar (EP231X) S3_S/20/20170719, S13_S/20/20170719, S15_S/20/20170719, S42_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	15-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
HDPE Soil Jar (EP231X) S74_S/20/20170720, S56_S/20/20170720, PS28/29/20170720, PS48/20/20170720, PS50/20/20170720, PS66/20/20170720	**20-Jul-2017**	**31-Jul-2017**	16-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EP231B: Perfluoroalkyl Carboxylic Acids								
HDPE Soil Jar (EP231X) S3_S/20/20170719, S15_S/20/20170719,	S13_S/20/20170719, S42_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	15-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
HDPE Soil Jar (EP231X) S74_S/20/20170720, PS28/29/20170720, PS50/20/20170720,	S56_S/20/20170720, PS48/20/20170720, PS66/20/20170720	**20-Jul-2017**	**31-Jul-2017**	16-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
HDPE Soil Jar (EP231X) S3_S/20/20170719, S15_S/20/20170719,	S13_S/20/20170719, S42_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	15-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
HDPE Soil Jar (EP231X) S74_S/20/20170720, PS28/29/20170720, PS50/20/20170720,	S56_S/20/20170720, PS48/20/20170720, PS66/20/20170720	**20-Jul-2017**	**31-Jul-2017**	16-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
EP231P: PFAS Sums								
HDPE Soil Jar (EP231X) S3_S/20/20170719, S15_S/20/20170719,	S13_S/20/20170719, S42_S/20/20170719	**19-Jul-2017**	**31-Jul-2017**	15-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓
HDPE Soil Jar (EP231X) S74_S/20/20170720, PS28/29/20170720, PS50/20/20170720,	S56_S/20/20170720, PS48/20/20170720, PS66/20/20170720	**20-Jul-2017**	**31-Jul-2017**	16-Jan-2018	✓	**31-Jul-2017**	09-Sep-2017	✓

Matrix: **WATER**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F) RB01/67/20170719		**19-Jul-2017**	----	----	----	**26-Jul-2017**	15-Jan-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	23-Jan-2018	✓
Clear Plastic Bottle - Unspecified; Lab-acidified (EG020A-F) RB02/67/20170720		**20-Jul-2017**	----	----	----	**27-Jul-2017**	16-Jan-2018	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) RB01/67/20170719		**19-Jul-2017**	----	----	----	**27-Jul-2017**	16-Aug-2017	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	24-Aug-2017	✓
Clear Plastic Bottle - Unspecified; Lab-acidified (EG035F) RB02/67/20170720		**20-Jul-2017**	----	----	----	**27-Jul-2017**	03-Aug-2017	✓

Matrix: **WATER**

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

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP231A: Perfluoroalkyl Sulfonic Acids								
HDPE (no PTFE) (EP231X) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	23-Jan-2018	✓
EP231B: Perfluoroalkyl Carboxylic Acids								
HDPE (no PTFE) (EP231X) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	23-Jan-2018	✓
EP231D: (n:2) Fluorotelomer Sulfonic Acids								
HDPE (no PTFE) (EP231X) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	23-Jan-2018	✓
EP231P: PFAS Sums								
HDPE (no PTFE) (EP231X) S74_S/20/20170720, PS50/20/20170720	PS28/29/20170720,	**27-Jul-2017**	----	----	----	**31-Jul-2017**	23-Jan-2018	✓

Quality Control Parameter Frequency Compliance

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

Matrix: **SOIL**

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

Quality Control Sample Type *Analytical Methods*	*Method*	*Count* QC	Regular	*Rate (%)* **Actual**	**Expected**	*Evaluation*	*Quality Control Specification*
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	5	37	**13.51**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	4	39	**10.26**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	3	25	**12.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	4	39	**10.26**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	5	36	**13.89**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	2	10	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	6	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	2	6	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	3	36	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	2	10	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	2	6	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	2	6	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

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

Quality Control Sample Type / Analytical Methods	Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Evaluation	Quality Control Specification
Method Blanks (MB) - Continued							
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	3	36	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	2	10	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	36	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

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

Quality Control Sample Type / Analytical Methods	Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Evaluation	Quality Control Specification
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	4	28	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	25	**16.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	25	**8.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered 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 (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060A. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO_2) is automaticaly measured by infra-red detector.
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 504,505)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM amended 2013.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270D. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260B. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM amended 2013.
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270D Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	SOIL	In-House. A portion of soil is extracted with MTBE. The extract is taken to dryness, made up in mobile phase. Analysis is by LC/MSMS, ESI Negative Mode using MRM. PFOS is quantified using a certified, traceable standard consisting of linear and branched PFOS isomers.
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection ($SnCl_2$)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by $SnCl_2$ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Porewater Extraction	EN82	SOIL	Extraction of porewater from sediment samples using centrifuge.
Sample Extraction for PFAS	EP231-PR	SOIL	In house
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Organotin Sample Preparation	ORG35	SOIL	In house: 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.

Updated COC 24/07/17 15.05 - KN

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 2.

Golder Associates Pty Ltd
118 Franklin Street,
Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

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PROJECT:	Port River Sampling	DATE RESULTS REQUIRED:	
PROJ No.:	1783241	E-MAIL RESULTS:	nacooper@golder.com
SAMPLED BY:	AS	CC RESULTS:	hkeynes@golder.com
CONTACT:	Naomi Cooper	LABORATORY:	ALS
		QUOTE No:	MSA

FREIG...

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Sample Jars: Hold	Sample Jars: 250g Jar	Sample Jars: 250g Jar (No Teflon Lid)	Analysis Required: SA EPA Waste Screen Basic	As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn	PAH/TRH/BTEX	PFAS	TBT	Acid Sulphate Soils	TOC	Comments
1	S3_S/20/20170719	19/07/2017	Natural	Surface		x	x	x			x	x	x	x	
2	S7_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
3	S13_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x	x	x			
4	S31_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
5	S15_S/20/2017-719	19/07/2017	Natural	Surface		x	x		x		x	x			
6	S15_S/29/2017-719	19/07/2017	Natural	Surface		x	x		x						
	S15_S/28/2017-719	19/07/2017	Natural	Surface		x	x		x						Please forward to MGT Eurofins
7	S15_M/20/2017-719	19/07/2017	Natural	Mid		x	x		x						
8	S23_S/20/20170719	19/07/2017	Natural	Surface		x	x	x							
9	S23_M/20/20170719	19/07/2017	Natural	Mid		x	x		x						
10	S32_S/20/2-170719	19/07/2017	Natural	Surface		x	x		x	x					
11	S38_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x			x	x	
12	S40_S/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
13	S42_S/20/20170719	19/07/2017	Natural	Surface		x	x		x		x	x			
14	PS08/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
15	PS10/20/20170719	19/07/2017	Natural	Surface		x	x		x	x					
16	PS26/20/20170719	19/07/2017	Natural	Surface		x	x	x							
17	S52_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
18	S58_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
19	S66_S/20/20170720	20/07/2017	Natural	Surface		x	x		x	x					
20	S72_S/20/20170720	20/07/2017	Natural	Surface		x	x	x					x	x	
				Totals :				4	17	11	4	4	3	3	

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Savaglia	Golder Associates	Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	Bharathi	ALS	Yes / No	Yes / No	25/7/17	11am	
RELEASED BY:			Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:			Yes / No	Yes / No			

Relinquished by Ru (Amy) 26/7/17 @ 12.15pm

Amy EF/MGT 26/7/17 15:39 556033

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Chain of Custody Record - Soil/Sediment Samples

Sheet 2 of 2

Golder Associates Pty Ltd
118 Franklin Street,
Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Port River Sampling	**DATE RESULTS REQUIRED:**	
PROJ No.:	1783241	**E-MAIL RESULTS:**	nacooper@golder.com
SAMPLED BY:	AS	**CC RESULTS:**	hkeynes@golder.com
CONTACT:	Naomi Cooper	**LABORATORY:**	ALS
		QUOTE No:	MSA

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Sample Jars: Hold	250g Jar	250g Jar (No Teflon Lid)	60ml non-preserved metals	Analysis Required: SA EPA Waste Screen Basic	As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn	PAH/TRH/BTEX	PFAS	TBT	Acid Sulphate Soils	TOC	Comments
21	S74_S/20/20170720	20/07/2017	Natural	Surface		x	x			x	x	x	x			
22	S80_S/20/20170720	20/07/2017	Natural	Surface		x	x		x							
23	S66_S/29/20170720	20/07/2017	Natural	Surface		x	x			x	x					
→	S66_S/28/20170720	20/07/2017	Natural	Surface		x	x			x	x					Please forward to MGT Eurofins
24	S56_S/20/20170720	20/07/2017	Natural	Surface		x	x			x		x	x			
25	S102_S/20/2017072	20/07/2017	Natural	Surface		x	x			x	x			x	x	
26	S60_S/20/20170720	20/07/2017	Natural	Surface		x	x			x	x			x	x	
27	S77_S/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
28	PS28/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
29	PS28/29/20170720	20/07/2017	Natural	Surface		x	x			x		x	x			
→	PS28/28/20170720	20/07/2017	Natural	Surface		x	x			x						Please forward to MGT Eurofins
30	PS48/20/20170720	20/07/2017	Natural	Surface		x	x			x	x	x	x			
31	PS50/20/20170720	20/07/2017	Natural	Surface		x	x		x			x	x			
32	PS66/20/20170720	20/07/2017	Natural	Surface		x	x			x		x	x			
33	PS66/29/20170720	20/07/2017	Natural	Surface		x	x			x						
→	PS66/28/20170720	20/07/2017	Natural	Surface		x	x			x						Please forward to MGT Eurofins
(broken)	PS68/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
34	PS70/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
35	PS6/20/20170720	20/07/2017	Natural	Surface		x	x			x	x					
36	RB01/67/20170719	19/07/2017						x		x						
37	RB02/67/20170720	20/07/2017						x		x	x					
				Totals :					2	19	12	7	7	2	2	

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	A.Savaglia	Golder Associates	Yes / No	Yes / No			
RECEIVED BY:	Bharathi	ALS	Esky Intact Yes / No	Security Seals Intact Yes / No	25/7/17	11am	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:			Esky Intact Yes / No	Security Seals Intact Yes / No			

Rec'd Am
26/7/17
12.15pm

Amy
EF|MGT
26/7/17 15:39
556033

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

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

Golder Associates Pty Ltd
118 Franklin Street
Adelaide
SA 5000

Attention: **Naomi Cooper**

Report	**556033-S**
Project name	PORT RIVER SAMPLING
Project ID	1783241
Received Date	Jul 26, 2017

Client Sample ID			**S15_S/28/2017-719**	**S66_S/28/2017 0720**	**PS28/28/20170 720**	**PS66/28/20170 720**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**M17-Jl32966**	**M17-Jl32967**	**M17-Jl32968**	**M17-Jl32969**
Date Sampled			**Jul 19, 2017**	**Jul 20, 2017**	**Jul 20, 2017**	**Jul 20, 2017**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	-	< 20	-	-
TRH C10-C14	20	mg/kg	-	< 20	-	-
TRH C15-C28	50	mg/kg	-	< 50	-	-
TRH C29-C36	50	mg/kg	-	< 50	-	-
TRH C10-36 (Total)	50	mg/kg	-	< 50	-	-
BTEX						
Benzene	0.1	mg/kg	-	< 0.1	-	-
Toluene	0.1	mg/kg	-	< 0.1	-	-
Ethylbenzene	0.1	mg/kg	-	< 0.1	-	-
m&p-Xylenes	0.2	mg/kg	-	< 0.2	-	-
o-Xylene	0.1	mg/kg	-	< 0.1	-	-
Xylenes - Total	0.3	mg/kg	-	< 0.3	-	-
4-Bromofluorobenzene (surr.)	1	%	-	61	-	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	-	< 0.5	-	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	-	< 20	-	-
TRH C6-C10	20	mg/kg	-	< 20	-	-
TRH >C10-C16	50	mg/kg	-	< 50	-	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	-	< 50	-	-
TRH >C16-C34	100	mg/kg	-	< 100	-	-
TRH >C34-C40	100	mg/kg	-	< 100	-	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	-	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	-	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	-	-
Acenaphthene	0.5	mg/kg	-	< 0.5	-	-
Acenaphthylene	0.5	mg/kg	-	< 0.5	-	-
Anthracene	0.5	mg/kg	-	< 0.5	-	-
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	-	-
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	-	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	-	< 0.5	-	-
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	-	-
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	-	-
Chrysene	0.5	mg/kg	-	< 0.5	-	-
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	-	-

Client Sample ID			S15_S/28/2017-719	S66_S/28/2017 0720	PS28/28/20170 720	PS66/28/20170 720
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**M17-JI32966**	**M17-JI32967**	**M17-JI32968**	**M17-JI32969**
Date Sampled			**Jul 19, 2017**	**Jul 20, 2017**	**Jul 20, 2017**	**Jul 20, 2017**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Fluoranthene	0.5	mg/kg	-	< 0.5	-	-
Fluorene	0.5	mg/kg	-	< 0.5	-	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	-	-
Naphthalene	0.5	mg/kg	-	< 0.5	-	-
Phenanthrene	0.5	mg/kg	-	< 0.5	-	-
Pyrene	0.5	mg/kg	-	< 0.5	-	-
Total PAH*	0.5	mg/kg	-	< 0.5	-	-
2-Fluorobiphenyl (surr.)	1	%	-	113	-	-
p-Terphenyl-d14 (surr.)	1	%	-	128	-	-
Heavy Metals						
Arsenic	2	mg/kg	11	13	9.9	14
Barium	10	mg/kg	21	31	28	29
Beryllium	2	mg/kg	< 2	< 2	< 2	< 2
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	22	29	27	28
Cobalt	5	mg/kg	< 5	< 5	< 5	< 5
Copper	5	mg/kg	28	43	43	39
Lead	5	mg/kg	25	35	27	33
Manganese	5	mg/kg	130	240	240	220
Mercury	0.1	mg/kg	0.2	0.2	0.2	0.3
Nickel	5	mg/kg	9.4	12	11	12
Zinc	5	mg/kg	70	99	96	94
% Moisture	1	%	28	39	44	38

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Jul 29, 2017	14 Day
- Method: LTM-ORG-2010 TRH C6-C36			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Jul 29, 2017	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Jul 29, 2017	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
BTEX	Melbourne	Jul 29, 2017	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Polycyclic Aromatic Hydrocarbons	Melbourne	Jul 29, 2017	14 Day
- Method: LTM-ORG-2140 PAH and Phenols in Soils by GCMS			
Heavy Metals	Melbourne	Jul 29, 2017	180 Day
- Method: LTM-MET-3030 by ICP-OES (hydride ICP-OES for Mercury)			
% Moisture	Melbourne	Jul 27, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

Company Name: Golder Associates Pty Ltd (Adelaide)
Address: 118 Franklin Street
Adelaide
SA 5000

Project Name: PORT RIVER SAMPLING
Project ID: 1783241

Order No.:
Report #: 556033
Phone: 08 8213 2100
Fax: 618 8213 2101

Received: Jul 26, 2017 3:39 PM
Due: Aug 2, 2017
Priority: 5 Day
Contact Name: Naomi Cooper

Eurofins | mgt Analytical Services Manager : Sarah Gould

Sample Detail						Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Zinc	Polycyclic Aromatic Hydrocarbons	BTEX	Moisture Set	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794																					
Perth Laboratory - NATA Site # 23736																					
External Laboratory																					
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																
1	S15_S/28/2017-719	Jul 19, 2017		Soil	M17-Jl32966	X	X	X	X	X	X	X	X	X	X	X	X			X	
2	S66_S/28/20170720	Jul 20, 2017		Soil	M17-Jl32967	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	PS28/28/20170720	Jul 20, 2017		Soil	M17-Jl32968	X	X	X	X	X	X	X	X	X	X	X	X			X	
4	PS66/28/20170720	Jul 20, 2017		Soil	M17-Jl32969	X	X	X	X	X	X	X	X	X	X	X	X			X	
Test Counts						4	4	4	4	4	4	4	4	4	4	4	4	1	1	4	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

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

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

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

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

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

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

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

Results <10 times the LOR : No Limit

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

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

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

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

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

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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Barium	mg/kg	< 10			10	Pass	
Beryllium	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	116			70-130	Pass	
TRH C10-C14	%	95			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	110			70-130	Pass	
Toluene	%	100			70-130	Pass	
Ethylbenzene	%	98			70-130	Pass	
m&p-Xylenes	%	110			70-130	Pass	
Xylenes - Total	%	109			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	78			70-130	Pass	
TRH C6-C10	%	110			70-130	Pass	
TRH >C10-C16	%	106			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	98			70-130	Pass	
Acenaphthylene	%	101			70-130	Pass	
Anthracene	%	118			70-130	Pass	
Benz(a)anthracene	%	73			70-130	Pass	
Benzo(a)pyrene	%	112			70-130	Pass	
Benzo(b&j)fluoranthene	%	103			70-130	Pass	
Benzo(g.h.i)perylene	%	130			70-130	Pass	
Benzo(k)fluoranthene	%	116			70-130	Pass	
Chrysene	%	130			70-130	Pass	
Dibenz(a.h)anthracene	%	98			70-130	Pass	
Fluoranthene	%	115			70-130	Pass	
Fluorene	%	112			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	93			70-130	Pass	
Naphthalene	%	104			70-130	Pass	
Phenanthrene	%	91			70-130	Pass	
Pyrene	%	119			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	94			80-120	Pass	
Barium	%	104			80-120	Pass	
Beryllium	%	97			80-120	Pass	
Cadmium	%	100			80-120	Pass	
Chromium	%	101			80-120	Pass	
Cobalt	%	99			80-120	Pass	
Copper	%	108			80-120	Pass	
Lead	%	99			80-120	Pass	
Manganese	%	98			80-120	Pass	
Mercury	%	99			75-125	Pass	
Nickel	%	102			80-120	Pass	
Zinc	%	101			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	M17-JI32293	NCP	%	88			75-125	Pass	
Barium	M17-JI32293	NCP	%	98			75-125	Pass	
Beryllium	M17-JI32293	NCP	%	94			75-125	Pass	
Cadmium	M17-JI32293	NCP	%	96			75-125	Pass	
Chromium	M17-JI32293	NCP	%	66			75-125	Fail	Q08
Cobalt	M17-JI32293	NCP	%	87			75-125	Pass	
Copper	M17-JI32293	NCP	%	100			75-125	Pass	
Lead	M17-JI32293	NCP	%	82			75-125	Pass	
Manganese	M17-JI32293	NCP	%	119			75-125	Pass	
Mercury	M17-JI32293	NCP	%	108			70-130	Pass	
Nickel	M17-JI32293	NCP	%	90			75-125	Pass	
Zinc	M17-JI32293	NCP	%	90			75-125	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	M17-JI34260	NCP	%	115			70-130	Pass	
TRH C10-C14	B17-JI30565	NCP	%	125			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	M17-JI34260	NCP	%	126			70-130	Pass	
Toluene	M17-JI34260	NCP	%	118			70-130	Pass	
Ethylbenzene	M17-JI34260	NCP	%	114			70-130	Pass	
m&p-Xylenes	M17-JI34260	NCP	%	125			70-130	Pass	
o-Xylene	M17-JI34260	NCP	%	122			70-130	Pass	
Xylenes - Total	M17-JI34260	NCP	%	124			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	M17-JI34260	NCP	%	89			70-130	Pass	
TRH C6-C10	M17-JI34260	NCP	%	119			70-130	Pass	
TRH >C10-C16	B17-JI30565	NCP	%	122			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	M17-JI33984	NCP	%	112			70-130	Pass	
Acenaphthylene	M17-JI33984	NCP	%	118			70-130	Pass	
Anthracene	M17-JI33984	NCP	%	129			70-130	Pass	
Benz(a)anthracene	M17-JI33984	NCP	%	82			70-130	Pass	
Benzo(a)pyrene	M17-JI33984	NCP	%	126			70-130	Pass	
Benzo(b&j)fluoranthene	M17-JI33984	NCP	%	114			70-130	Pass	
Benzo(g.h.i)perylene	M17-JI33984	NCP	%	122			70-130	Pass	
Benzo(k)fluoranthene	M17-JI33984	NCP	%	118			70-130	Pass	
Chrysene	M17-JI33984	NCP	%	125			70-130	Pass	
Dibenz(a.h)anthracene	M17-JI33984	NCP	%	128			70-130	Pass	
Fluoranthene	M17-JI33984	NCP	%	112			70-130	Pass	
Fluorene	M17-JI33984	NCP	%	119			70-130	Pass	
Indeno(1.2.3-cd)pyrene	M17-JI33984	NCP	%	120			70-130	Pass	
Naphthalene	M17-JI33984	NCP	%	99			70-130	Pass	
Phenanthrene	M17-JI33984	NCP	%	102			70-130	Pass	
Pyrene	M17-JI33984	NCP	%	114			70-130	Pass	

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Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M17-JI32293	NCP	mg/kg	24	24	<1	30%	Pass	
Barium	M17-JI31116	NCP	mg/kg	370	330	11	30%	Pass	
Beryllium	M17-JI32293	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Cadmium	M17-JI32293	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M17-JI31116	NCP	mg/kg	1500	1400	7.0	30%	Pass	
Cobalt	M17-JI32293	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Copper	M17-JI32293	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M17-JI32293	NCP	mg/kg	24	22	7.0	30%	Pass	
Manganese	M17-JI31116	NCP	mg/kg	410	390	5.0	30%	Pass	
Mercury	M17-JI32293	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M17-JI32293	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Zinc	M17-JI31116	NCP	mg/kg	450	420	5.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M17-JI32960	NCP	%	16	15	8.0	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	M17-JI31969	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	B17-JI30564	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	B17-JI30564	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	B17-JI30564	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	M17-JI31969	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	M17-JI31969	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	M17-JI31969	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	M17-JI31969	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	M17-JI31969	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	M17-JI31969	NCP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	M17-JI31969	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	M17-JI31969	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	B17-JI30564	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	B17-JI30564	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	B17-JI30564	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	M17-JI32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Phenanthrene	M17-Jl32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	M17-Jl32967	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	

Comments

Sample Integrity

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

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q08	The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference

Authorised By

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National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

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

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

APPENDIX D

Important Information

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APPENDIX D

Marine habitat assessment

December 2017

REPORT

ORIGIN ENERGY QUARANTINE POWER STATION

Project LISA
Port River Habitat Assessment

Submitted to:
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Origin Energy
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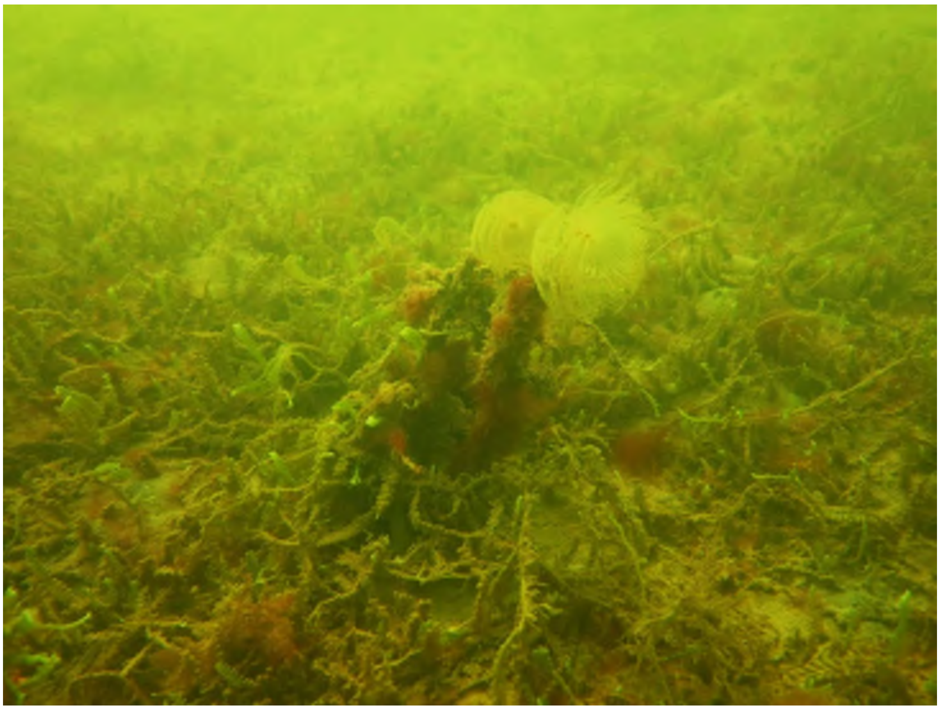

Report Number. 1783241-007-R-Rev0

Distribution:

1 eCopy - Origin Energy
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Golder Associates

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1.0 INTRODUCTION

1.1 Background

The site location is within the Port River, adjacent to Origin Energy's (Origin) Quarantine Power Station (QPS) on Torrens Island, South Australia., Port River is the western branch of a large tidal estuary on the eastern side of Gulf St Vincent. Port River extends inland through the Inner Harbour of Port Adelaide, to the constructed salt-water West Lakes in the north-western suburbs of Adelaide. As an active Port, the river morphology has been permanently modified by industrial development along the banks and flood plain, as well as significant flood mitigation works inclusive of mitigation channels and levees which isolated it from the River Torrens. Despite the heavy development along much of the Port River, there are remnant areas of mangrove, saltmarsh and seagrass communities which provide important ecological functions.

Given the imperative to improve the security of electricity generation and supply to South Australia, Origin is proposing an expansion of its QPS. This expansion would involve the conversion of a natural gas turbine to Liquefied Petroleum Gas (LPG). The proposal would require the periodic delivery of LPG to the facility via a Small Gas Carrier (SGC). LPG would need to be pumped from the SGC to a barge with a capacity of 3000L. This would be permanently moored close to the QPS within Port River and would be connected to the facility via a submerged pipeline. For the SGC to access the LPG barge, dredging of the sea bed would be required. The area to be dredged is approximately 300 m x 80 m.

This Aquatic Habitat Assessment is has been commissioned to support the assessment of potential environmental impact of the dredging work. The aim of this investigation is to provide a detailed characterisation of the aquatic environment within the proposed dredge area.

1.2 Purpose of this report

Golder Associates Pty Ltd (Golder) was commissioned by Origin to undertake an aquatic habitat assessment of a defined area of the Port River adjacent to the QPS located on Torrens Island. The purpose of this investigation was to provide an assessment of the ecological communities present within the designed site and immediate surrounds. To achieve this, Golder carried out a desktop review of publically available information relating to the existing environmental conditions of the area and recorded threatened species or communities which may have been previously identified in proximity to the site.

Golder's marine team then carried out a field study to:

- identify the habitats present and their distributions;
- provide estimates of abundance and percentage cover of marine vegetation;
- assess the quality of habitats present, and
- assess the occurrence or potential occurrence of threatened and protected species as well as pest species.

2.0 SAMPLING METHODOLOGY

2.1 Study Locations

The study area is shown in Appendix A. The areas surveyed were chosen based on the proposed dredging plans provided by Origin in July 2017.

2.2 Diver Surveys

Diver surveys were conducted at 20 sites within the proposed dredge area (Appendix A) using surface supplied breathing apparatus (SSBA).

The diver provided a description of the riverbed within a five meter radius of the site. This included, a description of the sediment, estimates of percent cover and condition of vegetation, and presence/absence of invertebrates. In addition, photos were taken at each site for further analysis and species identification.

2.3 Towed Video Transects

Towed video transects were used to gain a broad understanding of the distribution of habitats within the proposed dredge area and its surroundings (Appendix A). Five video transects were deployed in the proposed dredge area, which comprised three 300 m transects running parallel to the shore at different depths, and two 80 m transect running perpendicular to the shore.

An additional six transects were deployed to gain an understating of the habitats in the broader vicinity of the dredge area (Appendices A and B). This included:

- two transects inshore of the dredge area (eastern side) to assess the habitats present in the area where the submerged pipeline is proposed to be laid;
- two north of the dredge area (Reference Area North);
- and two south of the dredge area (Reference Area South).

A handheld GPS was used to mark changes in habitat type when recording video transects.

The transect videos were paired with the field GPS points and reviewed on a desktop computer to characterise the changes in habitats for input into Geographic Information System (GIS) for production of a habitat map.

3.0 RESULTS

3.1 Habitat Distributions

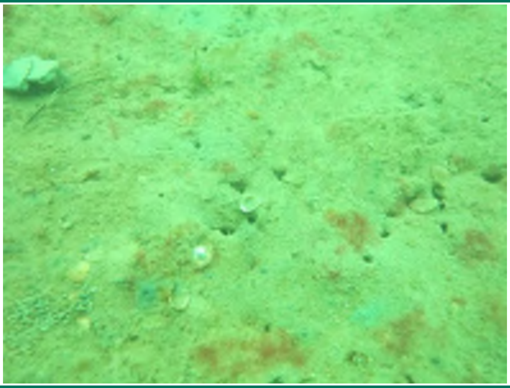
3.1.1 Dredge Area

The dredge area typically ranged from 3-6 meters in depth and was primarily characterised soft sediments composed of silt, mud and shell grit covered by dense mats of the cryptogenic green algae *Caulerpa cylindracea,* interspersed with the invasive green algae *Caulerpa taxifolia*, the introduced European fan worm *Sabella spallanzanii,* and the razor clam *Pinna bicolor* (Table 1)*.* Densities of Caulerpa were typically greatest towards the shore side of the dredge area and reduced in density towards the shipping channel (Appendix C).

A species of epiphytic red algae (red algae sp. 1) was often found growing on the fronds of *Caulerpa* and the shells razor clams, as well as on the sediment (Table 1). However, as *Caulerpa* densities decreased towards the shipping channel, red algae 1 became the most abundant vegetation, despite having a relatively patchy coverage of the riverbed (Appendices C and D).

The sediment of the riverbed was comprised of a soft silty mud with intermitted patches of shell grit. The presence of burrows in areas of exposed riverbed indicate the presence of infauna communities (e.g. worms, molluscs, crustaceans) (Table 1). Additionally, the scattered hard substratum provided by razor clam shells allowed for the settlement of sponges and ascidians.

Table 1: Dominant habitats and species – Dredge area.

Caulerpa spp. mats – primarily comprised of *Caulerpa cylindracea* with some patches of *Caulerpa taxifolia.*	*Sabella spallanzanii* – often found anchored to the shells of razor clams or other hard surfaces.
	
Red algae sp.1 – grows epiphytically and on the riverbed.	Bare substrate – Dominate habitat near shipping, burrows indicating the presence of infauna.
	

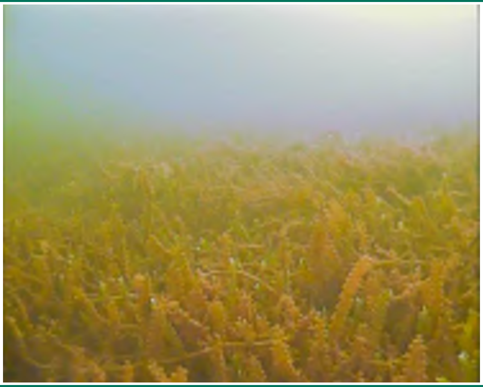
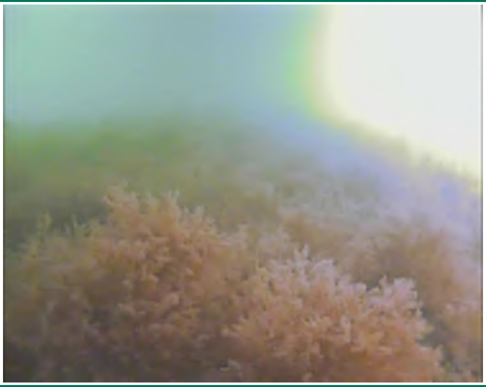
3.1.2 Inshore Area

The eastern region between the dredge area and the shore where the submerged flexible pipe will connect the barge to the QPS land facilities has been investigated by two video transects along shore (Appendix A). Due to the shallow water depth restricting boat access, this area was not fully covered (Appendix C).

This inshore area surveyed was primarily dominated by dense mats of *Caulerpa* spp. in water depths ranging from 2-5 meters (Table 2). In the shallow waters (<2 m depth) there were patches and established seagrass beds of *Zostera* sp. (Table 2; Appendices B). These seagrass beds displayed a low to high percentage cover, ranging up to approximately 70% cover in the most established areas. Moderate amounts of epiphyte growth were also observed on the seagrass blades. The seagrass beds might extend further in the shallow/intertidal zone, however this was unable to be assessed due to the shallow water depth limiting the survey by boat.

A second species of red algae (red algae sp. 2) was found growing in dense mats between seagrass meadows (Table 2; Appendix C).

Table 2: Dominant habitats and species - Inshore.

Caulerpa spp.	Red algae sp. 2
	
Seagrass – *Zostera* sp.	
	

3.1.3 Reference Area - North

In the northern reference area there were extensive seagrass beds in the shallow waters (approx. <2m depth) (Appendix B), presenting a moderate to high degree of epiphyte growth on the seagrass blades. In the deeper waters towards the shipping channel, the habitat became dominated by dense mats of *Caulerpa* spp. (Table 3).

Table 3: Dominant habitats and species – Reference Area North.

Seagrass with epiphytes~~.~~	*Caulerpa* spp.
	

3.1.4 Reference Area - South

In the southern reference area, the river bed was predominately covered by *Caulerpa* (Appendix B), with interspersed razor clams and *Sabella spallanzanii* (Table 4).

Table 4: Dominant habitats and species –Reference Area South.

Caulerpa spp.


3.2 Receptor Identification

The species found during the surveys, including habitat forming species are listed in the Table 5.

Both macroalgae *Caulerpa taxifolia* and *C. cylindracea* were present in the dredge area and surrounding areas (Appendices B and C). Both *C. taxifolia* and *C. cylindracea* are introduced species to South Australian waters. *Caulerpa taxifolia* is native to tropical areas around the world; however due to extensive use in the aquarium trade and its resilient nature, *C. taxifolia* has colonised many areas outside its natural range and is declared a noxious species in South Australia under the *Fisheries Management Act 2007*. *Caulerpa cylindracea* is native to the tropics of Australia; however it is introduced in South Australia and considered an exotic species under the Fisheries Management Act meaning it cannot be deposited, released or allowed to escape without specific authorisation. It was found in abundance in the survey area up to 90% percentage cover forming dense mats, seemingly outcompeting *C. taxifolia*.

Seagrass *Zostera* sp. was found outside the proposed dredge area, inshore in the shallow parts of the river (Appendices B and C). As native vegetation, clearance of seagrass such as *Zostera* sp. is regulated in South Australia (*Native Vegetation Act 1991*).

The dredge area is located within the Adelaide Dolphin Sanctuary (Adelaide Dolphin Sanctuary (ADS) Act 2005) and habitats. The purposes of the ADS Act are to protect the dolphin population of the Port River estuary and Barker Inlet and to protect the natural habitat of that population.

Table 5: Species found during the surveys and their conservation status.

Common name	Latin name	Pest species under the Fisheries Management Act 2007	Conservation status (EPBC, FM Act 2007, Native Vegetation Act 1991)	Presence in dredge area
Seagrass				
Eelgrass	*Zostera* sp.	No	Native Vegetation Act 1991[1]	Absent
Macroalgae				
Caulerpa	*Caulerpa taxifolia*	Yes[2]	None	Present
Caulerpa	*Caulerpa cylindracea*	Yes[3]	None	Present
Red algae 1.	Unknown	No	None	Present
Red algae 2.	Unknown	No	Unknown	Absent
Invertebrates				
Tunicate	*Urochordata* spp.	No	None	Present
Sea anemone	*Actiniaria* spp.	No	None	Present
Bristle worms	Polychaeta spp.	No	None	Present
European fan worm	*Sabella spallanzanii*	Yes[2]	None	Present
Razor clam	*Pinna bicolor*	No	None	Present
Blue swimmer crab	*Portunus pelagicus*	No	None	Present

[1]Native vegetation clearance is related under the South Australia Native vegetation Act 1991.
[2]*Caulerpa taxifolia* and the European fan worm are declared as noxious species in South Australia under the Fisheries Management Act 2007 - "It may not be held or traded in South Australia without specific authorisation" (PIRSA 2017).
[3]*Caulerpa cylindracea* is an exotic species in SA under the Fisheries Management Act 2007 - "It may not be deposited, released or allowed to escape into any waters in South Australia without specific authorisation" (PIRSA 2017).

A search was performed on the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) in order to assess if species or communities of conservation importance are likely to be present in the proposed dredge area and surroundings (5 km search radius). A likelihood of impact has been assessed based the presence likelihood and on the potential direct and indirect impacts of the dredging operations and development. Table 6 summarises the database search for marine species and presence and impact likelihood. The results of the full search is presented in Appendix D.

Table 6: Species or communities of conservation importance[1] potentially present in the dredge area and surroundings, and likelihood of impact.

Common name[2]	Latin name	Cons. Status[3]	Presence likelihood	Likelihood of impact
Reptiles				
Loggerhead Turtle	*Caretta caretta*	E	Unlikely	Very Unlikely
Green Turtle	*Chelonia mydas*	V	Unlikely	Very Unlikely
Leatherback Turtle	*Dermochelys coriacea*	E	Unlikely	Very Unlikely
Fish				
Syngnathids (pipefish, pipehorses, seadragons, seahorses)	Syngnathids	P	Potential	Unlikely
Great White Shark	*Carcharodon carcharias*	V; P	Potential	Unlikely
Porbeagle Shark	*Lamna nasus*	M	Unlikely	Very unlikely
Mammals				
Whales, seals, sea lions, Dolphins		P	Potential	Unlikely
Bottlenose dolphins[4]		P	Most likely	Unlikely
Bryde's Whale	*Balaenoptera edeni*	M; P	Unlikely	Very unlikely
Pygmy Right Whale	*Caperea marginata*	M; P	Unlikely	Very unlikely
Southern Right Whale	*Eubalaena australis*	E; P	Unlikely	Very unlikely
Dusky Dolphin	*Lagenorhynchus obscurus*	M; P	Unlikely	Very unlikely
Humpback Whale	*Megaptera novaeangliae*	V; P	Unlikely	Very unlikely
Australian Sea-lion	*Neophoca cinerea*	V; P	Potential	Unlikely

[1]EPBC, NPW Act 1972, FM Act 2007

[2]Only the strictly marine species were retained.

[3]V= vulnerable, E= endangered, CE= critically endangered, R= rare, M=migratory, P= protected in SA).

[4]Bottlenose dolphins (Adelaide Dolphin Sanctuary (Adelaide Dolphin Sanctuary Act 2005)).

4.0 DISCUSSION

4.1 Potential impacts on the marine environment

The potential impacts (direct and indirect) of dredging operations on the marine environment is listed in Table 7.

Table 7: Potential impacts of dredging operations on Port River marine environment.

Potential impact	Potentially affected species/group of species	Expected impact
Direct		
Removal (sediment extraction)	Vegetation, sessile and low mobility species	Habitat loss will be limited to algal communities and soft sediment fauna which are expected to recolonise the sediments
Permanent installation (e.g. mooring and flexible pipe)	Vegetation and sessile species	Habitat loss will be extremely minor in nature. to algal communities and soft sediment fauna which are expected to recolonise
Underwater noise during dredging and mooring installation	Marine mammals; dolphins	No blasting is envisaged. Temporary increase in underwater noise through dredge activity. Dolphins are highly mobile and are expected to temporarily move away from the immediate dredging work area.
Indirect		
Increase of turbidity	Vegetation, sessile organisms	An increase in turbidity can lead to smothering of marine flora and fauna. The actual amount of bed material put into suspension by dredging will depend on the type of dredge used, the way in which it is operated, and on what sort of controls there are on hopper overflows. Zostera beds adjacent to the channel are subjected to repeated increases in sedimentation caused by natural events such as storms, and by the passage of large ships and tugs.
Water quality	All	Sediments have been tested and results are presented in another report (Golder, 2017). Negligible impact is expected.
Disposal of spoil	Receiving environment with potential dispersal of pests	Anecdotal advice from EPA has indicated that deep water disposal has been the only effective treatment in limiting the spread of *Caulerpa* spp.

Based on the survey and the existing information, the dredging operations should have a limited direct impact on the marine environment.

Impacts to protected matters under the EPBC, NPW and FM Acts are considered to be unlikely. Direct habitat loss will be limited to algal communities and soft sediments and will be restricted to the dredge area. Direct habitat loss should not have an impact on Port Adelaide river vegetation and fauna.

Benthic invertebrates such as blue swimmer crabs and razor clams were observed within the proposed dredge area, as well as numerous sediment burrows indicating the presence of infauna communities. Sessile fauna and low mobility species will be directly impacted by the dredging activities, although those impacts will be confined to the dredge area. Mobile species such as crabs, fish, and marine mammals are not expected to be significantly impacted as they can avoid the dredge area during operations.

Port Adelaide River and tributaries sustain a bottlenose dolphin population protected under the Adelaide Dolphin Sanctuary (Adelaide Dolphin Sanctuary Act 2005). Potential impacts of dredging operations on dolphins in Port Adelaide river is discussed below.

Attention should be brought to limit indirect impact on seagrass and to avoid dissemination of marine pests (discussed below).

4.1.1 Adelaide River Dolphins

The Adelaide Dolphin Sanctuary Act 2005 aims at protecting Port Adelaide River dolphin population and to protect the natural habitat of this population within the ADS. The dredging operations should have a limited impact on key habitats present within the ADS (seagrass and mangroves). Temporary increase of turbidity (may affect foraging) and noise (may impede dolphin communication, foraging and navigation) during the dredging operations may affect the dolphins. However it is expected that these impacts will be restricted in time (duration of the dredging operations is estimated at two weeks) and that dolphins have the ability to move away to avoid the affected area.

4.1.2 Seagrass

Seagrasses play an important role in numerous coastal processes. They provide habitat, nursery and feeding grounds for numerous marine species, assist in the capture and cycling of nutrients, and contribute to the capture and stabilisation of sediment (Butler and Jernakoff 1999).

Seagrasses were only observed in the shallow nearshore waters adjacent to the dredge area and upstream location. As such, there would be no direct impacts as a result of dredging activities in the proposed dredge area. The survey showed that seagrasses beds were more common south of the dredge area and inshore (Reference Area South and Inshore Area). In these areas, the seagrasses were colonised by epiphytes, with moderate to high epiphytes loadings. Epiphytic growth may negatively affect seagrasses by affecting carbon and nutrient uptake, oxygen diffusion and by reducing light availability (Jenakoff et al. 1996). High epiphytic growth on seagrass may be the result of high levels of nutrients in the system (Moore and Wetzel 2000), however other factors can control growth of epiphytes on seagrass (e.g. abundance of grazers, seasons, light exposure) (Borowitzka et al. 2006).

Indirect impacts that may have a detrimental effect to the seagrasses include increases in turbidity and sedimentation. Increases in turbidity and sediment deposition can impact the productivity of seagrasses by reducing the availability of light reducing photosynthetic capacities. This can result in degradation and/or overall loss of seagrass biomass (Erftemeijer and Lewis 2006). Trailing suction hopper dredger is the preferred type of dredge for the dredging operation (Golder, 2017b). This type of dredge pumps the sediment from the seabed into a hopper. The decanted excess water rich in clay and fines is discharged from the keel of the ship, reducing the distance of discharge form the seabed and therefore helping at reducing turbidity and facilitating sedimentation of the dredging overflow. Overflow systems (anti-turbidity systems/valve) could also be fitted on THSD dredger to limit the amount of turbidity. It is expected that the dredging operations should be limited in time (estimated at 2 weeks – Golder, 2017b). Based on the dredger type and duration of operations, it is expected that turbidity and noise will be limited in time (duration of the dredging operations). With the tidal currents, the turbid plume will move in a North-South axis following the river channel direction and be flushed out at sea by river current and outgoing tides. Whilst little siltation is expected inshore of the dredge area, the deployment of silt curtains supported by floating booms deployed along the dredge on the inshore side may contribute to minimising the effects of temporary increase of turbidity and silt deposition on the adjacent seagrass beds (indirect impact).

Although not fully verified during the habitat survey due to boat limited access, survey, there is the potential for seagrass beds to occur in the shallow/intertidal zone inshore of the dredge area. In this area, a ca 110 m flexible pipe is proposed to be laid to connect the barge to QPS land facilities (Appendix C). There is potential direct impact to the seagrasses potentially present with the installation of the pipe on the seabed. However this impact is expected to be very located (restricted to the pipe path). The potential direct loss of seagrass would be limited in terms of area (<20 m^2) compared to the existing seagrass beds found in the main survey area and in the Reference Area North (Appendices B and C). Additional impact caused by the pipe may be expected by dragging on the seabed if not secured on the seafloor or not floating over the seafloor at all tidal phases. Attention should be brought to assess short and long-term impact of the flexible pipe during QPS LPG operational phase.

4.1.3 Marine pests

The introduced algae *Caulerpa taxifolia* (listed as pest in SA) and *C. cylindracea* were found in high densities within the proposed dredge area and at its vicinity (see Appendices B and C). Both *Caulerpa* species were previously recorded in Port Adelaide River (PIRSA 2017); Golder 2013).

Barge and vessel anchorage, dredging activity and equipment dragging on the bottom will result in the fragmentation of *Caulerpa* spp. and the potential dissemination of algae fragments under the influence of tidal movements. As per guidelines for dealing with *Caulerpa*, the recommendations from Primary Industries and Regions SA with regards to the noxious *Caulerpa taxifolia* are stated below:

- Avoid boating near or disturbing beds of the weed.
- Inspect any equipment used in the Port River before using it in any other area.
- Wash ropes and other equipment after use in plastic bins using freshwater and bleach.
- Inspect diving and boating equipment for the weed before and after use.
- Collect any fragments of the weed you may have accidentally collected on your equipment and place it in a biodegradable plastic bag. Place it in a garbage bin. Do not return any fragments to the sea. (source: http://www.pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/introduced_seaweed#toc0; visited the 5/09/2017)

These recommendations should be followed and unnecessary disturbance of the river bed colonised by *Caulerpa* should be avoided.

The previous capital dredging campaign demonstrated that disposal of spoil at depth (i.e. approximately 30 m at the Spoil Disposal Grounds in Gulf St Vincent) killed the *Caulerpa* biomass and accordingly restricted the spread of *Caulerpa* species. With the high cover of *Caulerpa* within this Project's dredge site, disposal at the Spoil Disposal Grounds is deemed to sufficiently treat the risks of *Caulerpa* spread.

Dredged spoil is expected to contain pest species (e.g. *Caulerpa* and the European fan worm). These should be considered when assessing disposal options to avoid further colonisation.

5.0 CLOSURE

Direct impact of the dredging operation should affect low conservation status species and communities.

Seagrasses (*Zostera* sp.) were not present within the dredge area. As such, dredging activities will not have a direct impact on seagrass. Temporary indirect impacts during dredging operations on seagrass outside of the dredge area may result from a suspended sediment plume. Sediment plumes increasing turbidity and siltation may be contained through the use of an overflow valve (anti-turbidity system), slow dredging runs and/or using silt curtains when dredging.

In addition, seagrasses potentially present in the shallowest adjacent zones to the dredge area could be impacted when installing the submerged flexible pipeline. Such impact should be restricted to the small area corresponding the pipe path and be temporary, limited to the installation phase if movements of the pipe on the seabed are constrained.

Cumulative impacts are not expected due to the limitation in time and in area of the dredging operations.

Noxious and pest aquatic species were found in the dredge area. Caution should be taken during dredging operations and for disposal of the dredged spoil to avoid the dissemination of pests in the aquatic system and the infestation of new areas.

6.0 IMPORTANT INFORMATION

Your attention is drawn to the document – "Important Information", which is included in Appendix E of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

7.0 REFERENCES

Borowitzka, M.A., Lavery, P.S., van Keulen, M., 2006. Epiphytes of seagrasses. In: Larkum, A.W.D., Orth, P.J. & Duarte, C.M. (eds), Seagrasses: Biology, Ecology and Conservation. Springer: berlin. pp. 441-461.

Butler, A., Jernakoff, P., 1999. Seagrass in Australia - strategic review and development of an R & D plan. Fisheries Research and Development Corporation and CSIRO.

Erftemeijer, P.L. and Lewis, R.R.R., 2006. Environmental impacts of dredging on seagrasses: a review. *Marine pollution bulletin*, *52*(12), pp.1553-1572.

Golder, 2013. 137663005-001-M-Rev0. Diver Reconnaissance Survey of Berth 8 and the Caulerpa Trench, Outer Harbor, South Australia.

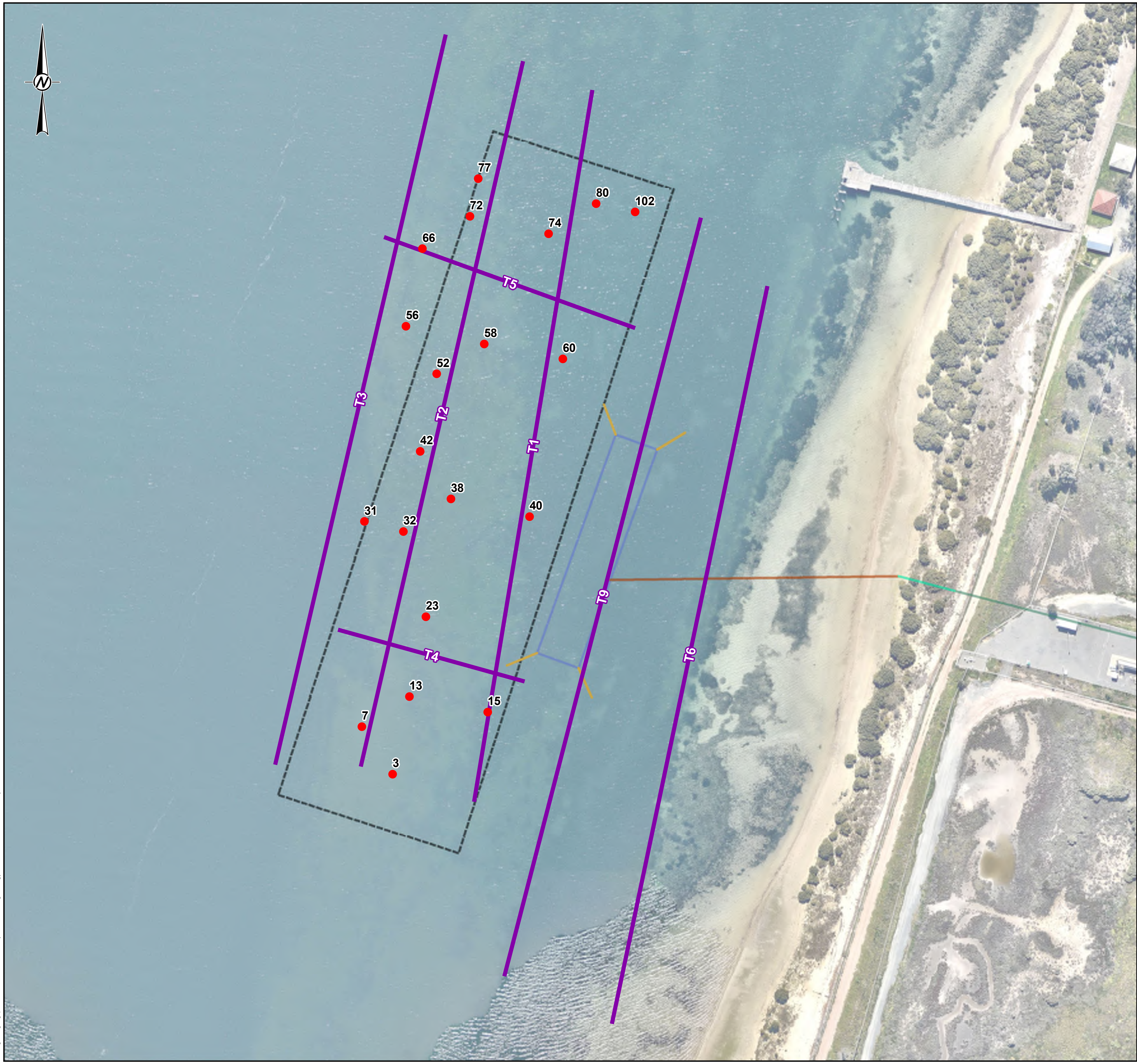
Jernakoff P., Brearley A. & Nielsen J., 1996. Factors affecting grazer-epiphytes interactions in temperate seagrass meadows. *Oceanography and Marine Biology: an Annual Review*, 34: 109-162.

National Assessment for Dredging Guidelines 2009. Commonwealth of Australia. *National Assessment Guidelines for Dredging (*NADG). Canberra.

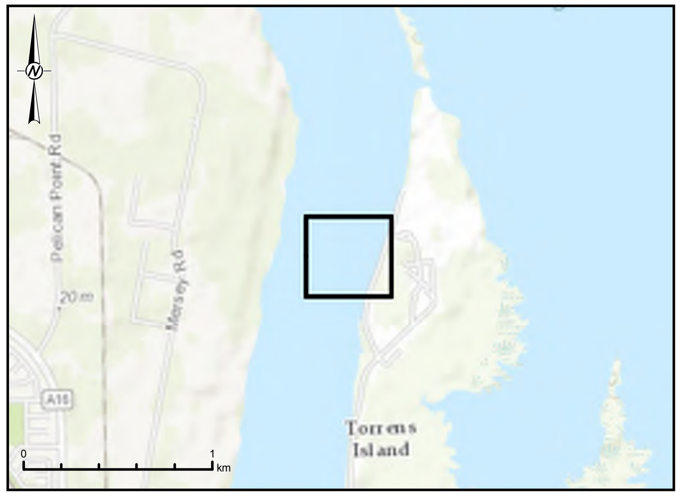
Primary Industries and Regions SA (PIRSA) (2017). Introduced seaweed. Online resource: http://www.pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/introduced_seaweed#toc0, Accessed the 5/09/2017.

APPENDIX A

Study area, diver surveys and towed video transects locations



LOCATION MAP



LEGEND

- Diver Surveys
- Video Transects
- Pipeline - Below Ground
- Pipeline - Above Ground
- Mooring Chain
- Flexible Pipe
- Dredging Area
- Barge

NOTES

1. Imagery dated 10/09/2015, sourced from nearmap.com.
2. Location map sourced from Esri online basemaps.

0 20 40 60 80 100 120
METRES

REFERENCE SCALE: 1:1,500 (at A3)

PROJECTION: GDA 1994 MGA Zone 54

CLIENT
ORIGIN

PROJECT
PROJECT LISA

TITLE
STUDY AREA, DIVER SURVEYS AND VIDEO TRANSECT LOCATIONS

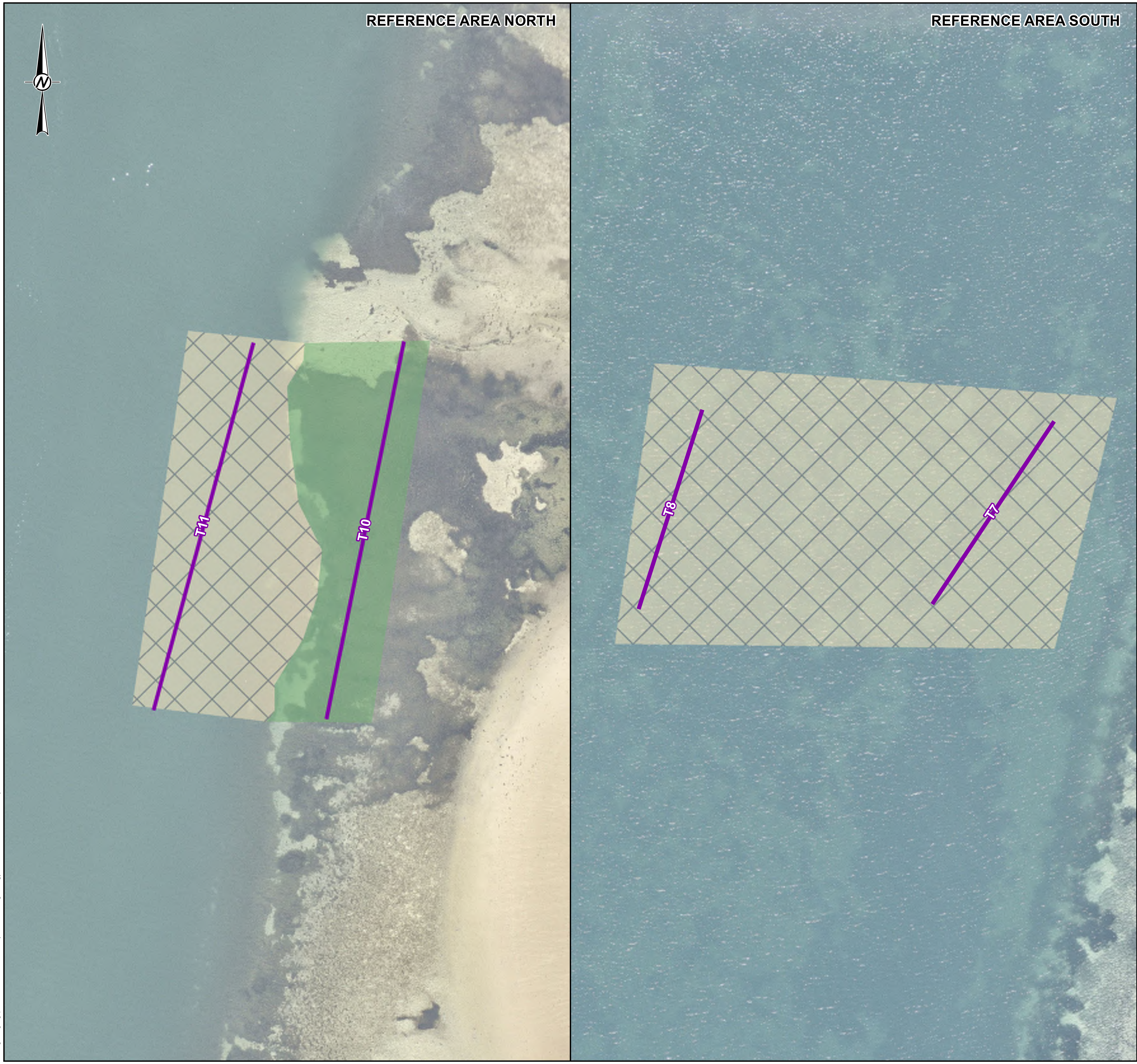
CONSULTANT
Golder Associates

YYYY-MM-DD	2017-12-05
PREPARED	CJS
DESIGN	-
REVIEW	LVC
APPROVED	LVC

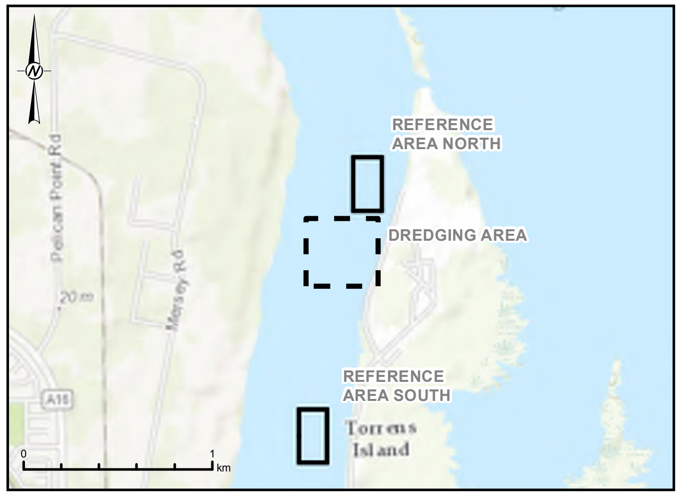
PROJECT No.	CONTROL	Rev.	FIGURE
1783241	007-R	0	1

APPENDIX B

Towed video transects locations and Habitats distribution - Reference Areas



LOCATION MAP



LEGEND

Video Transects

Video Transect Habitats

Zostera sp.

Caulerpa spp.

NOTES

1. Imagery dated 01/06/2017, sourced from nearmap.com.
2. Location map sourced from Esri online basemaps.

0 20 40 60 80 METRES

REFERENCE SCALE: 1:1,000 (at A3)

PROJECTION: GDA 1994 MGA Zone 54

CLIENT
ORIGIN

PROJECT
PROJECT LISA

TITLE
UPSTREAM AND DOWNSTREAM VIDEO TRANSECT LOCATIONS - HABITATS DISTRIBUTION

CONSULTANT

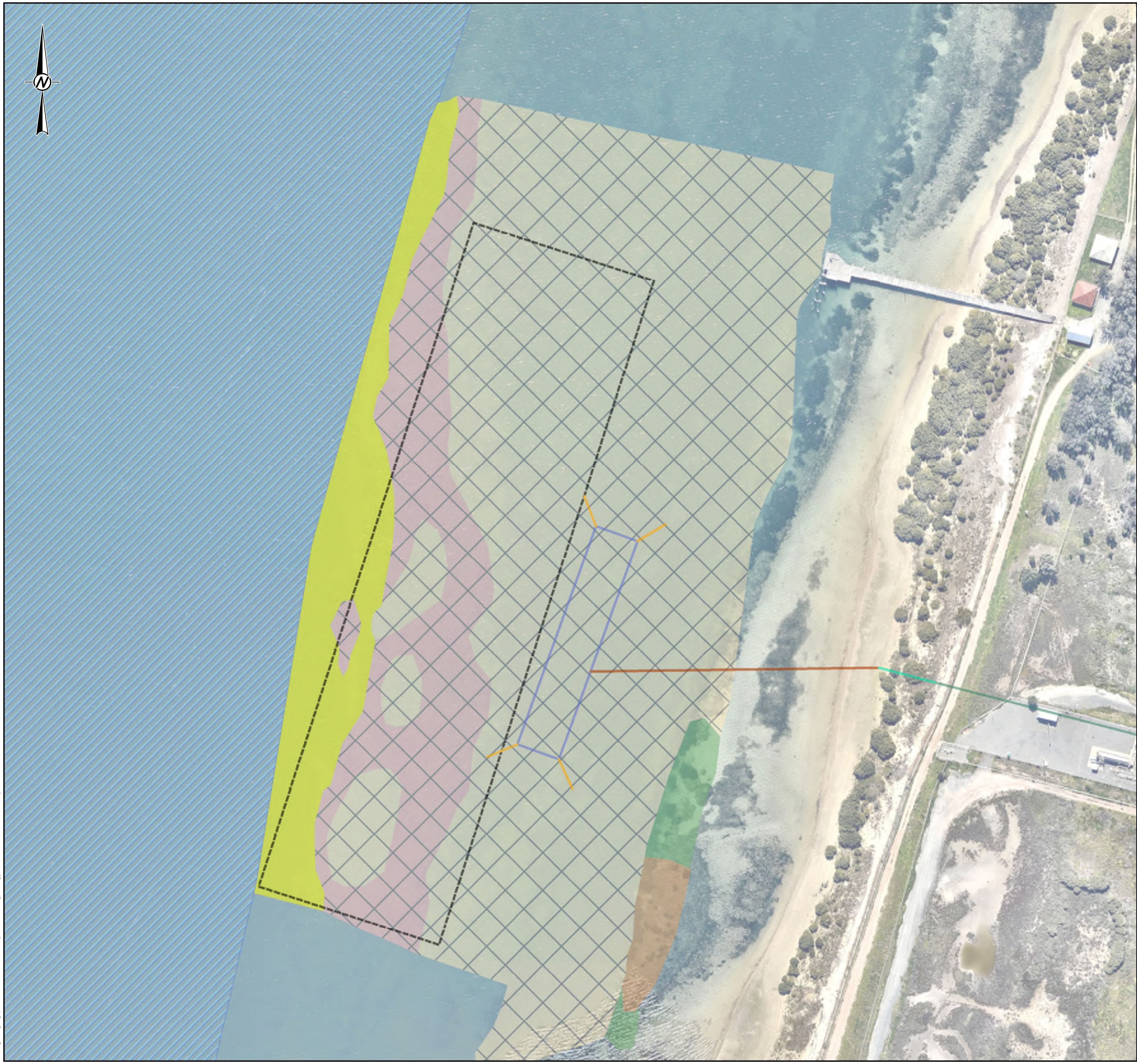
Golder Associates

YYYY-MM-DD	2017-12-05
PREPARED	CJS / AFE
DESIGN	NJT
REVIEW	LVC
APPROVED	LVC

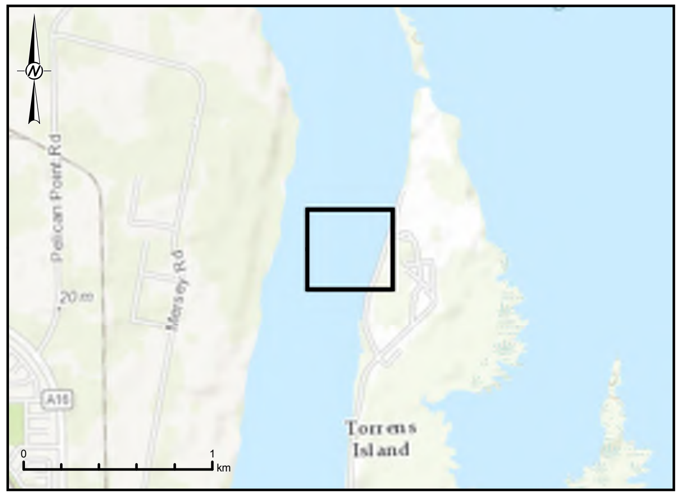
PROJECT No.	CONTROL	Rev.	FIGURE
1783241	007-R	0	2

APPENDIX C

Habitats distribution – Dredge Area



LOCATION MAP



LEGEND

- Pipeline - Below Ground
- Pipeline - Above Ground
- Mooring Chain
- Flexible Pipe
- Dredging Area
- Barge
- Shipping Channel

Main Habitat

- Silt / Mud / Shell Grit
- Soft Sediment with Patchy Red Algae 1 and Caulerpa spp. (<25% cover)
- Soft Sediment with Patchy Red Algae 2
- Zostera sp.
- Caulerpa spp. (>50% cover)

NOTES

1. Imagery dated 10/09/2015, sourced from nearmap.com.
2. Location map sourced from Esri online basemaps.

0 20 40 60 80 100 120
METRES

REFERENCE SCALE: 1:1,500 (at A3)

PROJECTION: GDA 1994 MGA Zone 54

CLIENT
ORIGIN

PROJECT
PROJECT LISA

TITLE
INTERPOLATED MAIN HABITATS DISTRIBUTION

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-12-05
PREPARED	CJS / AFE
DESIGN	NJT
REVIEW	LVC
APPROVED	LVC

PROJECT No.	CONTROL	Rev.	FIGURE
1783241	007-R	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3

25mm

APPENDIX D

EPBC Act Protected Matters Report (5 km radius)

Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

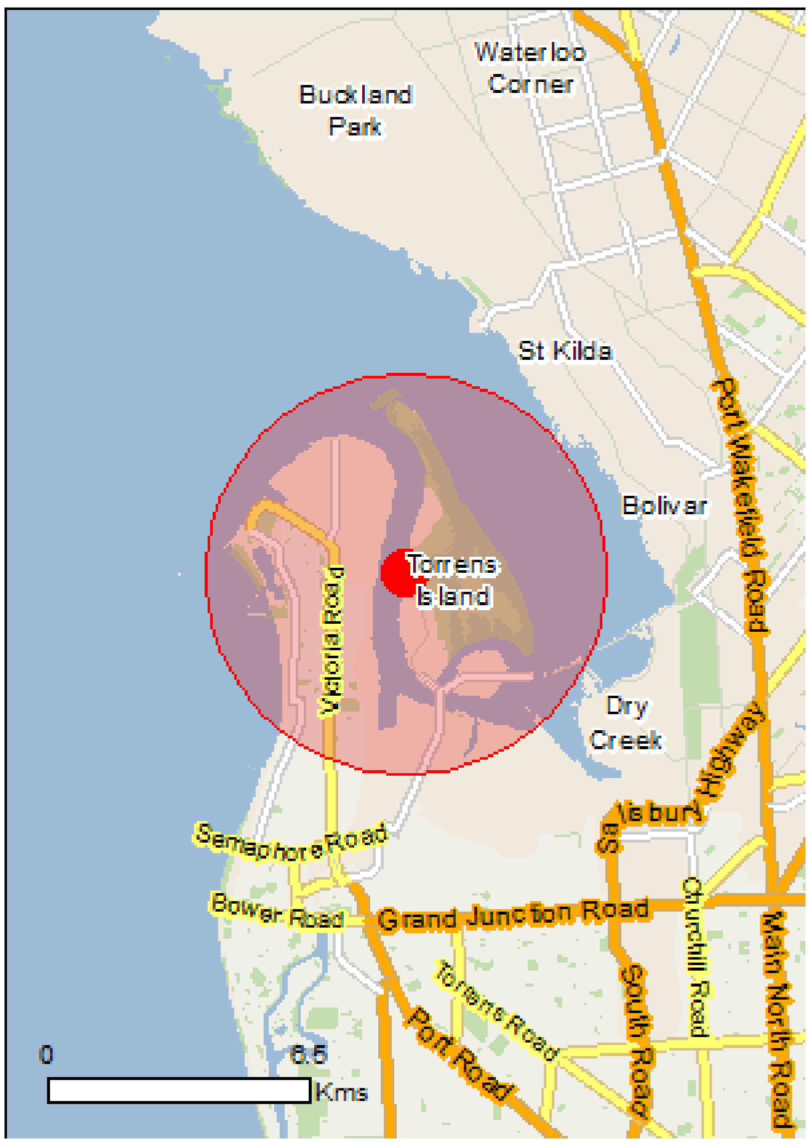
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

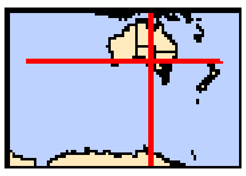
Report created: 07/09/17 14:18:26

Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	40
Listed Migratory Species:	58

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	100
Whales and Other Cetaceans:	8
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	35
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Acanthiza iredalei rosinae Slender-billed Thornbill (Gulf St Vincent) [67080]	Vulnerable	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area

Name	Status	Type of Presence
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area
Prasophyllum validum Sturdy Leek-orchid [10268]	Vulnerable	Species or species habitat may occur within area
Tecticornia flabelliformis Bead Glasswort [82664]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Maritime Safety Authority
Commonwealth Land - Australian National Railways Commission
Commonwealth Land - Defence Housing Authority

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Larus dominicanus Kelp Gull [809]		Breeding known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Name	Threatened	Type of Presence
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Torrens Island	SA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Barker Inlet & St Kilda	SA
Port Gawler & Buckland Park Lake	SA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-34.78851 138.51764

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX E

Important Information

IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

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Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification.

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APPENDIX E

Air quality assessment

Air Quality Assessment of Quarantine Power Station, Torrens Island

Prepared for:

Origin Energy Power Pty Ltd

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Final

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Glossary

Term	Definition
$\mu g/m^3$	micrograms per cubic metre
°C	degrees Celsius
km	kilometre
MW	Megawatt
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
Nomenclature	**Definition**
CO	carbon monoxide
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
Abbreviations	**Definition**
Air Quality EPP	*Environment Protection (Air Quality) Policy 2016*
LPG	Liquid petroleum gas
QPS	Quarantine Power Station
QPSX	Quarantine Power Station with expansion
SA EPA	South Australia Environment Protection Authority
TAPM	The Air Pollution Model

EXECUTIVE SUMMARY

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station on Torrens Island, Adelaide. The assessment is to support a Development Application for Project LISA, which will allow Unit 5 to operate on either LPG or natural gas as required.

The Air Quality Assessment has used a dispersion modelling approach. A site-specific meteorological data file has been generated using the TAPM and CALMET meteorological models. The meteorological modelling has accounted for local terrain and land use features of the surrounding region.

Emission rates and stack characteristics have been determined from the manufacturer's specifications, emission limits, and emissions information provided by Origin. Emission rates and stack characteristics of the proposed units have been selected to provide a worst-case estimate of the potential impact of Project LISA on air quality. Dispersion modelling scenarios have also been selected to reflect proposed expansion project to install up to 3 additional units at Quarantine Power Station (QPSX project) and the upgrade of the gas turbines on existing Units 1-4, which may occur before or after commissioning of Project LISA.

The CALPUFF dispersion model has been used to predict ground-level concentrations of nitrogen dioxide due to Project LISA and QPSX project. Scenarios have been assessed that reflect the commissioning of Project LISA both before and after the planned upgrade of gas turbines on Units 1-4.

The Air Quality Assessment has shown that ground-level concentrations of nitrogen dioxide due to Project LISA in all modelled scenarios ***comply*** with the air quality criteria at all locations across the model domain outside the QPS site boundary. The predicted ground-level concentrations of nitrogen dioxide have included a conservative estimate of the ambient background levels of nitrogen dioxide. The maximum cumulative concentrations were predicted to be, at most, 34% of the air quality criteria.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station (QPS) on Torrens Island, Adelaide. The assessment is to support a Development Application (DA) for Project LISA, which will allow Unit 5 to operate on either LPG or natural gas as required.

Origin currently operates the QPS, which supplies power to the South Australian market during periods of peak demand. The existing power station consists of four Alstom GT10B gas turbines (Units 1-4) and one GE 9E gas turbine (Unit 5) each operating primarily on natural gas and with a combined capacity to generate up to 224 megawatts (MW) of electricity. Origin proposes to replace the gas turbines on Units 1-4 over the next three to four years as part of routine maintenance and to expand the power station's generating capacity by a nominal 160 to 180 MW using up to three additional three new gas turbines. In addition, Origin proposes to begin operating Unit 5 on liquid petroleum gas (LPG) as required. This air quality assessment is to support Origin's DA for the dual fuel operation of Unit 5 (Project LISA).

There is some uncertainty around the timing of the replacement of the gas turbines on Units 1-4, the QPSX project, and commissioning of Project LISA. The air quality assessment has accounted for this uncertainty by considering four dispersion modelling scenarios that are conservative, as they include the QPSX project, and reflect the possible commissioning of Project LISA both before and after the replacement of the gas turbines on Units 1-4.

This assessment has addressed the following scope of works:

- Describe the relevant regulatory requirements including relevant air pollutants and maximum concentration criteria relevant to Project LISA.
- Describe the neighbouring land use, potential sensitive receptors and existing ambient air quality levels in the vicinity of the QPS.
- Develop a site-specific meteorological data file for the site, and describe the meteorological patterns relevant to dispersion of emissions from the QPS after commissioning of Project LISA.
- Estimate emissions of NO_x from Project LISA based on a review of manufacturer's specifications, emission limits, and emissions information provided by Origin.
- Conduct dispersion modelling to predict ground-level concentrations of NO_2 due to Project LISA and QPSX.
- Assess the results of the dispersion modelling against the relevant maximum concentration criteria with the addition of a representative ambient background concentration.

2. THE PROJECT

Project LISA is a customised solution to increase the fuel supply to one of the largest gas turbine generators in South Australia and de-constrain a network that reaches capacity using natural gas.

The QPS has a generation capacity of 224 MW consisting of:

- Units 1- 4 (96 MW total) commissioned in 2002.
- Unit 5 (128 MW) commissioned in 2009.

Origin proposes to upgrade Unit 5 to have dual fuel capabilities (LPG and natural gas) with associated fuel storage on a barge in Port River.

The Project will supply LPG from a SGC (Replenishment Ship) to a Storage Barge that is moored in Port River.

The Storage Barge has been designed to provide for 4.5 days of continuous operation of the 128 MW gas turbine (equivalent to 13,000 MWh of fuel storage). LPG will be transferred via secure ship-to-barge and then Barge-to-Unit pipes and hoses, as used on existing LPG ships owned by Origin.

After some equipment upgrades and installation of new vaporisers, Unit 5 will use LPG to generate electricity in response to peaking power needs. Response times are rapid (i.e. within 24 minutes) and constrained only by Unit 5 start-up times. Dual fuel is required because start-up and shut-down of the turbine in Unit 5 will still require natural gas.

The location of QPS on Torrens Island is shown in Figure 1.

Figure 1 Quarantine Power Station and surrounds

3. AIR QUALITY ASSESSMENT METHODOLOGY

3.1 Overview

The assessment is based on a dispersion modelling study incorporating source characteristics and operational activity data with meteorology that is representative of the site and surrounding region. The assessment has been prepared in accordance with the SA EPA's document: *Ambient air quality assessment* (SA EPA, 2016), regulatory requirements (Section 4) and best practice approaches. The proposed methodology was developed with agreement from EPA personnel prior to the assessment being conducted.

The site location and surrounding environment has been described in Section 5 in terms of:

- Land-use
- Terrain features
- Sensitive receptor locations.

The existing air quality in the region has been described in Section 5 based on:

- National Pollutant Inventory (NPI) database for sources in the region
- Ambient air quality monitoring data recorded by the SA EPA's monitoring network.

The local meteorology at the site, including wind speed, direction, atmospheric stability and mixing height, have been described using site-specific data generated by the TAPM and CALMET meteorological models (Section 6).

The assessment has focused on nitrogen dioxide (NO_2) as this is the key pollutant emitted to the atmosphere from gas turbines. For operation using both natural gas and LPG other pollutants that may be emitted in very small quantities include carbon monoxide, particulate matter, volatile organic compounds (VOCs) and sulfur dioxide. These have not been explicitly assessed, as they are typically emitted in trace amounts. NO_2 is a suitable indicator of the overall risk to air quality posed by Project LISA.

Emission rates of NOx and stack characteristics have been selected based on a review of stack test data, manufacturer's specifications, emission limits, and emissions information provided by Origin (Section 7).

The following scenarios have been considered in assessing Project LISA should this occur ***prior*** to the replacement of the four existing GT10B gas turbines:

- Scenario 1:
  - Existing Units 1-4
  - Unit 5 running on natural gas
  - Units 6-8 (QPSX project)
- Scenario 2:
  - Existing Units 1-4
  - Unit 5 running on LPG (Project LISA)
  - Units 6-8 (QPSX project).

The following two scenarios have been considered in assessing Project LISA should this occur ***after*** the replacement of the four existing GT10B gas turbines:

- Scenario 3:
  - Upgraded Units 1-4

    - Unit 5 running on natural gas
    - Units 6-8 (QPSX project)
- Scenario 4:
    - Upgraded Units 1-4
    - Unit 5 running on LPG (Project LISA)
    - Units 6-8 (QPSX project).

Predicted ground-level concentrations of NO_2 due to Project LISA have been predicted using the CALPUFF dispersion model, driven by the site-specific meteorological data generated by TAPM/CALMET. Ground-level concentrations have been determined across a Cartesian grid of receptors (Section 8).

The potential cumulative impact of Project LISA other existing sources of NO_2 in the vicinity has been estimated using conservative background concentrations derived from monitoring data recorded at the nearest SA EPA ambient air quality monitoring stations. The predicted ground-level concentrations of NO_2 due to Project LISA plus existing sources of NO_2 have been assessed by comparison with the legislated maximum concentration criteria. (Section 8).

3.2 Meteorology

The prognostic model TAPM (developed by the Commonwealth Scientific and Industrial Research Organisation [CSIRO], version 4.0.5) and the diagnostic meteorological model CALMET (developed by EarthTec, version 6.5.0) were used to generate the three-dimensional meteorological dataset for the region. Following discussions with the EPA, 2009 was selected for the meteorological model simulation as a representative year. The TAPM generated dataset was evaluated by comparison with monitoring data from the SA EPA's Le Fevre site. This evaluation is presented in Appendix A.

The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the innermost nest. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

The three-dimensional wind field produced by TAPM/CALMET was then used to create a meteorological file suitable for us with the CALPUFF dispersion model.

Details of the model configuration and evaluation are presented in Appendix A.

3.3 Emission Rates

Emission rates for the existing units have been selected based on a review of available stack test data from 2007 to 2017 and the emission limits in the Air Quality EPP. Emission rates of NOx and stack characteristics for proposed units and the proposed operation of Unit 5 with LPG have been based on a review of manufacturer's specifications, emission limits, and emissions information provided by Origin (Section 7). Where possible, the combination of emission parameters likely to result in worst-case air quality impacts have been selected for each unit.

3.4 Dispersion Modelling

The air quality impact assessment was conducted in accordance with recognised techniques for dispersion modelling. Air dispersion modelling was conducted using the CSIRO air dispersion model TAPM and the meteorological field was further refined using the CALMET meteorological model. CALPUFF was used to predict ground-level concentrations of nitrogen dioxide across the model domain due to the Project LISA.

CALPUFF is an advanced non-steady-state air quality modelling system. Twelve months of modelled meteorological data was used as input for the dispersion model in order to include all weather conditions likely to be experienced in the region during a typical year. The modelling has been used to predict maximum ground-level concentrations of air pollutants across a Cartesian grid and at the locations of the nearest sensitive receptors.

Source characteristics and pollutant emission rates were incorporated into a dispersion modelling study. This was conducted using a standard and regulated model developed by EarthTec, the CALPUFF model (version 7.21). Emission sources were configured in CALPUFF. Source characteristics have been summarised in Section 7. Air emissions have been conservatively modelled as constantly emitting over 24 hours/day for the entire year.

Technical details of the configuration of the CALPUFF model are presented in Appendix A.

3.5 Methods for the conversion of NOx to NO_2

Nitric oxide (NO) that is emitted by power stations can undergo chemical transformation in the atmosphere to form NO_2. NO_2 is more toxic than NO and therefore it is important to quantify the transformation of NO to NO_2 in the atmosphere. Measurements around power stations in Central Queensland show, under worst possible cases, a conversion of 25-40% of the nitric oxide to nitrogen dioxide occurs within the first 10 kilometres of plume travel. During days with elevated background levels of hydrocarbons (generally originating from bush-fires, hazard reduction burning or other similar activities), the resulting conversion is usually below 50% in the first 30 kilometres of plume travel (Bofinger et al 1986). For this air dispersion modelling assessment, a ratio of 30% conversion of the oxides of nitrogen to nitrogen dioxide has been assumed, which is very conservative considering the short travel time of the plume to the maximum ground-level concentrations.

3.6 Cumulative Impacts

To determine the potential impact of Project LISA in conjunction with existing emission sources of NO_2, an estimate of the background level of NO_2 has been made using data recorded by the SA EPA's ambient air quality monitoring network. As discussed in Section 5.3.2, data from the three nearest monitoring sites at Le Fevre, Netley and Northfield has been analysed and conservative background values selected.

4. LEGISLATIVE FRAMEWORK FOR AIR QUALITY

In SA, environmental protection from the effects of emissions to air are managed by a range of policies and guidelines, with the foundation provided by the *Environment Protection Act 1993*. Section 25 of the *Environmental Protection Act 1993* imposes a general environmental duty on all persons undertaking an activity that pollutes or might pollute the environment, requiring them to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm. The Environment Protection (Air Quality) Policy 2016 (Air EPP) provides specific requirements for air quality regulation and management across the state, including maximum ground-level concentrations of air pollutants and stack emission limits.

Schedule 4 of the Air Quality EPP specifies limits to emissions to air of pollutants produced on premises emitted through a chimney, flue or vent. Emission limits of relevance to the QPS are reproduced in Table 1.

Table 1 Stack emission limits (Schedule 4 of the Air Quality EPP)

Pollutant	Activity	Maximum pollutant level
Oxides of nitrogen	Gas turbines for power generation of 10MW or greater – for gaseous fuels	70 mg/m³ referenced to 15% by volume of oxygen
Table note: * All volumes (m^3) are expressed as volume of dry gas at 0°C and 101.3 kPa.		

Schedule 2 of the Air Quality EPP specifies ambient air quality criteria specified as maximum ground level concentrations that are to occur at sensitive receptor locations. To demonstrate that no adverse effects will occur at ground level due to emissions from a proposed or existing facility, proponents are required to use atmospheric dispersion modelling techniques to predict the maximum ground-level concentrations which will result. Proponents are required to show that these maximum concentrations are less than the ground level concentrations specified in Schedule 2 of the Air Quality EPP at all sensitive receptor locations, and at all times. The specified maximum ground level concentrations are based on protecting public health and amenity, or other environmental factors. Ground level concentration limits of relevance to the QPS are reproduced in Table 2.

The assessment has also been conducted with reference to the SA EPA's guidance document *Ambient air quality assessment* (2016) and in consultation with SA EPA's technical air quality staff.

Origin operates QPS under the Environmental Authorisation (EA) Licence No. 13697.

Table 2 Air quality criteria used in the assessment (Schedule 2 of the Air Quality EPP)

Pollutant	Classification	Averaging time	Maximum concentration	
			µg/m³	ppm
Nitrogen dioxide	Toxicity	1-hour	250	0.12
		Annual	60	0.03

5. EXISTING ENVIRONMENT

5.1 Local terrain and land use

QPS is located on Torrens Island, approximately 15 km to the north of Adelaide CBD. The land surrounding the plant on Torrens Island is mainly low lying and coastal. The terrain at QPS and across the surrounding area is relatively flat, with the plant site at an elevation of approximately 5m above sea level.

Land use on the adjacent outer harbour to the east of the site along with the areas immediately south of Torrens Island is a mix of residential and industrial. Torrens Island is bordered to the east by the mangrove areas of the Barker Inlet. The greater Adelaide region is also a mix of residential and industrial land uses.

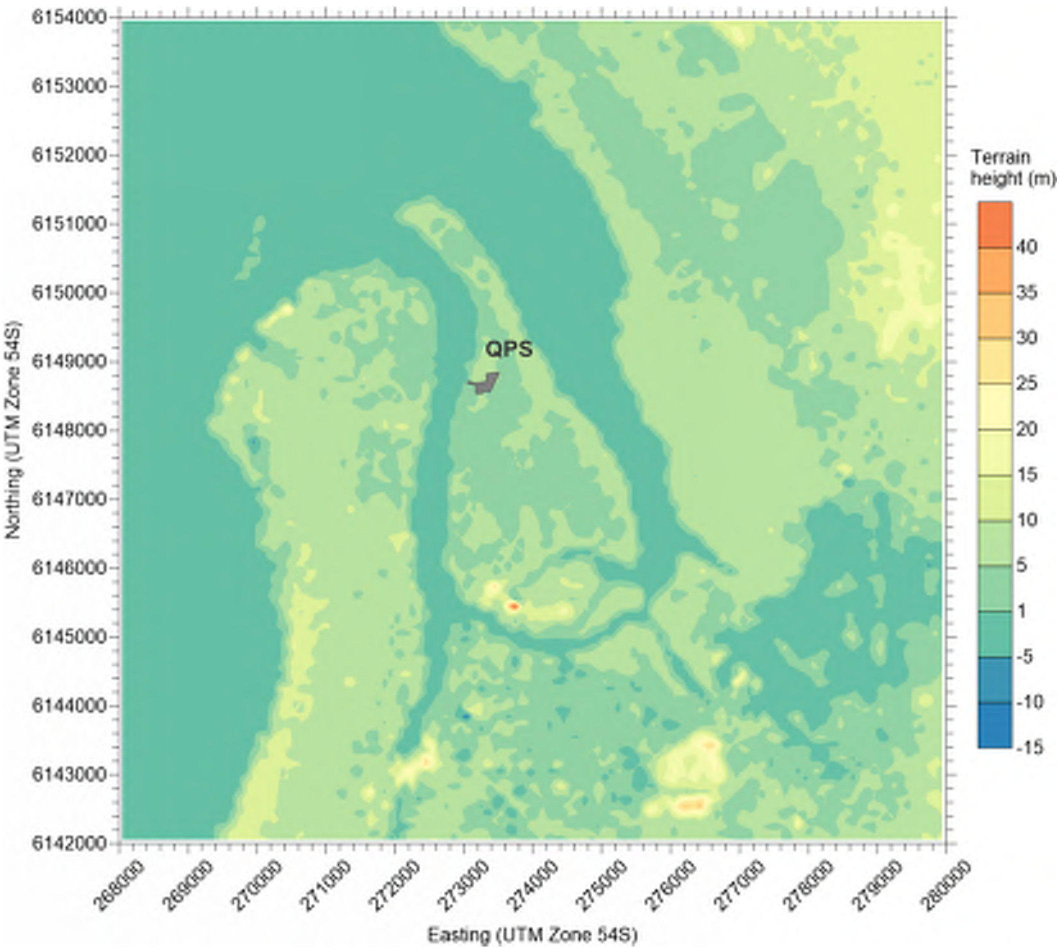

Figure 2 **Terrain elevation (m)**

5.2 Sensitive receptors

The nearest sensitive receptors to QPS are located over 2km west of the site. Ground level concentrations of air pollutants have been assessed across a Cartesian grid that encompasses all sensitive receptors in the local area.

5.3 Existing air quality

5.3.1 Existing sources of emissions

There are a variety of industries operating in the Torrens Island and Port Adelaide area. A search of the National Pollutant Inventory for the 2015-2016 reporting year identified 11 other facilities with emissions of the same key pollutants as the QPS. A summary of these industries, and the reported emissions of NO_x, CO and PM_{10} is presented in Table 3. The most significant source of NO_x emissions is the AGL Torrens Island Power Station, located approximately 3km south of QPS, followed by the Birkenhead Cement Plant, which is approximately 6km from QPS.

Table 3 Emissions inventory of NO_x, CO and particulates for facilities within 6km of QPS, as reported to the NPI for the 2015-2016 reporting year

Facility	Location	Industry	Distance and direction from the QPSX project	Emission rate (kg/year)		
				NO_x	CO	PM_{10}
Quarantine Power Station	Torrens Island	Electricity generation using natural gas	-	73,135	11,141	4,778
Quarantine Meter Station	Torrens Island	Natural gas metering station	-	232	195	17
Pelican Point Power Station	Outer Harbor	Electricity generation	1.9 NW	105,122	17,061	6,689
Pelican Point Meter Station	Outer Harbor	Natural gas metering station	1.9 NW	1,345	1,134	100
OSBORNE COGENERATION PLANT	Osborne	Electricity and steam production	2.4 SW	326,473	13,701	412
Flinders Adelaide Container Terminal	Outer Harbor	Container freight slipping	2.8 NW	6,695	4,108	684
Torrens Island Meter Station	Outer Harbor	Natural gas metering station	2.8 S	28,588	24,088	2,118
AGL TORRENS ISLAND POWER STATION	Torrens Island	Electricity supply – generating using natural gas & fuel oil	3.1 S	3,115,936	323,921	107,941
Malt Port Adelaide	Port Adelaide	Malting barley for the manufacture of malt	5.5 S	4,476	7,588	6,362
Viva Energy Birkenhead Bitumen Plant	Peterhead	Bitumen storage and distribution	5.8 SSW	1,215	1,015	90
Bolivar Wastewater Treatment Plant	Bolivar	Treatment of wastewater	5.9 NE	38,501	5,440	1,674
Birkenhead Plant	Birkenhead	Cement manufacturing	6.2 SSW	2,966,640	611,083	121,734

5.3.2 Existing ambient air quality

The EPA carries out air quality monitoring of criteria air pollutants for the Air NEPM at various locations in Adelaide, including Le Fevre Primary, Netley, Northfield, Kensington, Elizabeth and Christies Beach. The nearest monitoring stations to the QPS measuring levels of nitrogen dioxide are at Le Fevre, Netley and Northfield. The Le Fevre site is located closest to QPS and overall, has recorded lower concentrations of NO_2 than the Netley and Northfield sites.

Table 4 Ambient concentrations of NO_2 recorded at the nearest EPA monitoring stations

Monitoring site	Year	1-hour average NO_2 ($\mu g/m^3$)[1]			Annual average NO_2 ($\mu g/m^3$)[1]
		Maximum	90^{th} percentile	70^{th} percentile	
Le Fevre	2013	70.2	24.1	11.6	10.0
	2014	60.8	24.4	11.9	9.5
	2015	67.7	24.4	11.3	9.6
	2016	63.9	20.7	9.4	7.3
Netley	2013	77.7	34.5	15.4	12.1
	2014	86.2	37.6	18.5	14.6
	2015	88.4	35.7	16.9	13.5
	2016	73.3	32.0	13.2	12.1
Northfield	2013	67.7	27.0	11.9	10.6
	2014	76.2	27.9	13.5	11.8
	2015	69.6	30.1	15.0	13.1
	2016	73.3	26.3	11.3	10.4
Air NEPM standard		**250**			**60**

Table note:
[1] Based on conversion from parts per million (ppm) to $\mu g/m^3$ at 25°C and 1atm.

Table 5 presents the ambient background concentrations that have been selected for use in the assessment to determine cumulative levels of NO_x due Project LISA plus existing sources.

Table 5 Ambient background concentrations selected for use in the assessment

Pollutant	Averaging period	Ambient background concentration	Source
NO_x	1-hour	37.6	Maximum 90^{th} percentile measurement from Le Fevre, Netley or Northfield between 2013 and 2016
	Annual	14.6	Maximum measurement from Le Fevre, Netley or Northfield between 2013 and 2016

6. METEOROLOGY

The following sections describe the meteorology of the region surrounding the project, focusing on parameters that are important for dispersion of air pollutants, based on data generated by the TAPM/CALMET models.

6.1 Wind speed and wind direction

Wind speed and wind direction are important meteorological parameters that will influence the dispersion of air pollutants. Figure 3 illustrates the annual wind speed distribution during 2009 at the QPS site, as predicted by CALMET. The predominant wind directions are northeast and southwest, with the strongest winds being sea-breezes from the west.

The wind directions vary considerably throughout the year (Figure 4). During summer, winds are predominantly from the south-west. Through autumn and into winter, winds are increasingly from the west and northeast. Winds during spring occur primarily from the northeast, southwest and west. During winter, 34% of all strong winds (>5m/s) occur, with a further 30% of strong winds occurring during spring, primarily from the west during these seasons.

Figure 5 illustrates the diurnal distribution of winds. The most prominent feature is the south-westerly sea-breeze occurring in the afternoon (midday – 6pm). Winds are strongest during the day (6am – 6pm).

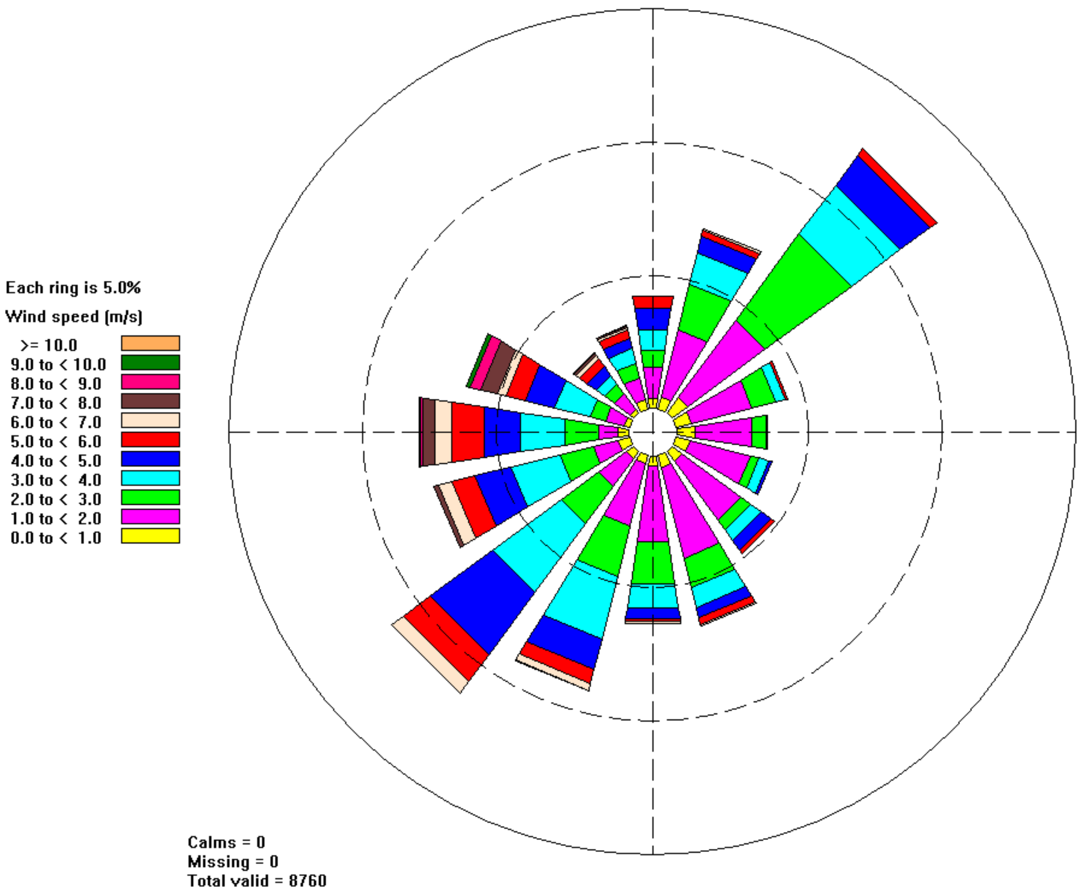

Figure 3 Annual distribution of winds at the project site (CALMET)

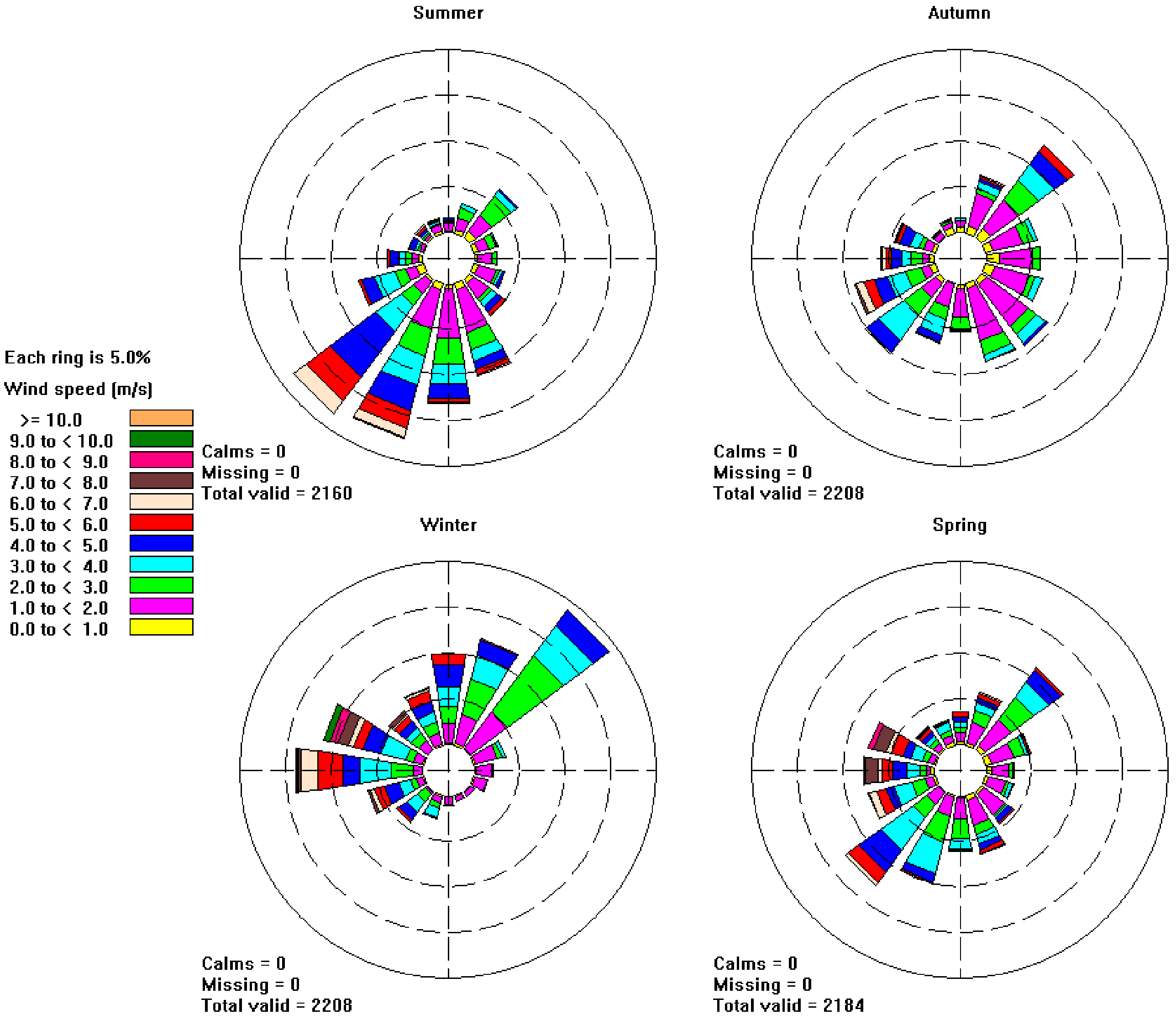

Figure 4 Seasonal distribution of winds at the project site (CALMET)

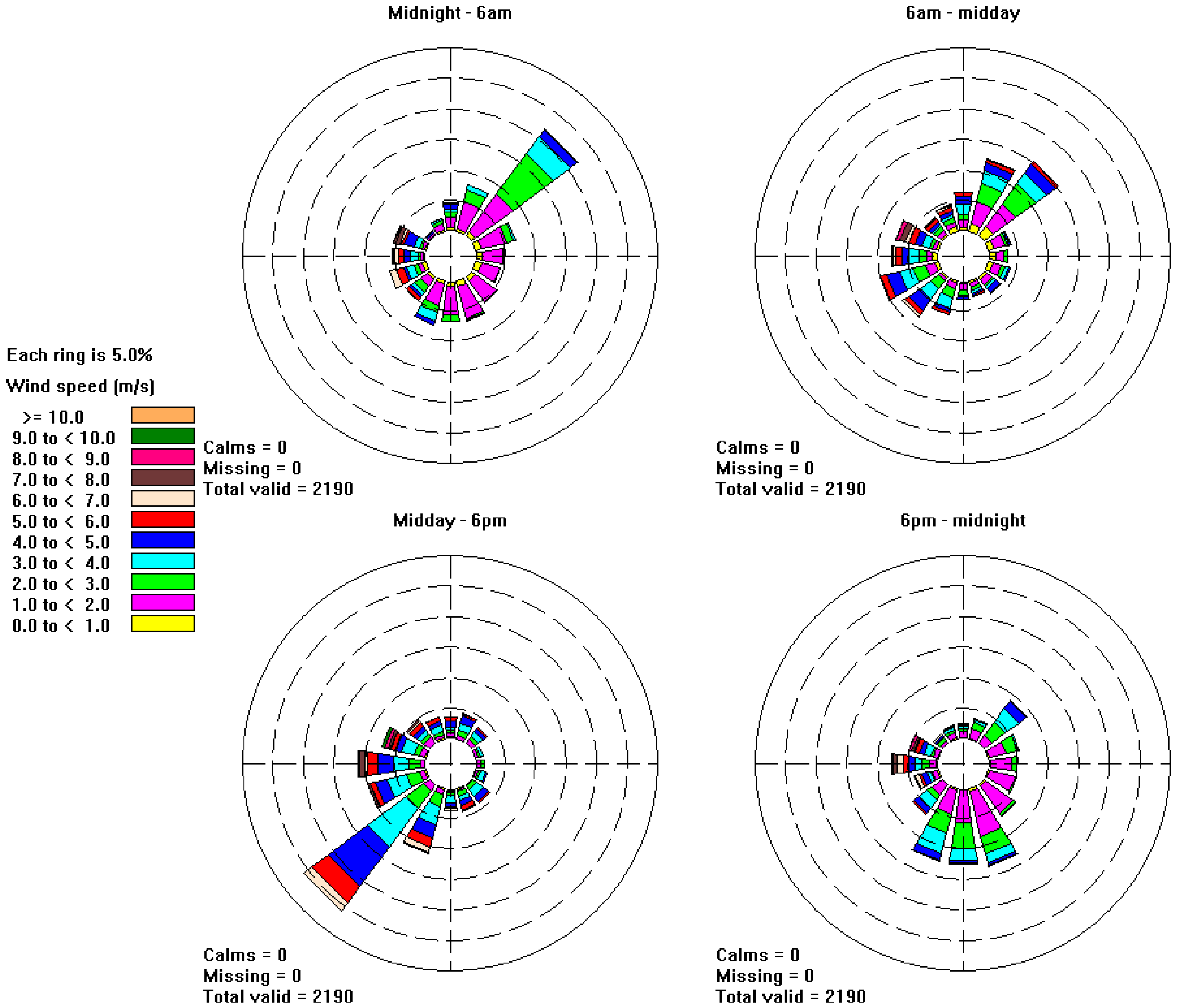

Figure 5 **Diurnal distribution of winds at the project site (CALMET)**

6.2 Atmospheric Stability

Stability classification is a measure of the stability of the atmosphere and can be determined from wind measurements and other atmospheric observations. The stability classes range from A class, which represents very unstable atmospheric conditions that may typically occur on a sunny day to F class stability, which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for the most frequently occurring Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (often classes E and F).

Table 6 shows the overall percentage of stability classes at the project site, and Figure 6 illustrates the diurnal distribution of stability classes. Class D stability occurs approximately 38% of the time due to moderate wind speeds generated by the site's proximity to the coastline and sea breezes. Class F stability occurs approximately 30% of the time and represents calm nights.

Table 6 Frequency of occurrence (%) of surface atmospheric stability at the project site under the Pasquil-Gifford stability classification scheme (as predicted by CALMET)

Pasquil-Gifford stability class	Classification	Frequency (%)
A	Extremely unstable	1%
B	Unstable	10%
C	Slightly unstable	14%
D	Neutral	38%
E	Slightly stable	7%
F	Stable	30%

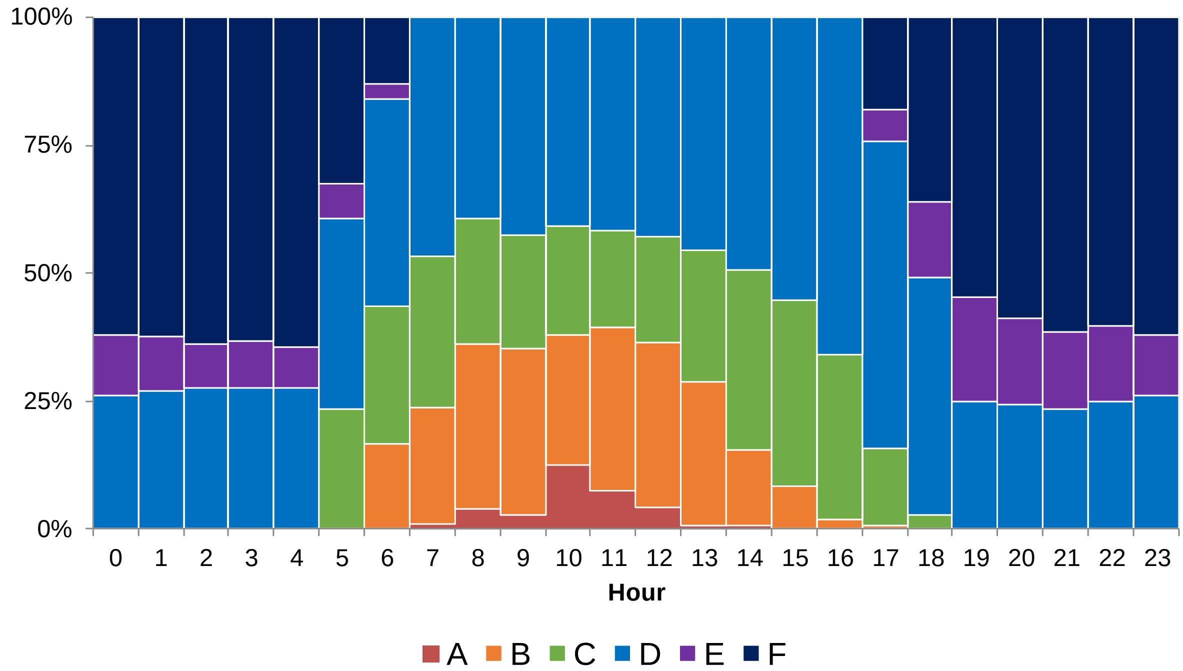

Figure 6 Diurnal distribution of stability classes at the project site

6.3 Mixing height

The mixing height refers to the height above ground within which air pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions, the mixing height is often quite low and dispersion is limited to within this layer. During the day, solar radiation heats the air at the ground level and causes the mixing height to rise. The air above the mixing height during the day is generally cooler. The growth of the mixing height is dependent on how well the air can mix with the cooler upper level air and therefore depends on meteorological factors such as the intensity of solar radiation and wind speed. During strong wind speeds, the air will be well mixed, resulting in a high mixing height.

Mixing height information at the QPS site is presented in Figure 7. The data shows that the mixing height develops around 6 am, increases to a peak at 1 to 3 pm before descending rapidly until 6pm.

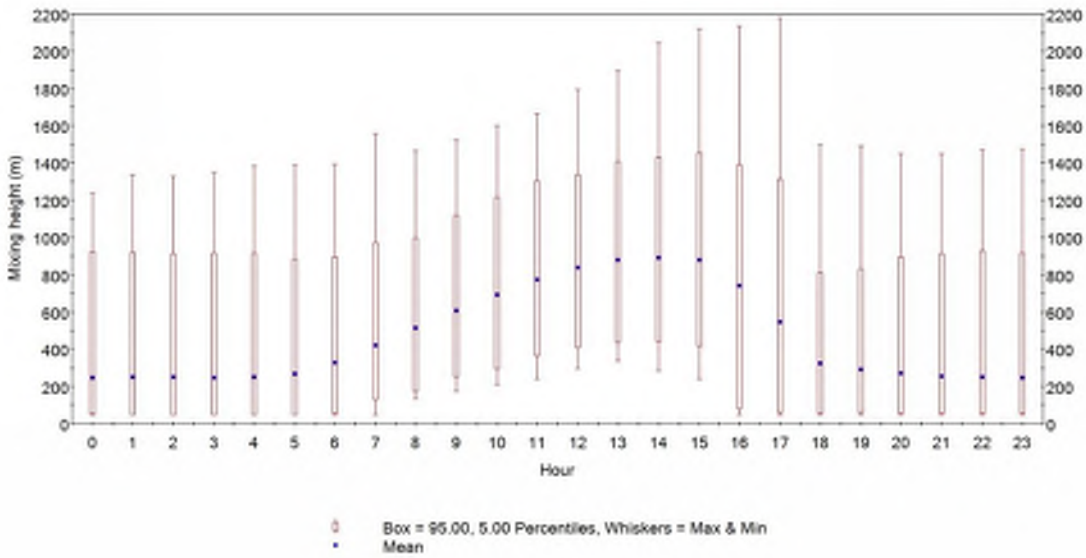

Figure 7 Diurnal profile of modelled mixing height at the project site (CALMET)

7. EMISSIONS TO THE ATMOSPHERE

For this assessment, emission rates and stack characteristics have been selected for dispersion modelling based on historical stack testing data, emission limits specified in the Air Quality EPP and manufacturer's specifications or performance guarantees

Table 7 presents the stack characteristics and emission rates selected for dispersion modelling scenarios 1 and 2, and Table 8 presents the stack characteristics and emission rates selected for dispersion modelling scenarios 3 and 4. Historical stack testing data for Units 1 - 5 is presented in Appendix B for reference.

Table 7 Scenario 1 and 2 - Stack characteristics and emission rates used in the dispersion modelling

Parameter	Units	Units 1 – 4 (existing)	Unit 5 (existing – natural gas)	Unit 5 (existing – LPG)	Units 6-8 (new)
Stack height[1]	m	18	25	25	30
Diameter[1]	m	2.6	5.7	5.7	3.2
Temperature	°C	526[2]	470[2]	470[2]	495[3]
Exit velocity	m/s	25.0[4]	35[5]	35[5]	36.3[3]
Actual flow rate	m^3/s	191.7[6]	1,034[8]	1,034[8]	302.9[9]
Normalised flow rate	Nm^3/s (0°C, dry, 15% O_2)	59[10]	390[11]	390[11]	76.5[12]
Moisture content	%	6.5[13]	6.3[13]	6.3[13]	Not provided
CO_2 concentration	%	3.4[13]	3.4[13]	3.4[13]	Not provided
Oxygen concentration	%	14.9[12]	15.5[13]	15.5[13]	Not provided
NOx (as NO_2)	mg/Nm^3 at 15% O_2	70[7]	70[7]	73.8[17]	51.3[3]
	g/s	4.13[14]	27.3[15]	28.8[15]	3.9[16]

Table notes:
[1] Provided by Origin
[2] Minimum temperature measured in stack tests between 2007 and 2017
[3] Minimum value from information supplied by Origin for four modes of operation
[4] Conservative value, selected to be lower than the expected exit velocity provided by Origin of 36 m/s (which may apply to full load modes of operation only)
[5] Minimum velocity measured in stack tests between 2007 and 2017, less a 5% safety margin
[6] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/m^3) from exhaust composition breakdown
[7] Air Quality EPP emission limit
[8] Average of values calculated from stack test normalised flow rates and exhaust parameters between 2007 and 2017
[9] Calculated from stack diameter and exit velocity
[10] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/Nm^3) from exhaust composition breakdown
[11] Maximum measured during stack tests between 2007 and 2017
[12] Calculated from provided NO_x concentration and emission rate
[13] Average of values reported in stack tests between 2007 and 2017
[14] Calculated from 70 mg/Nm^3, exhaust flow rate provided by Origin, and exhaust composition by weight.
[15] Calculated from maximum flow rate from stack tests between 2007 and 2017 and assumed NO_x concentration
[16] Maximum value from information supplied by Origin for four modes of operation.
[17] Calculated from a maximum NO_2 exhaust concentration of 36 ppm provided by Origin

Table 8 **Scenario 3 and 4 - Stack characteristics and emission rates used in the dispersion modelling**

Parameter	Units	Units 1 – 4 (upgraded)	Unit 5 (existing – natural gas)	Unit 5 (existing – LPG)	Units 6-8 (new)
Stack height[1]	m	18	25	25	30
Diameter[1]	m	2.6	5.7	5.7	3.2
Temperature	°C	519.8[1]	470[2]	470[2]	495[3]
Exit velocity	m/s	25.0[4]	35[5]	35[5]	36.3[3]
Actual flow rate	m^3/s	191.7[6]	1,034[8]	1,034[8]	302.9[9]
Normalised flow rate	Nm^3/s (0°C, dry, 15% O_2)	65.7[10]	390[11]	390[11]	76.5[12]
Moisture content	%	4.7[1]	6.3[13]	6.3[13]	Not provided
CO_2 concentration	%	5.1[1]	3.4[13]	3.4[13]	Not provided
Oxygen concentration	%	15.3[1]	15.5[13]	15.5[13]	Not provided
NOx (as NO_2)	mg/Nm^3 at 15% O_2	51[1]	70[7]	73.8[17]	51.3[3]
	g/s	3.35[14]	27.3[15]	28.8[15]	3.9[16]

Table notes:

[1] Provided by Origin

[2] Minimum temperature measured in stack tests between 2007 and 2017

[3] Minimum value from information supplied by Origin for four modes of operation

[4] Conservative value, selected to be lower than the expected exit velocity provided by Origin of 36 m/s (which may apply to full load modes of operation only)

[5] Minimum velocity measured in stack tests between 2007 and 2017, less a 5% safety margin

[6] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/m^3) from exhaust composition breakdown

[7] Air Quality EPP emission limit

[8] Average of values calculated from stack test normalised flow rates and exhaust parameters between 2007 and 2017

[9] Calculated from stack diameter and exit velocity

[10] Calculated from provided exhaust flow rate (kg/s) and exhaust density (g/Nm^3) from exhaust composition breakdown

[11] Maximum measured during stack tests between 2007 and 2017

[12] Calculated from provided NO_x concentration and emission rate

[13] Average of values reported in stack tests between 2007 and 2017

[14] Calculated from 51 mg/Nm^3, exhaust flow rate provided by Origin, and exhaust composition by weight.

[15] Calculated from maximum flow rate from stack tests between 2007 and 2017 and assumed NO_x concentration

[16] Maximum value from information supplied by Origin for four modes of operation

[17] Calculated from a maximum NO_2 exhaust concentration of 36 ppm provided by Origin

8. RESULTS

This section presents the results of the dispersion modelling assessment of NO_X emissions from Project LISA. The predicted ground-level concentrations of NO_2 across the model domain due to Project LISA project are presented in Plates 1 to Plate 16. The maximum predicted ground-level concentration of NO_2 outside the QPS site boundary are summarised in Table 9 to Table 12 for scenarios 1 to 4.

The results show that:

- Ground-level concentrations of NO_2 due to Project LISA in conjunction with the QPSX project and ambient background concentrations ***comply*** with the air quality criteria across the model domain.
- Ground-level concentrations of NO_2 due to Project LISA are predicted to be marginally lower after the upgrade of Units 1-4.
- The use of LPG rather than natural gas in Unit 5 results in a marginal increase in predicted ground-level concentrations of NO_2.
- At most, ground-level concentrations of NO_2 including a conservative ambient background concentration are predicted to be at most 34% of the air quality criteria.

Table 9 Scenario 1 - Maximum predicted ground-level concentrations of NO_2 outside the QPS site boundary (µg/m³)

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the site boundary due to existing Units 1-4, Unit 5 operating on natural gas, and the QPSX project				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	48.3	19%	85.9	34%	**250 µg/m³**
Annual average NO_2	0.5	0.8%	15.1	24%	**60 µg/m³**

Table 10 Scenario 2- Maximum predicted ground-level concentrations of NO_2 outside the QPS site boundary (µg/m³)

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the site boundary due to existing Units 1-4, Unit 5 operating on LPG, and the QPSX project				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	48.3	19%	85.9	34%	**250 µg/m³**
Annual average NO_2	0.5	0.9%	15.1	24%	**60 µg/m³**

Table 11 **Scenario 3 - Maximum predicted ground-level concentrations of NO_2 outside the QPS site boundary (µg/m^3)**

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the site boundary due to upgraded Units 1-4, Unit 5 operating on natural gas, and the QPSX project				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	42.6	17%	80.2	32%	**250 µg/m^3**
Annual average NO_2	0.5	0.7%	15.1	24%	**60 µg/m^3**

Table 12 **Scenario 4 - Maximum predicted ground-level concentrations of NO_2 outside the QPS site boundary (µg/m^3)**

Averaging period	Maximum predicted ground-level concentrations of NO_2 outside the site boundary due to upgraded Units 1-4, Unit 5 operating on LPG, and the QPSX project				Air quality criteria
	Project in Isolation	% of air quality criteria	Project plus background	% of air quality criteria	
1-hour average NO_2	42.6	17%	80.2	32%	**250 µg/m^3**
Annual average NO_2	0.5	0.7%	15.1	24%	**60 µg/m^3**

9. LIMITATIONS

This study necessarily relies on the accuracy of a number of data sets including, but not limited to:

- Meteorological information;
- Calculation of emission rates; and
- Characterisation of ambient NO_2 levels.

Where uncertainty exists in important properties of the Project LISA or QPSX, the assessment has erred on the side of caution and conservative inputs have been selected.

Some uncertainty exists in the selection of emissions data from the provided information. It is possible that the characteristics do not cover all operating scenarios (e.g. lower loads). Parameters have been selected to provide a conservative estimate of emission characteristics where possible.

Some uncertainty exists in the selection of emissions data from stack test reports for the existing units. Whilst the worst-case parameters have been selected, it is possible that the stack tests do not reflect all possible modes of operation of these units and may therefore not reflect the potential worst-case operating scenario for this unit. However, the use of the Air Quality EPP emission limit of 70 mg/Nm^3 to calculate emissions from these units helps to mitigate this uncertainty, as measured concentrations have typically been less than half this value.

Alternative methods exist for estimating the concentration of NO_2 generated by the conversion of NO_x as the plume disperses. However, due to the magnitude of the predicted ground-level concentrations in the assessment, the use of a more detailed method than a 30% conversion is unlikely to impact the outcome of the assessment.

The assessment has considered emissions of NOx. NO_2 is considered to be the key indicator for air quality impacts from the power station, with emissions of carbon monoxide, particulates and other air pollutants typically being relatively small in comparison with the use of either natural gas or LPG. This has been demonstrated by previous dispersion modelling of proposed expansion options for the facility (Katestone, 2012) in which predicted ground-level concentrations of NO_2 were found to be approximately 20-40% of the maximum concentration criteria, and all other pollutants, including CO, were found to be less than 3% of their respective maximum concentration criteria.

It is also important to note that numerical models are based on an approximation of governing equations and will inherently be associated with some degree of uncertainty. The more complex the physical model, the greater the number of physical processes that must be included.

There will be physical processes that are not explicitly accounted for in the model and, in general, these approximations tend to lead to an over prediction of air pollutant levels.

Overall, whilst there are a number of limitations and assumptions associated with this study, given the magnitude of the predicted ground-level concentrations of NO_2 (which are at most, 34% of the air quality criteria with the inclusion of a conservative ambient background) these features are unlikely to impact the outcome of the assessment.

10. CONCLUSIONS

Katestone Environmental Pty Ltd (Katestone) was commissioned by Origin Energy Power Pty Ltd (Origin) to complete an Air Quality Assessment of the Quarantine Power Station on Torrens Island, Adelaide. The assessment is to support a Development Application for Project LISA, which will allow Unit 5 to operate on either LPG or natural gas as required.

The Air Quality Assessment has used a dispersion modelling approach. A site-specific meteorological data file has been generated using the TAPM and CALMET meteorological models. The meteorological modelling has accounted for local terrain and land use features of the surrounding region.

Emission rates and stack characteristics have been determined from the manufacturer's specifications, emission limits, and emissions information provided by Origin. Emission rates and stack characteristics of the proposed units have been selected to provide a worst-case estimate of the potential impact of Project LISA on air quality. Dispersion modelling scenarios have also been selected to reflect proposed expansion project to install up to 3 additional units at Quarantine Power Station (Project QPSX) and the upgrade of the gas turbines on existing units 1-4, which may occur before or after commissioning of Project LISA.

The CALPUFF dispersion model has been used to predict ground-level concentrations of nitrogen dioxide due to Project LISA and QPSX. Scenarios have been assessed that reflect the commissioning of Project LISA both before and after the planned upgrade of gas turbines on Units 1-4.

The Air Quality Assessment has shown that ground-level concentrations of nitrogen dioxide due to Project LISA in all modelled scenarios ***comply*** with the air quality criteria at all locations across the model domain outside the QPS site boundary. The predicted ground-level concentrations of nitrogen dioxide have included a conservative estimate of the ambient background levels of nitrogen dioxide. The maximum cumulative concentrations were predicted to be, at most, 34% of the air quality criteria.

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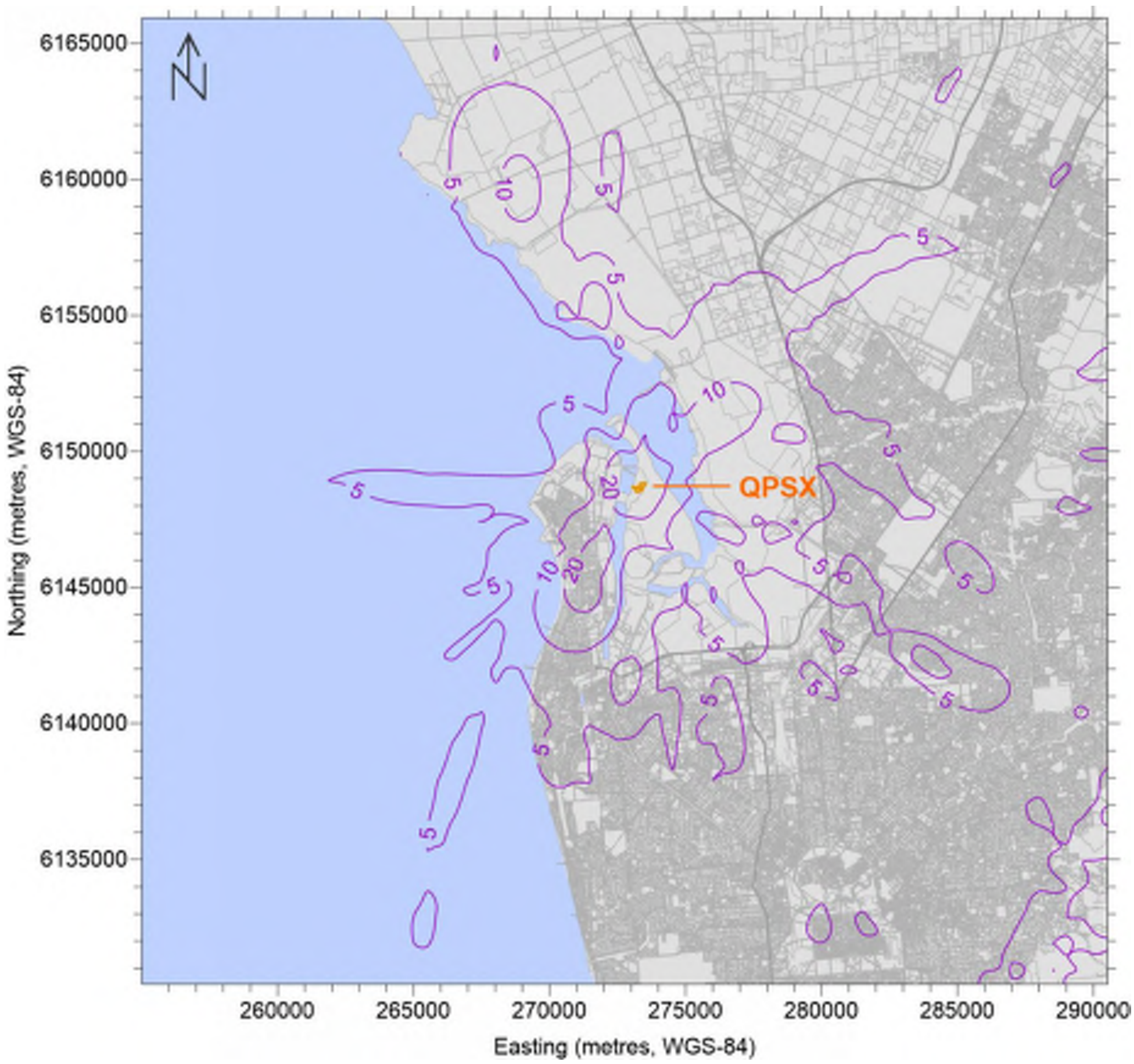

Plate 1	**Scenario 1 - Maximum 1-hour average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on natural gas and the QPSX project in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-hour	CALPUFF	µg/m^3
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Maximum contour	250 µg/m^3	Tania Haigh	December 2017

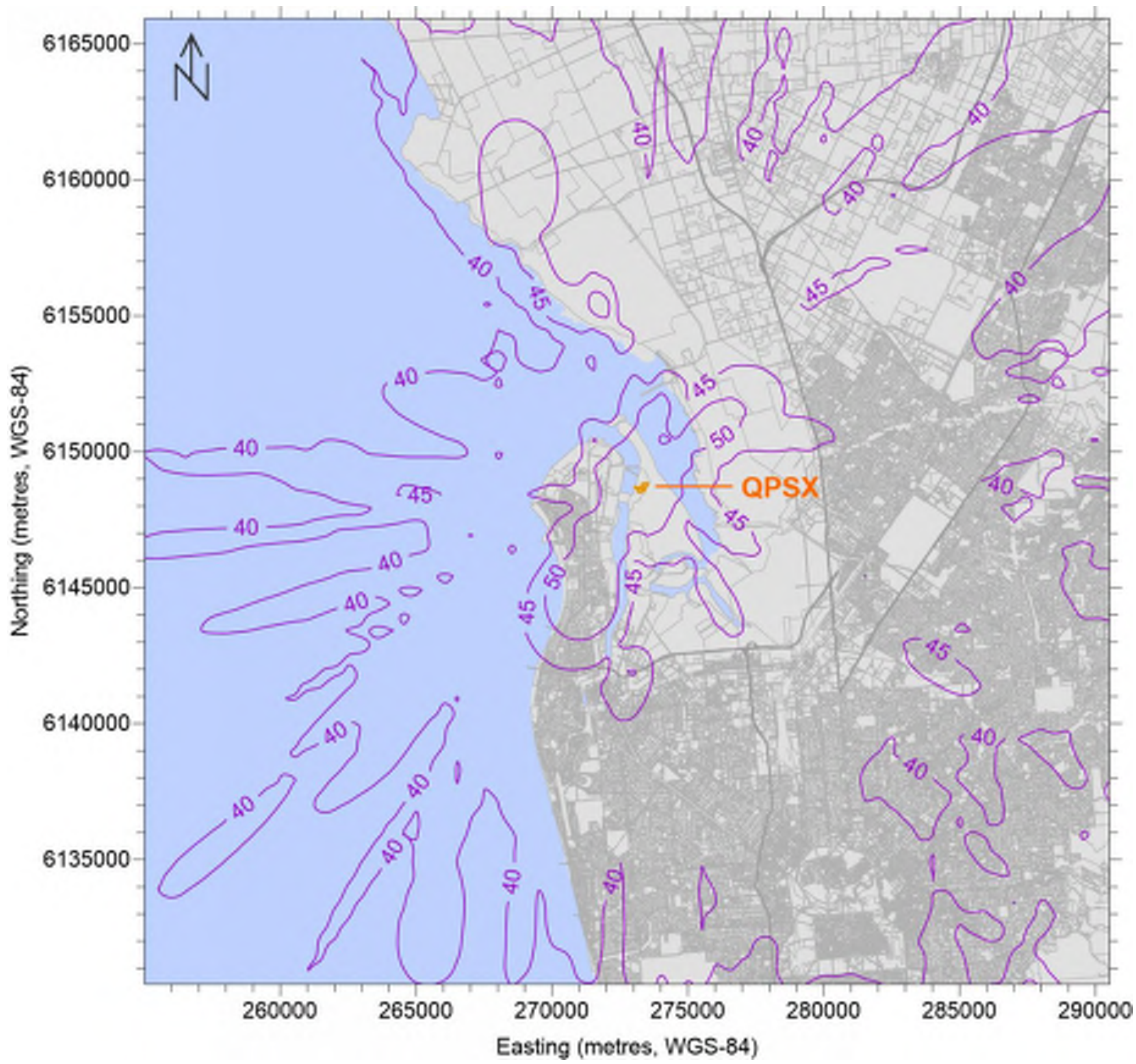

Plate 2	**Scenario 1 - Maximum 1-hour average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on natural gas and the QPSX project plus an ambient background concentration of 37.6 µg/m³**

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

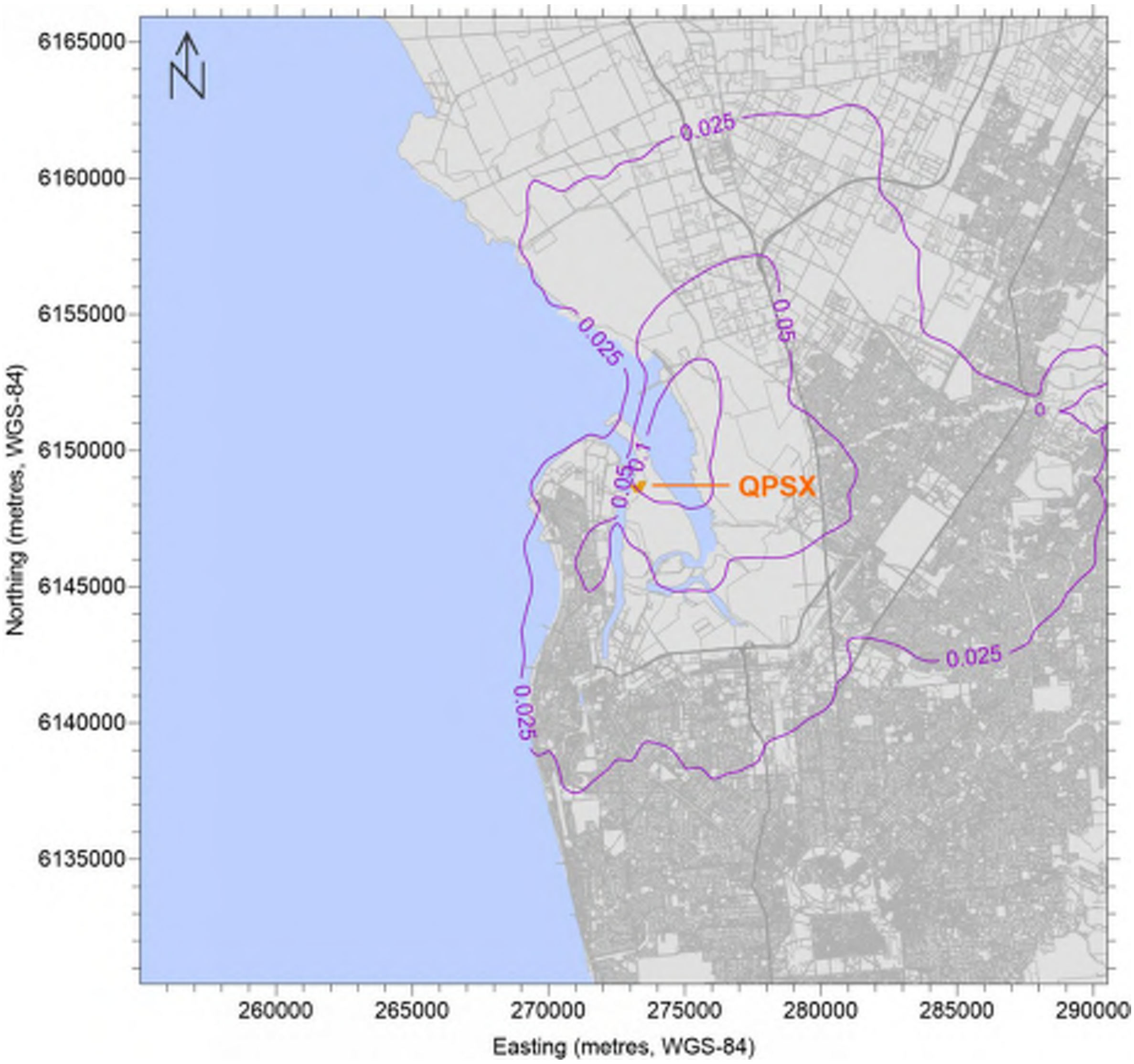

Plate 3	Scenario 1 – Annual average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on natural gas and the QPSX project in isolation		
Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m³
Type: Average contour	**Maximum concentration criteria:** 60 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

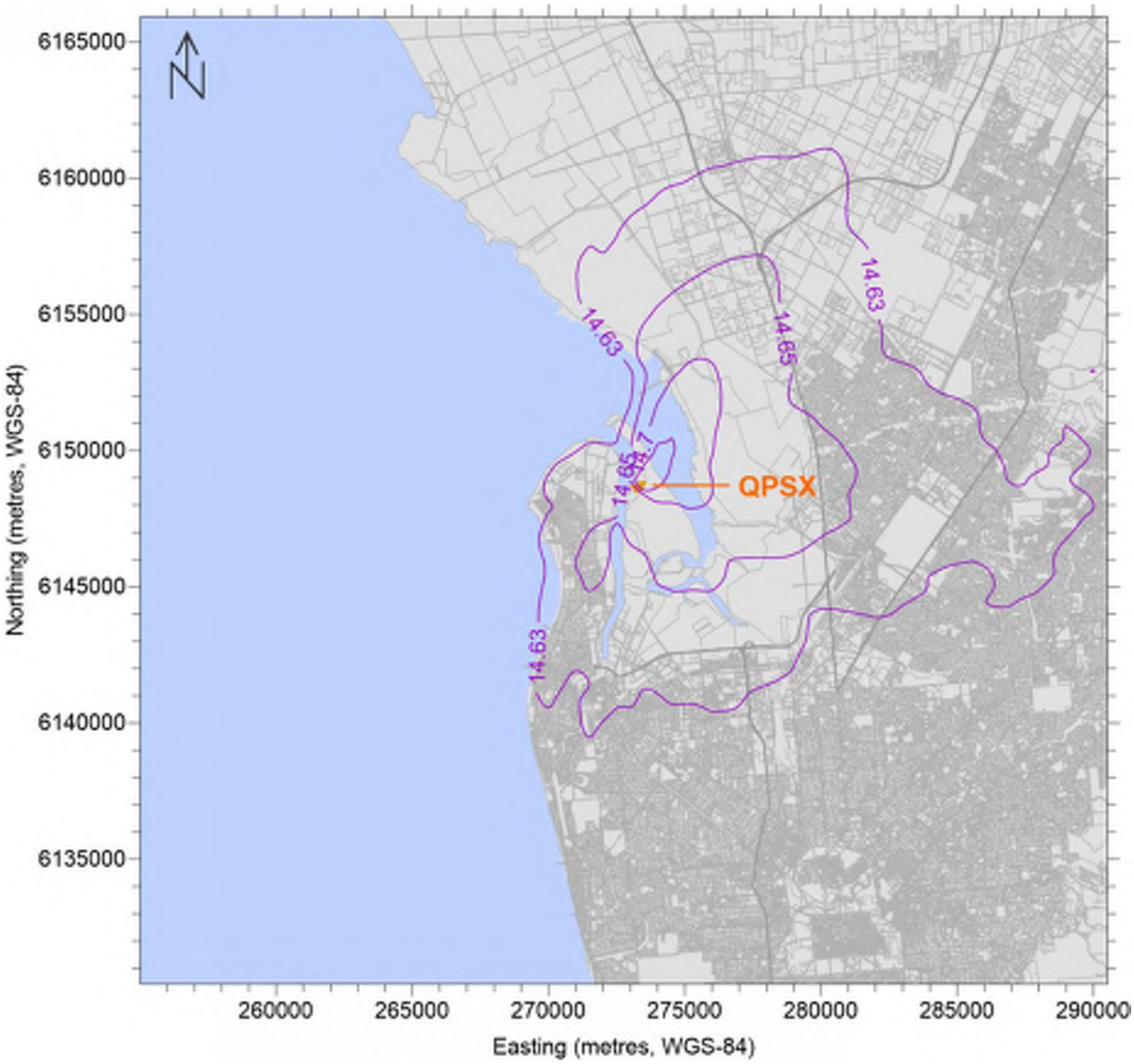

Plate 4	**Scenario 1 – Annual average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on natural gas and the QPSX project plus an ambient background concentration of 14.6 µg/m^3**		
Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Average contour	**Maximum concentration criteria:** 60 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

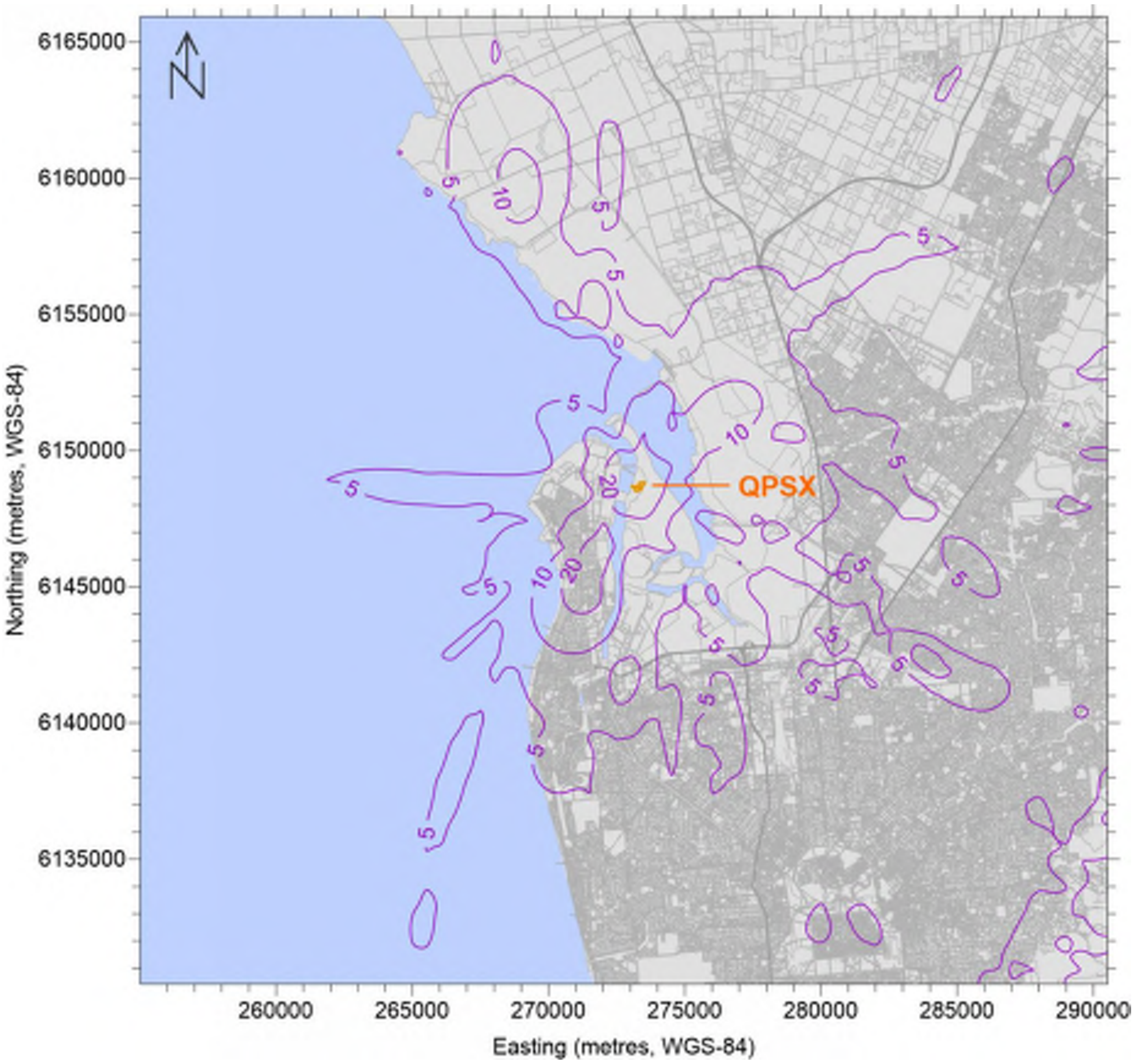

Plate 5	**Scenario 2 - Maximum 1-hour average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on LPG and the QPSX project in isolation**		
Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

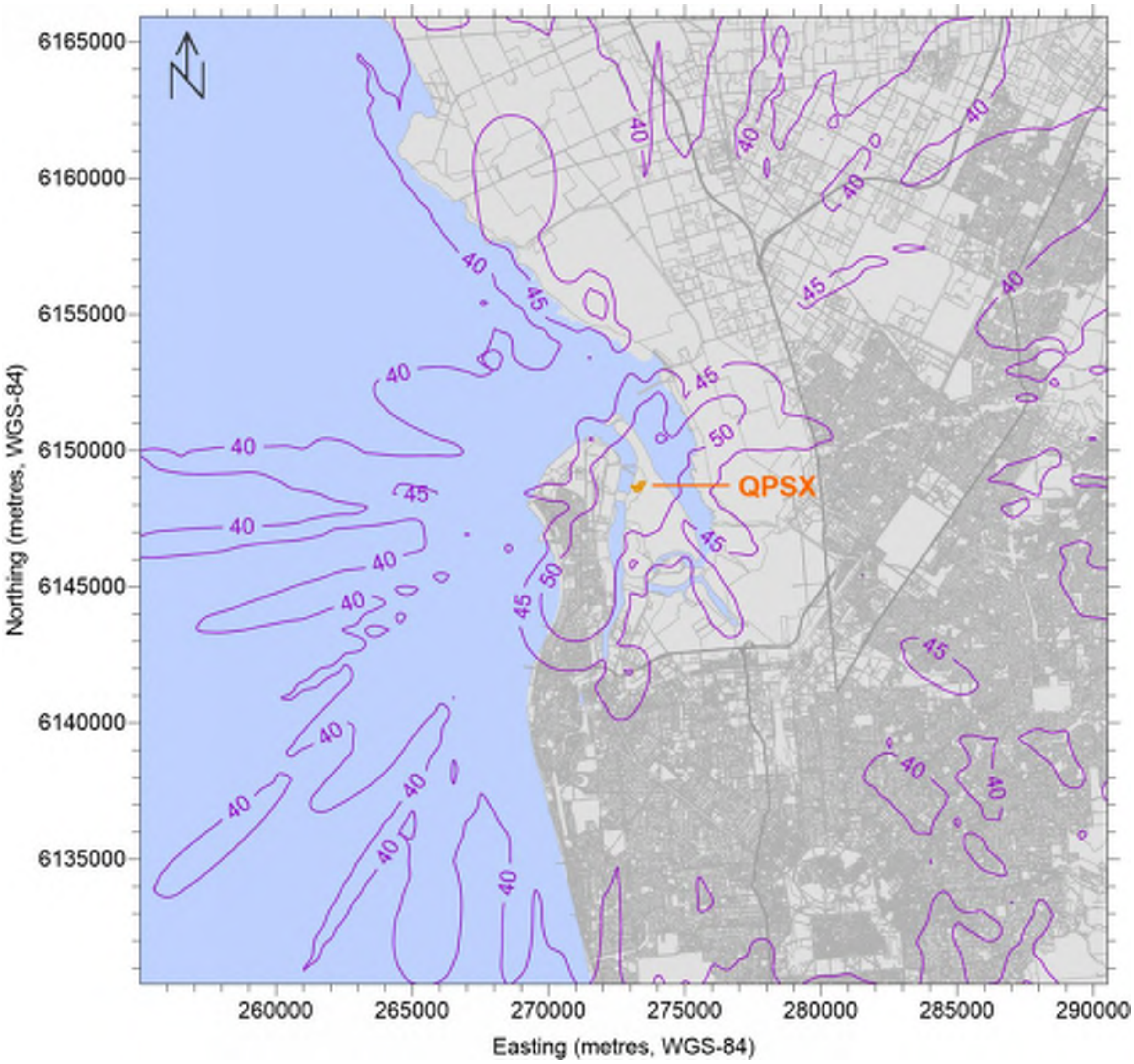

Plate 6	Scenario 2 - Maximum 1-hour average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on LPG and the QPSX project plus an ambient background concentration of 37.6 µg/m³

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

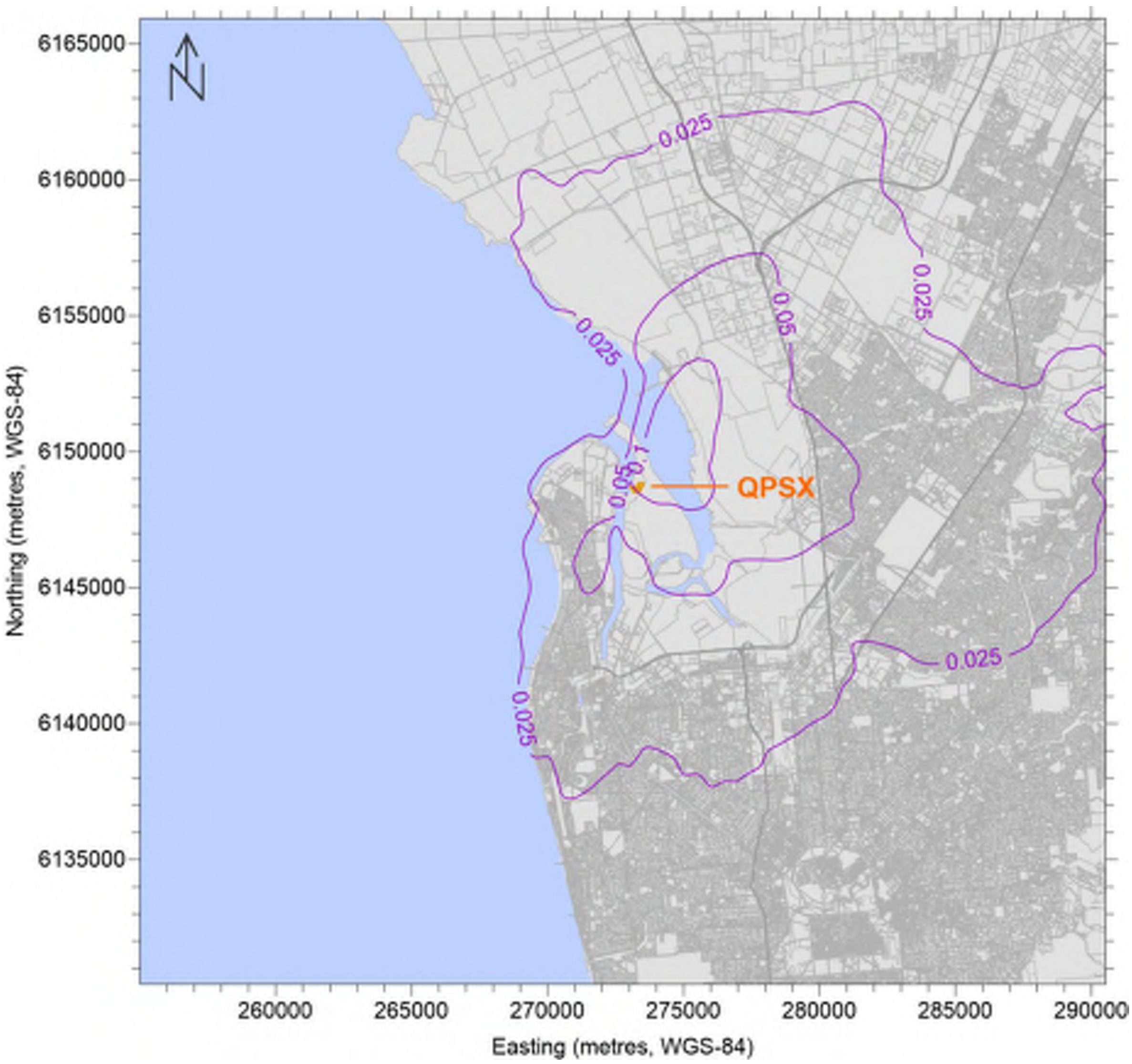

Plate 7	**Scenario 2 – Annual average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on LPG and the QPSX project in isolation**

Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m³
Type: Average contour	**Maximum concentration criteria:** 60 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

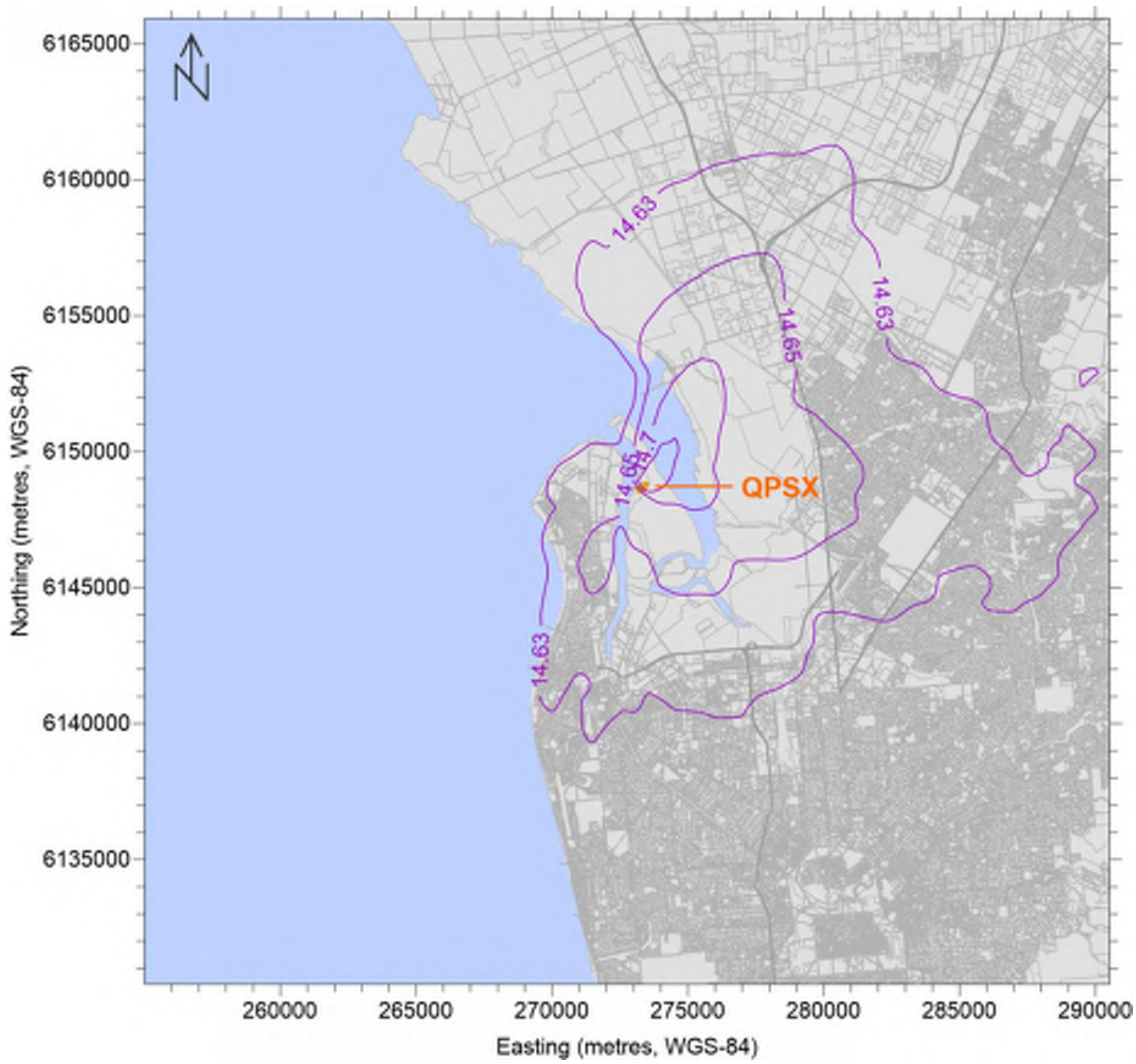

Plate 8	**Scenario 2 – Annual average ground-level concentration of NO_2 due to existing Units 1-4, Unit 5 operating on LPG and the QPSX project plus an ambient background concentration of 14.6 µg/m^3**

Location: Torrens Island, SA	**Averaging period:** 1-year	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Average contour	**Maximum concentration criteria:** 60 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

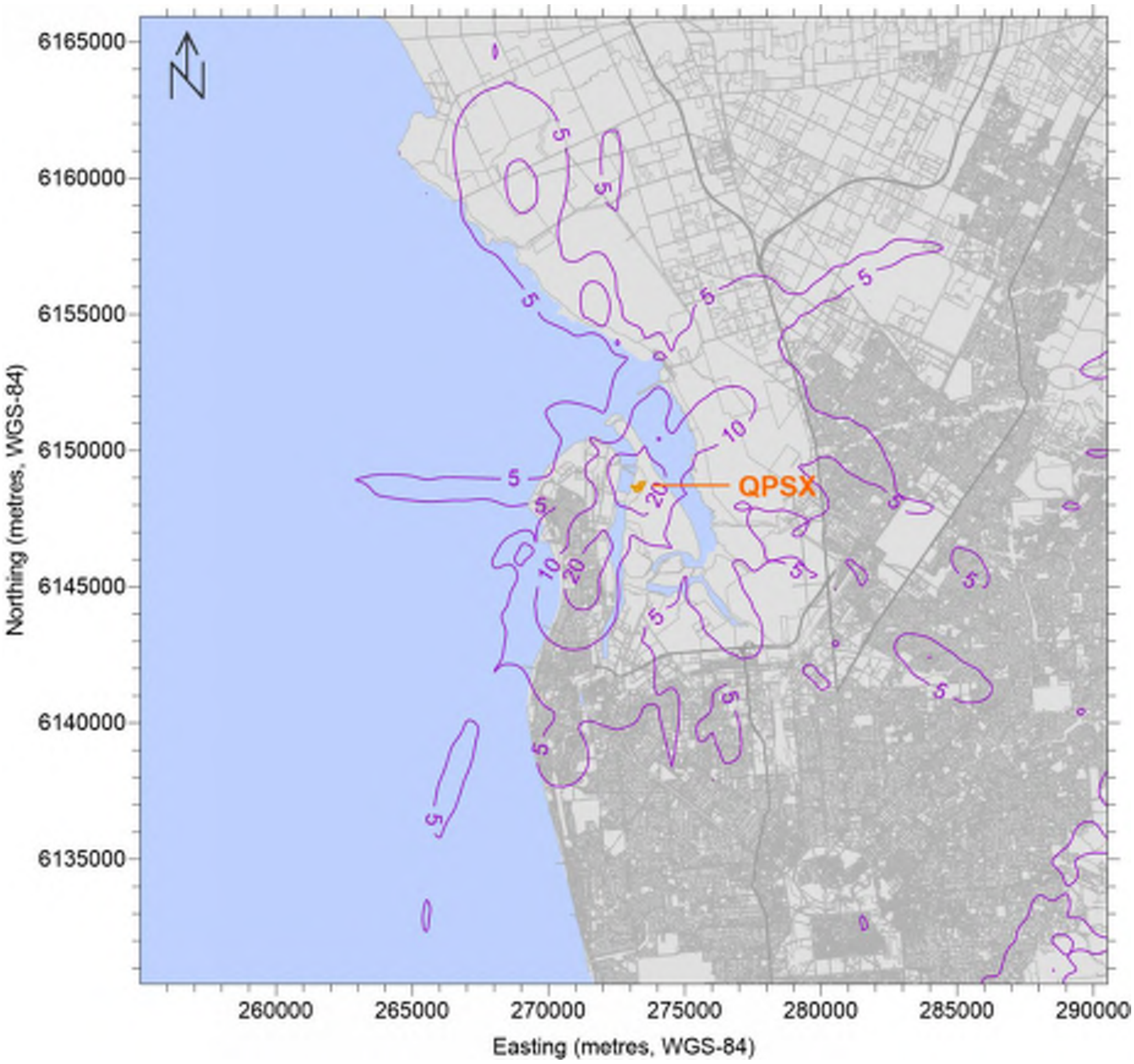

Plate 9	Scenario 3 - Maximum 1-hour average ground-level concentration of NO_2 due to the upgraded Units 1-4, Unit 5 operating on natural gas and the QPSX project in isolation

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-hour	CALPUFF	µg/m^3
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Maximum contour	250 µg/m^3	Tania Haigh	December 2017

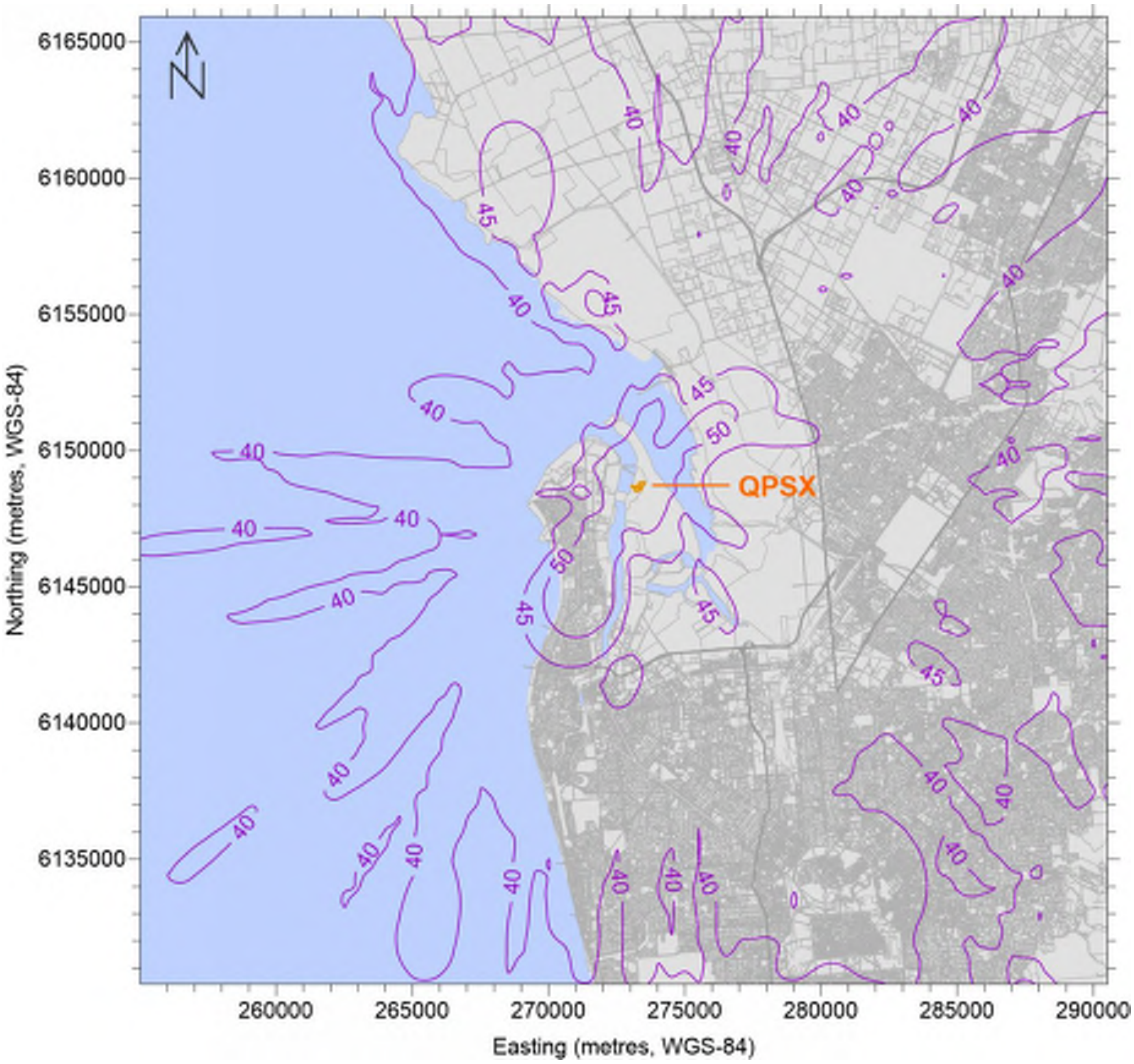

Plate 10	Scenario 3 - Maximum 1-hour average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on natural gas and the QPSX project plus an ambient background concentration of 37.6 µg/m^3

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m^3	**Prepared by:** Tania Haigh	**Date:** December 2017

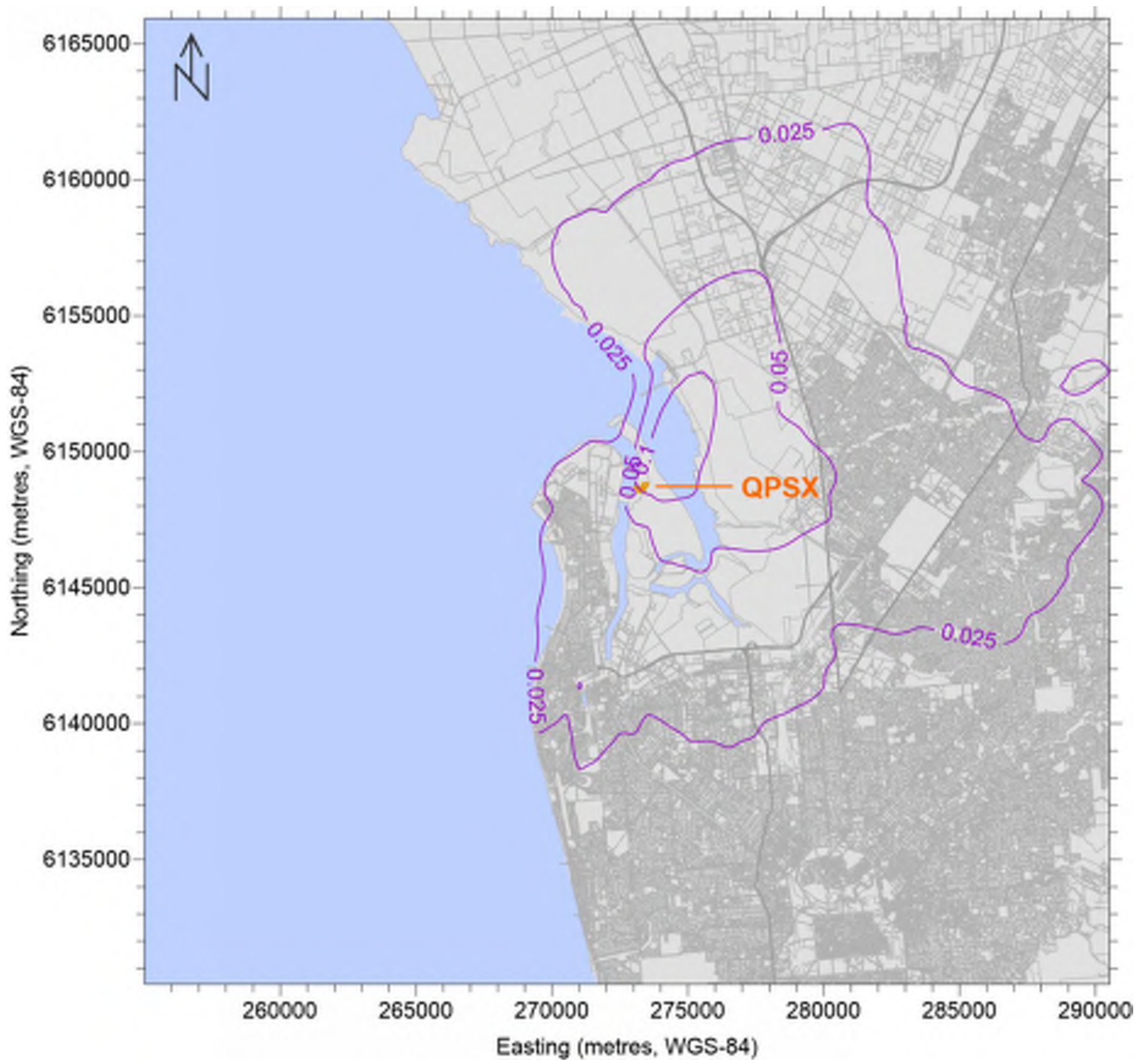

Plate 11	**Scenario 3 – Annual average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on natural gas and the QPSX project in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-year	CALPUFF	µg/m^3
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Average contour	60 µg/m^3	Tania Haigh	December 2017

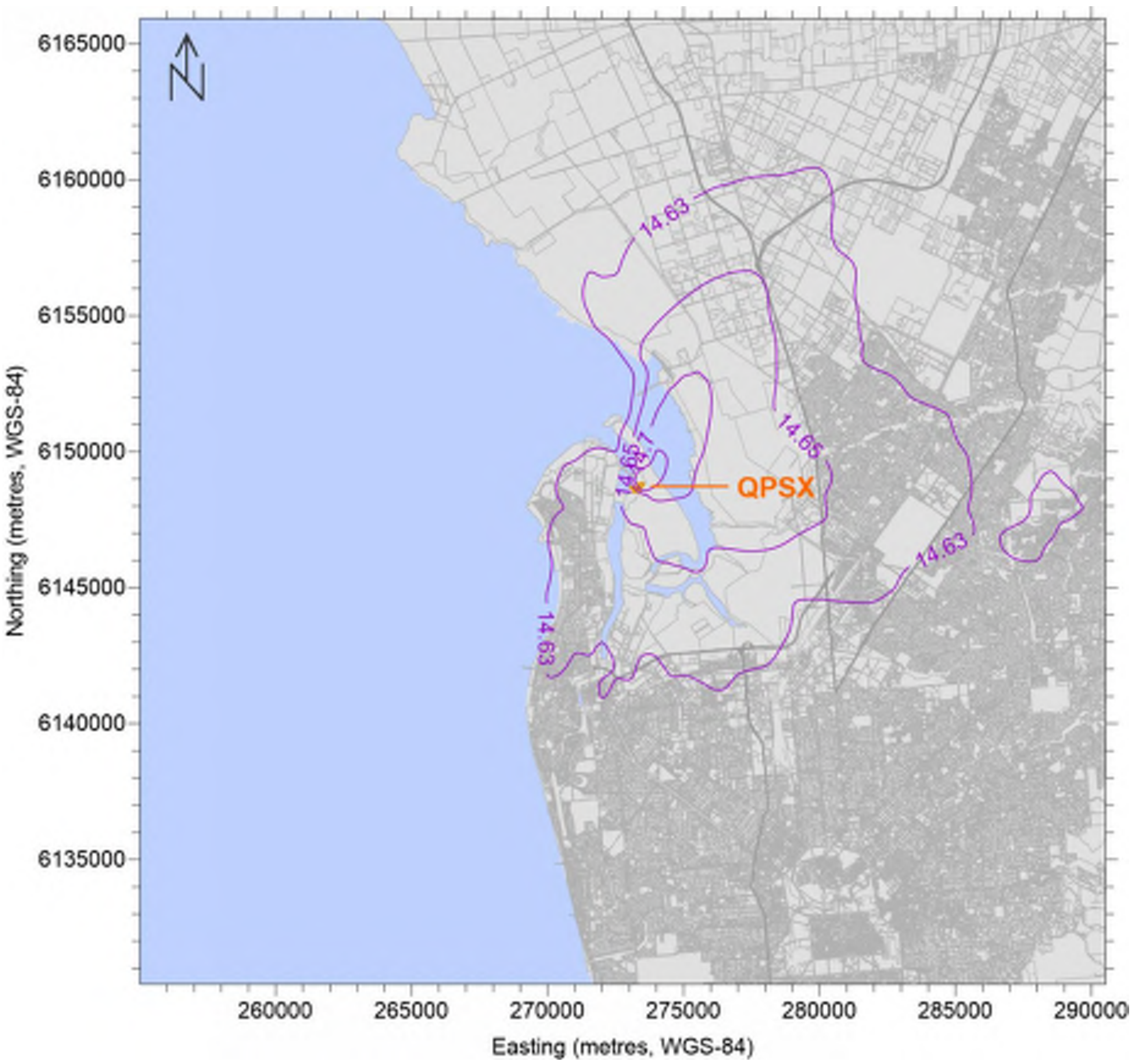

Plate 12	**Scenario 3 – Annual average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on natural gas and the QPSX project plus an ambient background concentration of 14.6 µg/m^3**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-year	CALPUFF	µg/m^3
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Average contour	60 µg/m^3	Tania Haigh	December 2017

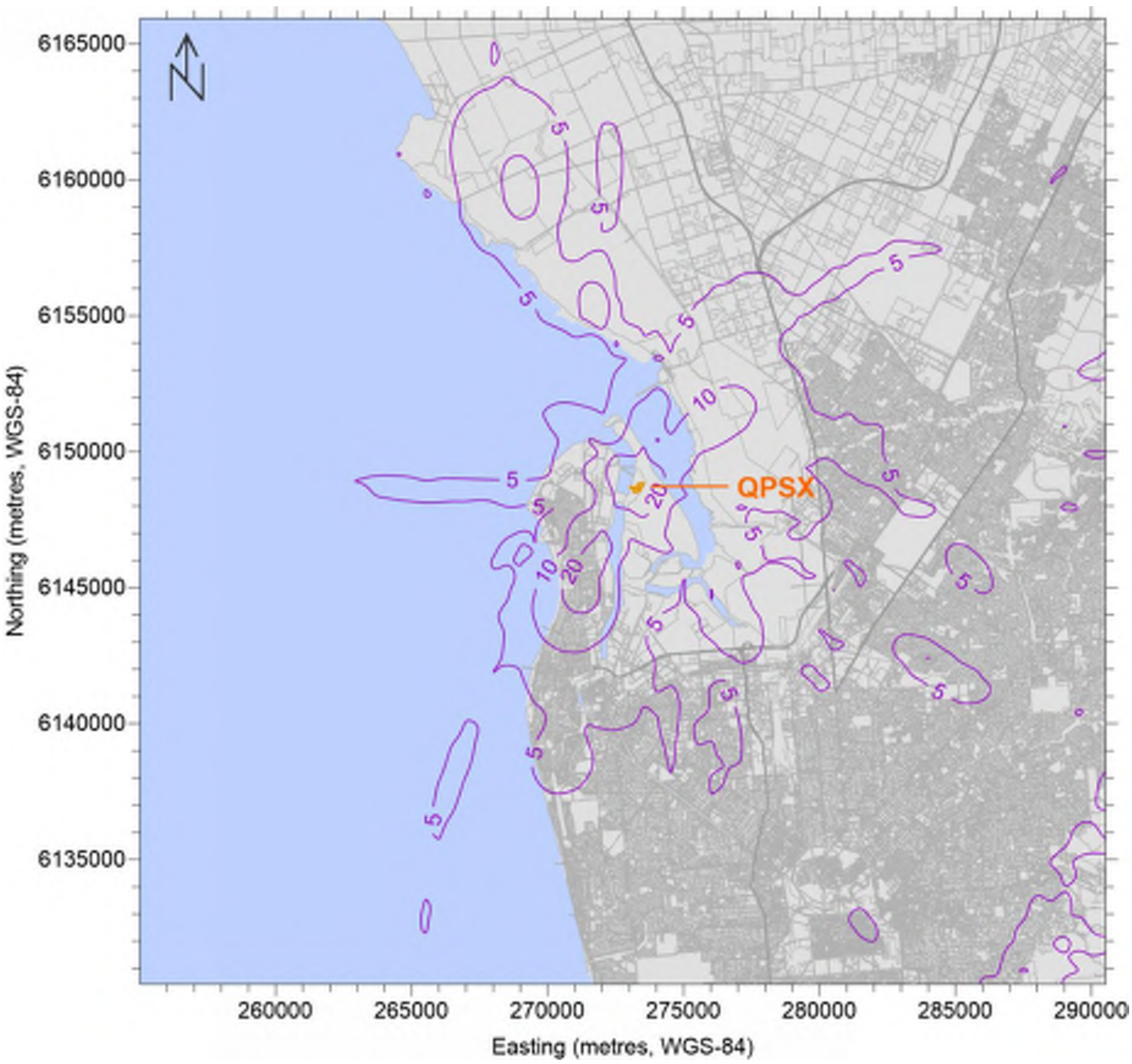

Plate 13	Scenario 4 - Maximum 1-hour average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on LPG and the QPSX project in isolation		
Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

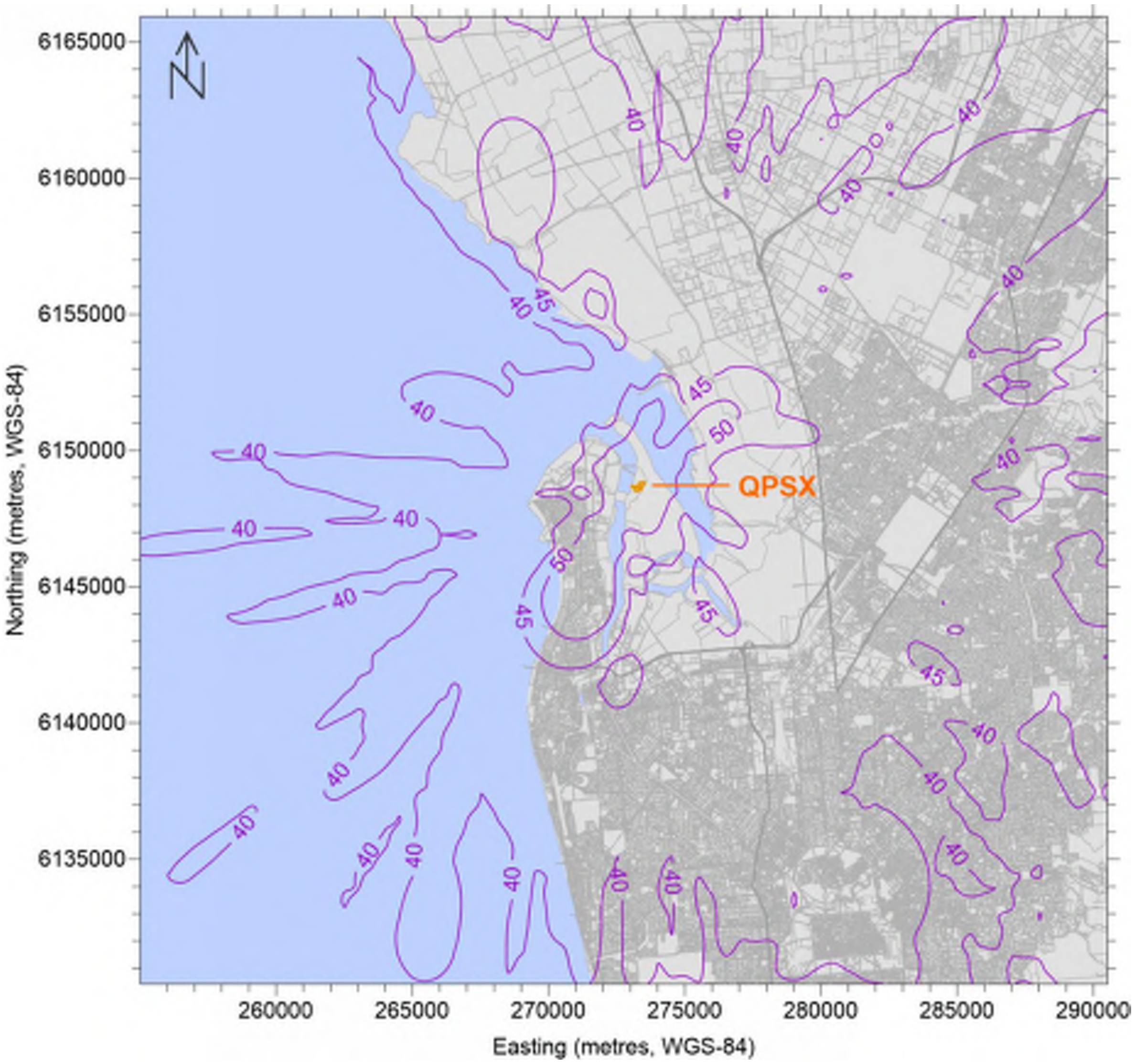

Plate 14	**Scenario 4 - Maximum 1-hour average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on LPG and the QPSX project plus an ambient background concentration of 37.6 µg/m³**

Location: Torrens Island, SA	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Maximum contour	**Maximum concentration criteria:** 250 µg/m³	**Prepared by:** Tania Haigh	**Date:** December 2017

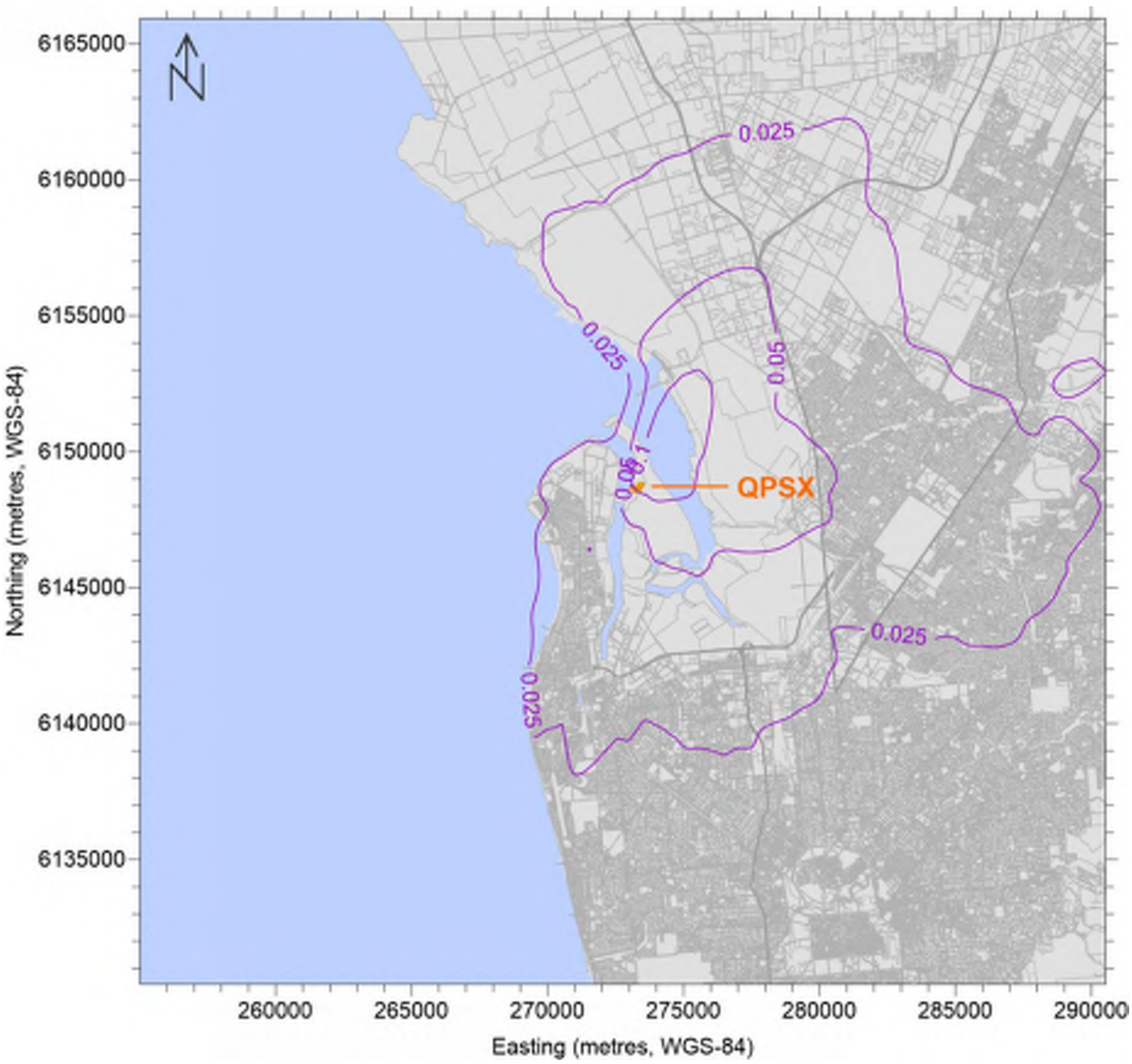

Plate 15 **Scenario 4 – Annual average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on LPG and the QPSX project in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-year	CALPUFF	µg/m³
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Average contour	60 µg/m³	Tania Haigh	December 2017

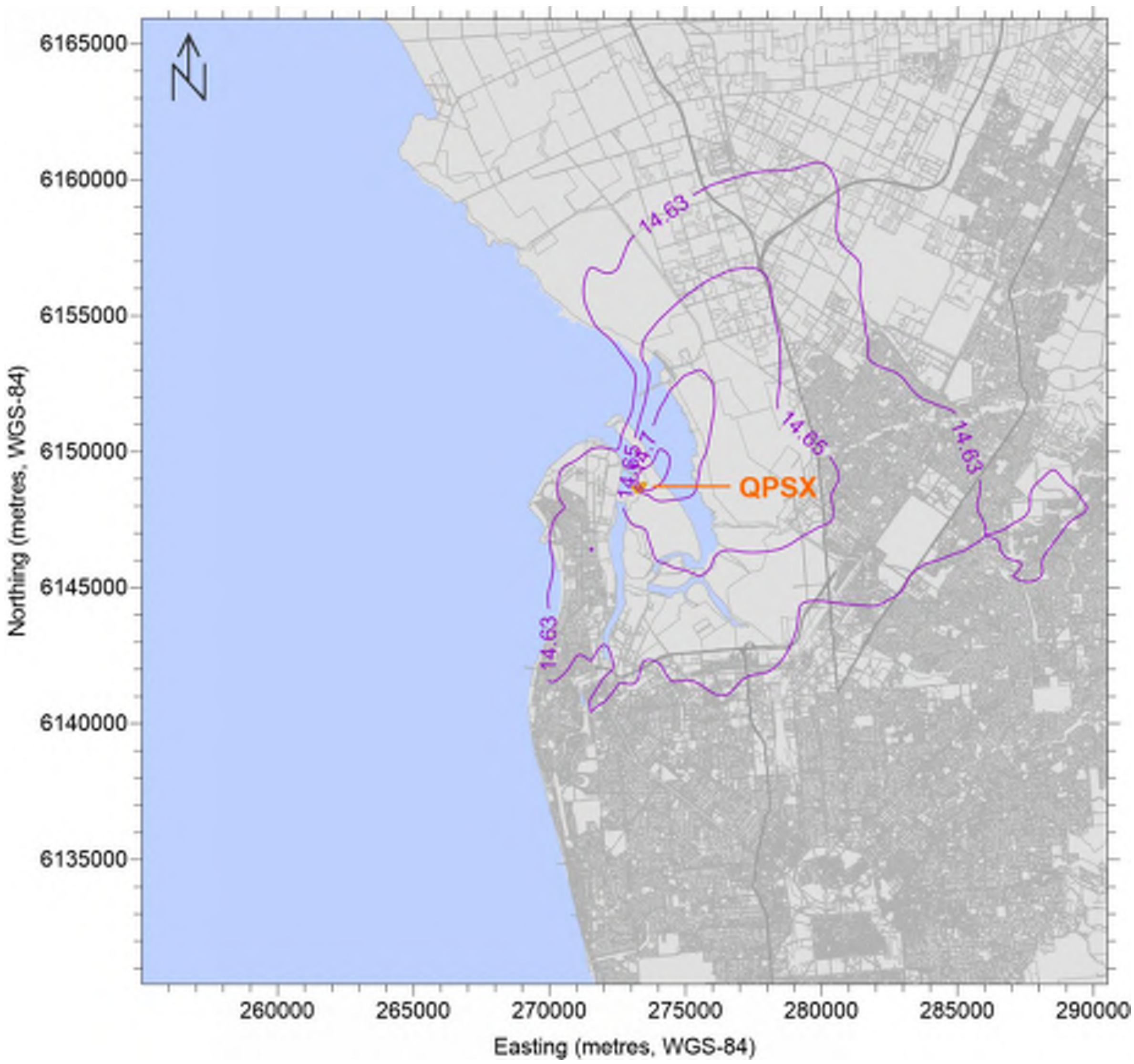

Plate 16	**Scenario 4 – Annual average ground-level concentration of NO_2 due to upgraded Units 1-4, Unit 5 operating on LPG and the QPSX project plus an ambient background concentration of 14.6 µg/m³**

Location:	**Averaging period:**	**Data source:**	**Units:**
Torrens Island, SA	1-year	CALPUFF	µg/m³
Type:	**Maximum concentration criteria:**	**Prepared by:**	**Date:**
Average contour	60 µg/m³	Tania Haigh	December 2017

APPENDIX A METEOROLOGICAL AND DISPERSION MODELLING METHODOLOGY

A1 METEOROLOGY

A1.1 TAPM meteorology

The meteorological model TAPM has been validated by the CSIRO, Katestone Environmental and others for many locations in Australia, in southeast Asia and in North America (CSIRO, 2008). Katestone has used the TAPM model throughout Australia as well as in parts of America, Bangladesh, New Caledonia and Vietnam. This model has performed well for simulating regional winds patterns. TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM is a prognostic meteorological model which predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres [m]). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy and soil, and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data were supplied on a grid resolution of approximately 75 km, and at elevations of 100 m to 5 km above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

The year 2009 was used for meteorological modelling, based on advice from EPA.

TAPM was configured as follows:

- Modelling period for one year from 1 January to 2009 December 2009;
- 40 x 40 grid point domain with an outer grid of 30 km and nesting grids of 10 km, 3 km and 1 km;
- 25 vertical levels;
- Grid centred near the QPSX project site (latitude –34° 47.0’, longitude 138° 31.0’);
- Geoscience Australia 9 second DEM terrain data;
- Land cover data based on TAPM’s default landuse database and edits based on a comparison against aerial imagery;
- Default options selected for advanced meteorological inputs; and
- No data assimilation.

A1.2 Comparison of TAPM output with observational data

The model validation in the following sections compares observational meteorological data from the SA EPA’s ambient monitoring site at Le Fevre with data derived from running TAPM.

Table A1 presents statistical comparisons of TAPM output (wind speed and temperature) to meteorological data recorded at the automatic weather station located at the exploration camp for the CCMP. Figure A1 shows probability density functions that graphically compare statistical distributions of meteorological parameters between the TAPM output and observational data. The TAPM output was extracted from the closest inner grid point to the location of the automatic weather station.

The following statistical measures of model accuracy are presented in the tables.

The mean bias, which is the mean model prediction minus the mean observed value. Values of the mean bias close to zero show good prediction accuracy.

The root mean square error (RMSE), which is the standard deviation of the differences between predicted values and observed values. The RMSE is non-negative and values of the RMSE close to zero show good prediction accuracy. The RMSE is given by:

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

where N is the number of observations, P_i are the hourly model predictions and O_i are the hourly observations

The index of agreement (IOA), which takes a value between 0 and 1, with 1 indicating perfect agreement between predictions and observations. The IOA is calculated following a method described in Willmott (1982), using the equation

$$\mathrm{IOA} = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

where N is the number of observations, P_i are the hourly model predictions, O_i are the hourly observations and O_{mean} is the observed observation mean.

The predicted wind speeds are within the benchmarks for performance and are therefore representative of the area. There temperature bias is larger than the benchmark, however, the index of agreement is within the benchmark range, and the mean and range of predicted temperatures is similar to the observed temperatures. The probability density functions illustrate reasonable agreement between predicted and observed meteorological data.

Table A1 A comparison of the observed meteorological data with the first-level TAPM output

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	3.2	2.9	-	17.7	16.9
Standard deviation	-	-	1.8	1.7	-	6.1	5.8
Minimum	-	-	0.0	0.0	-	3.2	5.0

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Maximum	-	-	10.5	9.8	-	43.5	40.3
Bias	0	<±0.5 m/s	0.3		<±0.5 °C	0.8	
Root mean square error (RMSE)	Close to 0	<2 m/s	1.1		-	2.0	
Index of agreement	Close to 1	>0.6	0.89		≥0.8	0.97	

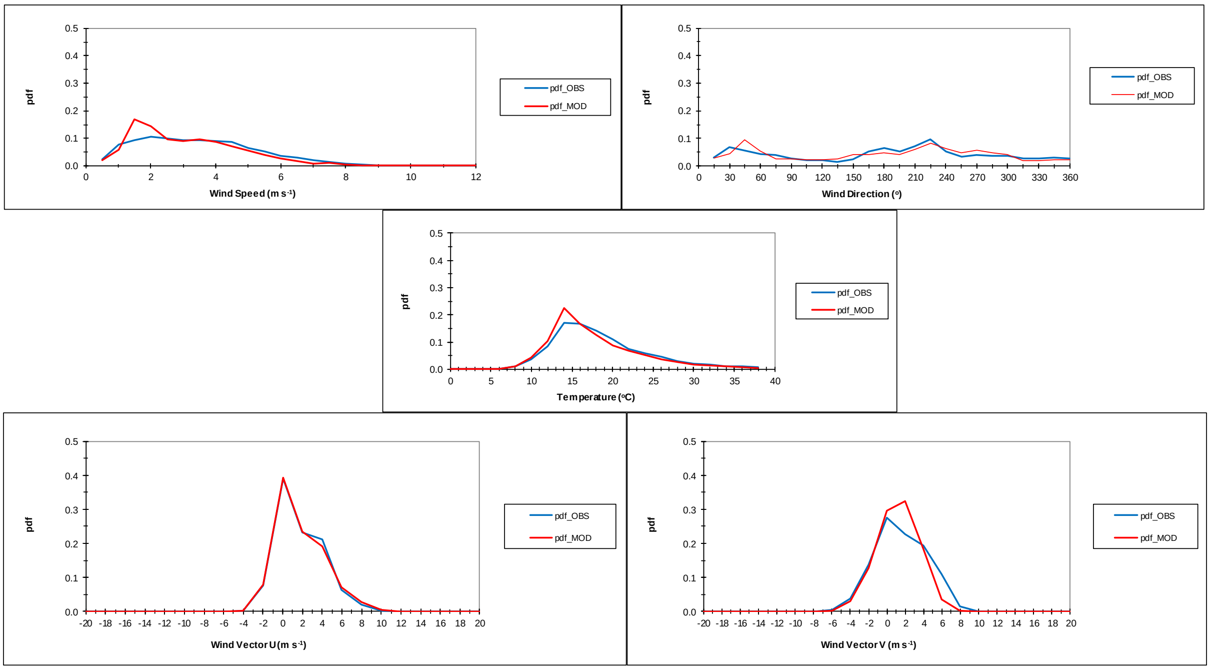

Figure A1 Probability density functions (pdfs) comparing observational data (blue) with TAPM data (red) at the SA EPA Le Fevre monitoring station

A1.3 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.5.0) was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 3km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was set up with twelve vertical levels with heights at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600, 4600 metres at each grid point.

All default options and factors were selected except where noted below.

Key features of CALMET used to generate the wind fields are as follows:

- 72 x 72 grid point domain with a spacing of 0.5 km
- 365 days (1 January 2009 to 31 December 2009)
- No observations mode, with prognostic wind fields generated by TAPM input as MM5/3D.dat at surface and upper air for "initial guess" field
- No extrapolation of surface wind observations
- Maximum search radius in averaging process set to 4 grid cells
- Terrain radius of influence set at 2 km
- No data assimilation.

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 72 by 72 grids at 0.5 km spacing, equivalent to the domain defined in CALMET

- 365 days modelled (1 January 2013 to 31 December 2013)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- No chemical transformation or deposition
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables
- Stack tip downwash, transitional plume rise and PDF used for dispersion under convective conditions.

All other options set to default.

Source coordinates are presented in Table A2.

Table A2 Source coordinates used in the dispersion modelling

Unit	Easting (metres, WGS-84)	Northing (metres, WGS-84)
Unit 1	273245	6148679
Unit 2	273275	6148654
Unit 3	273304	6148629
Unit 4	273336	6148604
Unit 5	273391	6148663
Unit 6	273410	6148812
Unit 7	273415	6148787
Unit 8	273419	6148762

APPENDIX B STACK TEST DATA

B1 NO_X CONCENTRATIONS AND EMISSION RATES

Figure B1 presents the measured NO_x concentrations for each unit, as reported in stack test reports from 2007. With the exception of 2007, all test results have complied with the Air EPP emission limit of 70 mg/Nm^3 (15% O_2). Calculated NO_x emission rates from Units 1-4 (presented in Figure B2) have average around 2-3 g/s, again with the exception of higher results in 2007. NO_x emissions from GT5 have ranged up to 6 g/s until 2017, when over 10 g/s was calculated.

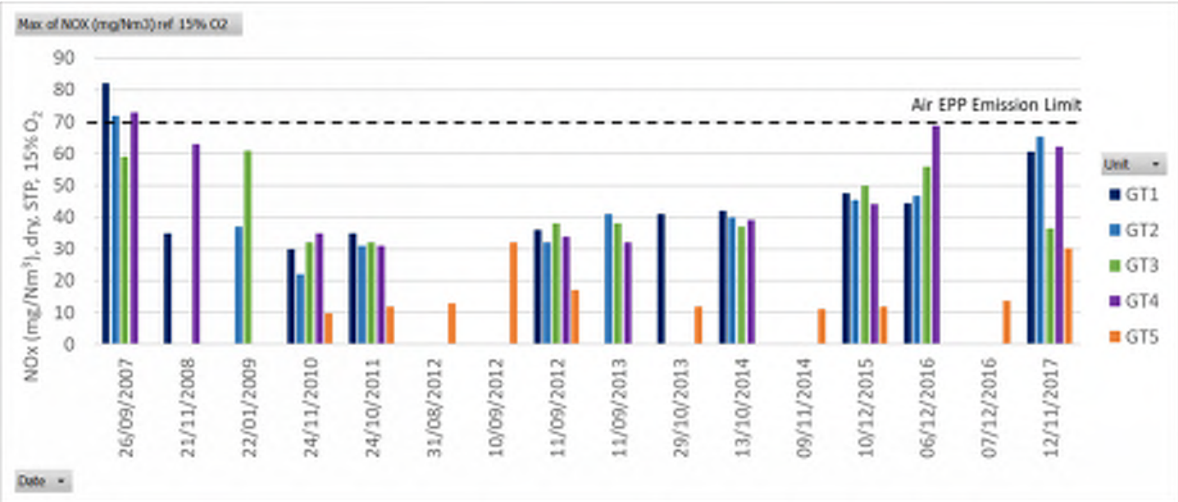

Figure B1 **NO_x concentrations as reported in annual stack test monitoring reports (mg/Nm^3, 15% O_2)**

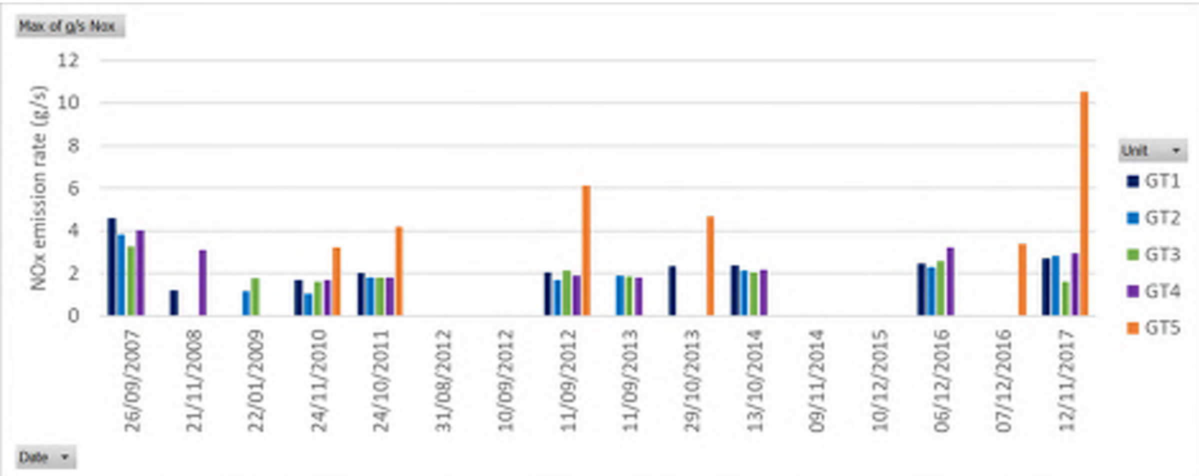

Figure B2 **NO_x emission rates calculated from annual stack test monitoring reports (g/s)**

Figure B3 presents exhaust temperatures measured for each unit since 2007. Exhaust temperatures for Units 1-5 have remained consistent, ranging from 520 °C to approximately 550 °C. Exhaust temperature for Unit 5 have exhibited a greater range, with measurements from approximately 470 °C to 550 °C.

Figure B**4** presents exit velocities reported for each unit since 2007. Exit velocities for Units 1-4 have ranged from 26 m/s to 34 m/s, while exit velocities for Unit 5 have ranged from 37 m/s to 46 m/s.

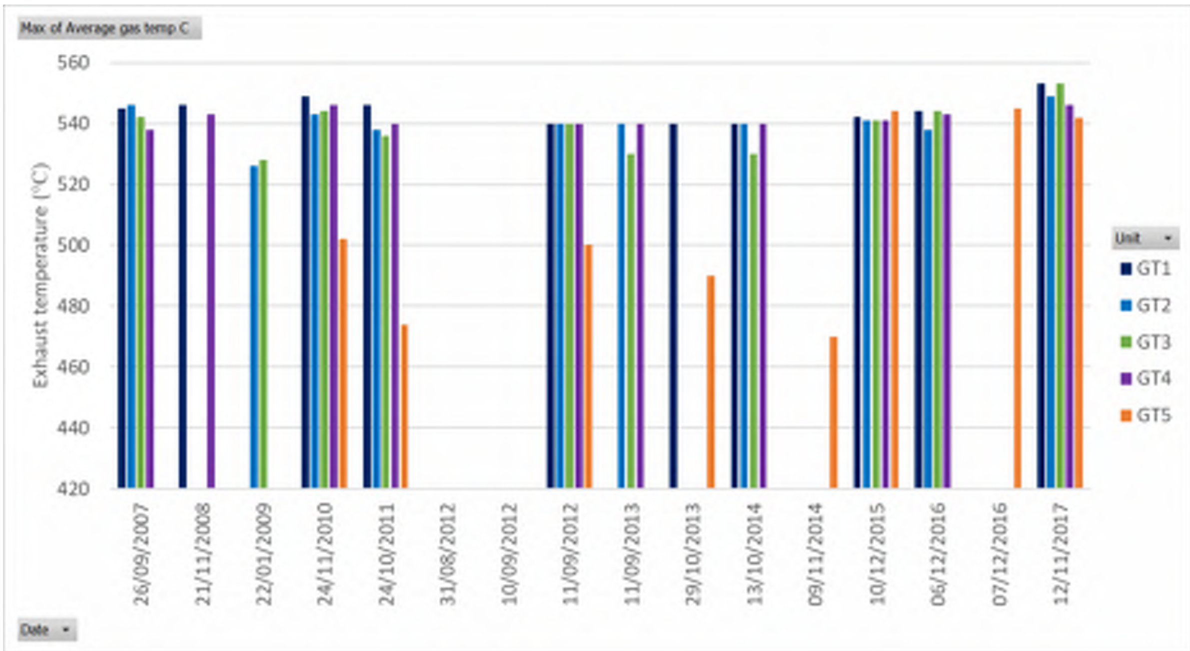

Figure B3 **Exhaust temperatures as reported in annual stack test monitoring reports (°C)**

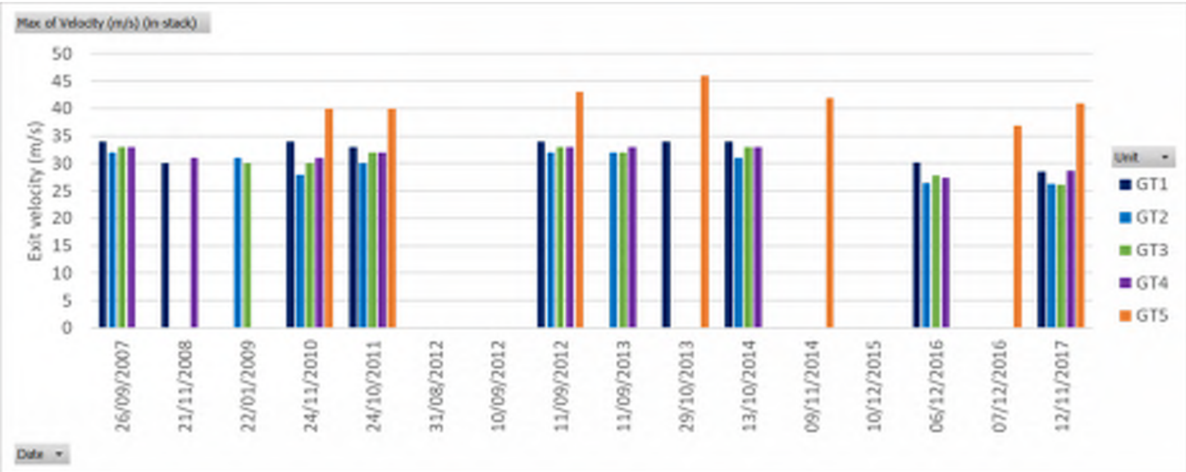

Figure B4 **Exit velocity as reported in annual stack test monitoring reports (m/s)**

Figure B5 presents the normalised flow rates as reported in annual stack test monitoring reports since 2007. For Units 1-4, these have ranged from 43 to 57 Nm^3/s (15% O_2). For GT5, these have ranged from 47 to 59 Nm^3/s (15% O_2). The highest flow rate for Units 1-4, and Unit 5, have been used to calculate the worst-case emission rate (g/s) of NO_x from the units, along with the assumed NO_x concentration.

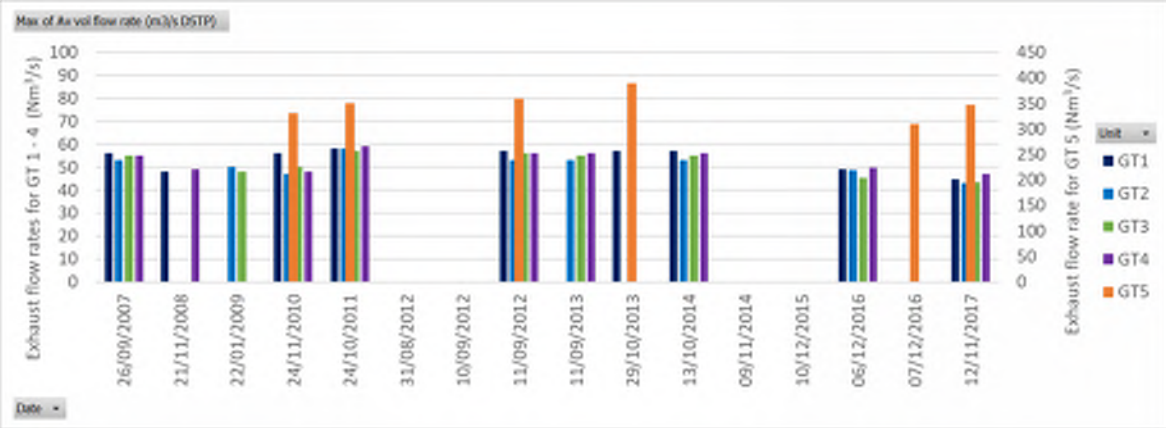

Figure B5 **Flow rates as reported in annual stack test monitoring reports (Nm^3/s, 15% O_2)**

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