Tweed Heads Travel Lift Boat Facility

Addendum Review of Environmental Factors

Transport for NSW

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Transport for NSW | August 2022

Prepared by Royal HaskoningDHV and Transport for NSW

Document controls

Approval and authorisation

Title	Tweed Heads Travel Lift Boat Facility Addendum Review of Environmental Factors
Accepted on behalf of Transport for NSW by:	Andrew Dooley Snr Project Manager, MIDO Greater Sydney
Signed:	
Dated:	18 August 2022

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1 Introduction

1.1 Proposed modification overview

Transport for NSW proposes to modify the Tweed Heads Travel Lift Boat Facility by changes to the design as a result of contamination testing and development of a Remediation Action Plan (RAP) (proposed modifications). Due to the site being idle, the removal of mangrove seedlings that have emerged at the site is also required. Specialist advice from an arborist has been sought regarding the management of a row of trees located adjacent to the site in Marina Park. In addition, the potential need for dewatering during the installation of a wastewater storage tank and associated activities has been identified by the Contractor. Key features of the proposed modifications would include:

- Proposed design changes – inclusion of a high visibility geotextile fabric marker layer and geogrid placed over all exposed subgrade surfaces as set out in the RAP
- Harm to marine vegetation – removal of up to twenty four mangrove seedlings that have emerged along the eastern and western edge of the existing slipway
- Arborist recommendations – inclusion of management measures for tree roots discovered during excavations
- Dewatering – possibility for dewatering activities during the installation of the wastewater storage tank, associated wastewater junction pit and drainage infrastructure.

The location of the proposed modifications is shown in Figure 1-1 and the proposed modifications are shown in Figure 1-2, Figure 1-3, Figure 1-4 and Figure 1-5. Chapter 3 describes the proposed modifications in more detail.

A review of environmental factors (REF) was prepared for the Tweed Heads Travel Lift Boat Facility REF on August 2021 (referred to in this addendum REF as the project REF). The project REF was placed on public display between 23.08.2021 and 17.09.2021for community and stakeholder comment. A submissions report, dated November 2021 was prepared to respond to issues raised.

Figure 1-1: Location of the proposed modifications (existing Tweed Heads slipway at Lot 717 DP 729484)

Figure 1-2: Location of mangrove seedling removal

Figure 1-3: Location of design modifications associated with the RAP (green shaded area)

Figure 1-4: Location of row of trees located adjacent to the site in Marina Park

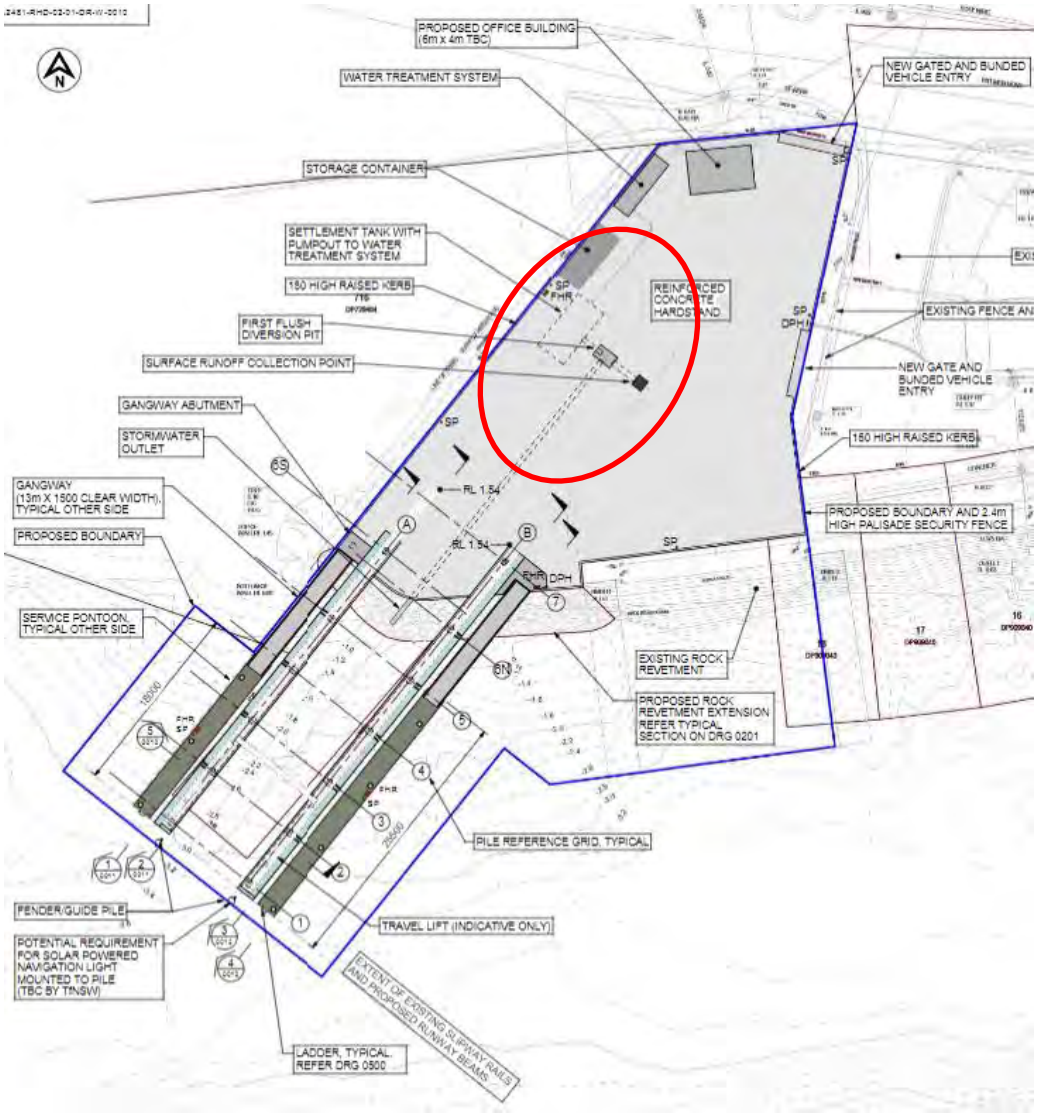

Figure 1-5: Location of possible dewatering activities

1.2 Purpose of the report

This addendum Review of Environmental Factors (REF) has been prepared by Royal HaskoningDHV on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This addendum REF is to be read in conjunction with the project REF. The purpose of this addendum REF is to describe the proposed modification, to document and assess the likely impacts of the proposed modification on the environment, and to detail mitigation and management measures to be implemented.

The description of the proposed work and assessment of associated environmental impacts has been undertaken in context of section 171 of the Environmental Planning and Assessment Regulation 2021, *Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* the Marinas and Related Facilities EIS Guideline (DUAP, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In doing so, the addendum REF helps to fulfil the requirements of Section 5.5 of the EP&A Act including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the addendum REF would be considered when assessing:

- Whether the proposed modification is likely to result in a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Urban Spaces under Division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report.
- The potential for the proposed modification to significantly impact any matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Agriculture, Water and the Environment for a decision by the Australian Government Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

2.1 Strategic need for the proposed modification

Chapter 2 of the project REF addresses the strategic need for the project, the project objectives and the options that were considered. The proposed modification described and assessed in this addendum REF is consistent with the strategic need for the project.

Detailed site contamination testing post determination of the project REF identified contamination in soil/sediment and groundwater. This contamination is being managed via the preparation and implementation of a RAP. The proposed design modifications are needed to meet the requirements of the RAP following the detailed site contamination testing.

The proposed harm to marine vegetation is needed as mangrove seedlings have emerged within the footprint of the proposed remediation and construction works.

The specialist advice from an arborist is required for management of the health of a row of trees located adjacent to the site in Marina Park.

The Contractor advised that the construction methodology aims to alleviate the need for dewatering activities during the installation of the wastewater storage tank, associated wastewater junction pit and drainage infrastructure. However, after reviewing the mean high-water level data, some of the excavation areas may be underwater during stages of the works (particularly high tide events). Therefore, excavation areas that experience groundwater and/or surface water ingress may require dewatering to assist with the Contractor's construction requirements. Any dewatering would be undertaken in accordance with a Dewatering Management Plan (DMP).

2.2 Proposal objectives and development criteria

Section 2.3 of the project REF identifies the proposal objectives and development criteria that apply to the proposed modifications.

The addendum REF is required as detailed site contamination testing post determination of the project REF identified contamination in soil/sediment and groundwater that resulted in changes to the design and development of a RAP. The site remediation and subsequent modifications to the design are required to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to reduce the human health and environmental risks posed by site contamination to an acceptable level.

2.3 Alternatives and options considered

As the mangrove seedlings have emerged within the footprint of the proposed remediation and construction works, their removal is unavoidable to achieve the project objectives and avoid further degradation of the site. No alternatives to their removal have been considered.

Excavation along the site boundary adjacent to the row of trees in Marina Park is unavoidable to meet the design requirements for the travel lift.

Groundwater egress during high tides to excavations for the wastewater storage tank, associated wastewater junction pit and drainage infrastructure may be unavoidable during particularly high tide events.

The consideration of alternatives and options for the site remediation are included in Section 4 of the RAP (JK Environments 2022) and have been summarised below.

2.3.1 Methodology for selection of the preferred option

The NSW EPA follows the hierarchy set out in NEPM 2013 for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

1. On-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated material so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

Or if the above are not practicable:

3. Consolidation and isolation of the soil by on-site containment within a properly designed barrier; and
4. Removal of contaminated material to an approved site or facility, followed where necessary by replacement with clean material; or
5. Where the assessment indicates that remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

The above hierarchy were respectively referred to as Option 1, Option 2, Option 3 etc in the RAP.

The NEPM 2013 and the WA DoH 2021 guidelines prefer the following asbestos remediation hierarchy:

1. Minimisation of public risk;
2. Minimisation of contaminated soil disturbance; and
3. Minimisation of contaminated material/soil moved to landfill.

The NSW EPA Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition) (2017) provides the following additional requirements to be taken into consideration:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed; and
- Where there are large quantities of soil with low levels of contamination, alternative strategies should be considered or developed.

2.3.2 Identified options

Options assessed for the site comprised:

- Option 1 On-site treatment of contaminated soil
- Option 2 Off-site treatment of contaminated soil
- Option 3 Consolidation and isolation of impacted soil by cap and containment
- Option 4 Removal of contaminated material to an appropriate facility and reinstatement with clean material
- Option 5 Implementation of management strategy

2.3.3 Analysis of options

Section 4.2 of the RAP (JK Environments 2022) includes a detailed assessment of options.

2.4 Preferred option

The preferred primary option for remediation is Option 3 (cap and contain) and the preferred secondary option for remediation of surplus soil is Option 4 (excavation and off-site disposal). These options were considered to be most appropriate considering the proposed development and lack of on-site and off-site treatment options.

It was considered that the preferred option will:

- Minimise public risk;
- Minimise significant disposal of contaminated material/soil moved to landfill;
- Isolate the soil on-site by containment within a properly designed barrier, thus reducing the potential exposure pathway and risks to site receptors;
- Provide an effective and robust low maintenance capping solution and a passive long term management procedure; and
- Once constructed the cap will be incidental to the maintenance of the facility in general.

The integrity of the cap will be maintained by the implementation of a Long Term Environmental Management Plan (LTEMP) and will require site identification documentation to note the presence of the contamination.

3 Description of the proposed modification

3.1 The proposed modification

Transport for NSW proposes to modify the Tweed Heads Travel Lift Boat Facility by changes to the design as a result of contamination testing and development of a Remediation Action Plan (RAP) (proposed modifications). Due to the site being idle, the removal of mangrove seedlings that have emerged at the site is also required. Specialist advice from an arborist has been sought regarding the management of a row of trees located adjacent to the site in Marina Park. In addition, the possibility for the need for dewatering during the installation of a wastewater storage tank and associated activities has been identified by the Contractor. The proposed modifications are shown in Figure 1-2, Figure 1-3 and Figure 1-4.

3.1.1 Harm to marine vegetation

The proposed harm to marine vegetation involves removal of up to twenty four mangrove seedlings that have emerged along the eastern and western edge of the existing slipway (refer Figures 3-1 and 3-2). The seedlings fall within the footprint of the construction works where remediation activities are proposed.

Figure 3-1: Mangrove seedlings on western edge of slipway

Figure 3-2: Mangrove seedlings on eastern edge of slipway

3.1.2 Design Changes

Detailed assessment of site contamination has led to the development of a RAP. A copy of the RAP is included in Appendix A. The proposed remediation options for the site require changes to the proposed design. These design changes comprise the inclusion of a high visibility geotextile fabric marker layer and geogrid placed over all exposed subgrade surfaces.

Figure 1-3 shows the extent of the remediation works. Figure 3-3 shows details of the proposed geotextile fabric marker layer and geogrid. All other aspects of the proposed site construction works remain the same.

3.1.3 Tree root management

Specialist advice was sought regarding the row of trees located adjacent to the site in Marina Park and has identified a number of recommended management measures for any tree roots discovered during excavation activities. These measures are discussed in Section 6.5.

3.1.4 Dewatering

Dewatering was not expected to be required for the construction activities and the Contractor has advised TfNSW that the construction methodology aims to alleviate the need for dewatering activities during the installation of the wastewater storage tank, associated wastewater junction pit and drainage infrastructure. However, after reviewing the mean high-water level data, the Contractor considers that some of the excavation areas may be underwater during stages of the works (particularly high tide events). Therefore, excavation areas that experience groundwater and/or surface water ingress may require dewatering to assist with the contractor's construction requirements. If dewatering is required, a Dewatering Management Plan (DMP) would be prepared.

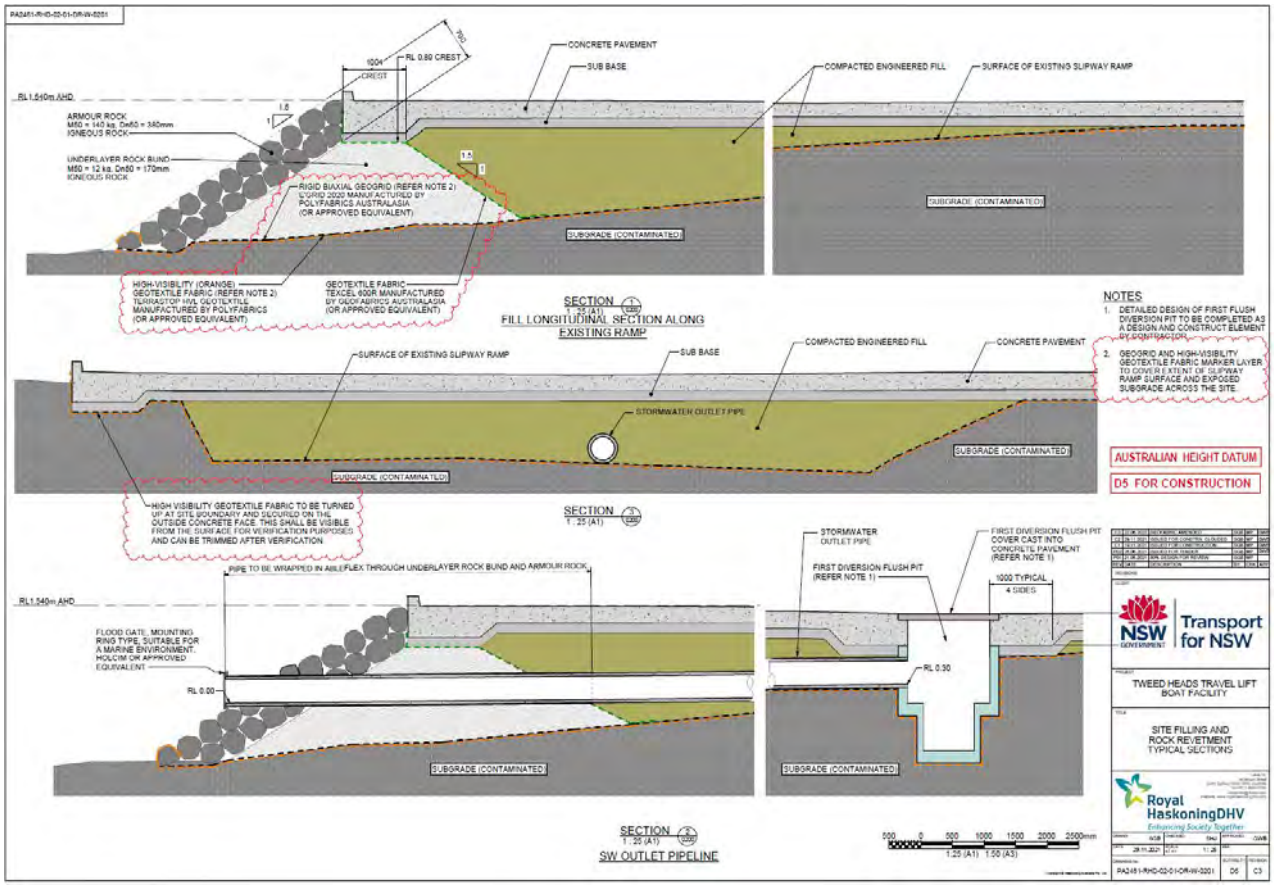

Figure 3-3: Design details of proposed geotextile fabric marker layer and geogrid

3.2 Design

Remediation is primarily based around the installation of an appropriate capping system over the contaminated soil in remediation Area A (refer Figure 1-3). The existing pavements in minor areas of the site (Areas B, C and D) are not proposed to be disturbed. The capping specified for Area A in the RAP includes high-visibility (orange) geofabric visual marker layer (TerraStopHVL Geotextile, Manufactured by Polyfabrics Australasia or approved equivalent) placed over the contaminated soil ground surface, followed by a geogrid mechanical barrier (E'GRID 2020 Rigid Biaxel Geogrid, Manufactured by Polyfabrics Australasia or approved equivalent) placed directly over the geofabric, followed by engineered fill to achieve site design levels, followed by a subbase and concrete pavement/hardstand as per the construction activities outlined in the project REF.

3.3 Construction activities

3.3.1 Work methodology

The following general sequence of works is anticipated for the remediation works:

- Site establishment;
- Preparation of an Asbestos Management Plan (AMP), Construction and Environmental Management Plan (CEMP), Hazardous Building Material Assessment (HAZMAT), and Acid Sulfate Soil Management Plan (ASSMP) for the proposed development prior to proceeding with remediation;

- Installation of silt curtain, erosion and sediment controls, and marker layer (i.e. high visibility geotextile fabric and geogrid) prior to construction of the rock bund/revetment in the lower section of the existing slipway ramp;
- Demolition/removal of structures, with full-time presence of validation consultant;
- Removal of surface ACM and asbestos clearance certificate to be issued by Licensed Asbestos Assessor (LAA);
- Remediation of the site by excavation and off-site disposal of surplus contaminated soils;
- Remediation (and validation) by capping of contaminated soils, and validation of this process; and
- Preparation of a LTEMP for the site.

As noted above, the proposed remediation option for the site requires changes to the proposed design. These design changes comprise the inclusion of a high visibility geotextile fabric marker layer and geogrid placed over all exposed subgrade surfaces.

The mangrove seedlings would be removed as part of the demolition phase of the work methodology. The management measures for tree roots and any dewatering will be adopted during the excavation phase of work. All other aspects of the construction activities are as per the project REF.

4 Statutory planning framework

4.1 Environmental Planning and Assessment Act 1979

The statutory basis for planning and environmental assessment in NSW is set out in the Environmental Planning and Assessment Act (EP&A Act) 1979 and Environmental Planning and Assessment Regulation (EP&A Regulation) 2021.

Part 4 of the EP&A Act sets out the development assessment requirements for those developments that require consent. Part 5 of the EP&A Act specifies the environmental impact assessment requirements for activities undertaken by or on behalf of public authorities that are permissible without development consent.

Chapter 2, Division 13, Clause 2.80 of State Environmental Planning Policy (Transport and Infrastructure) 2021 states that "Development for the purpose of wharf or boating facilities may be carried out by or on behalf of a public authority without consent on any land". As the proposed Tweed Heads Travel Lift works are characterised as 'development for the purpose of wharf or boating facilities', and are to be carried out by TfNSW on Crown Lands, the construction works do not require development consent under Part 4 of the EP&A Act and fall under Part 5 of the EP&A Act.

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

SEPP (Transport and Infrastructure) 2021 aims to facilitate the effective delivery of infrastructure within NSW by public authorities. It does this by prescribing the infrastructure related works that may be undertaken without development consent, although the public authority may still be required to obtain an approval, licence or permit under another Act, such as the Fisheries Management Act 1994.

Chapter 2, Division 13, Clause 2.80 of SEPP (Transport and Infrastructure) 2021 states that "Development for the purpose of wharf or boating facilities may be carried out by or on behalf of a public authority without consent on any land. 'Wharf or boating facilities' are defined as:

… a wharf or any of the following facilities associated with a wharf or boating that are not port facilities—

(a) facilities for the embarkation or disembarkation of passengers onto or from any vessels, including public ferry wharves,

(b) facilities for the loading or unloading of freight onto or from vessels and associated receival, land transport and storage facilities,

(c) wharves for commercial fishing operations,

(d) refuelling, launching, berthing, mooring, storage or maintenance facilities for any vessel,

(e) sea walls or training walls,

(f) administration buildings, communication, security and power supply facilities, roads, rail lines, pipelines, fencing, lighting or car parks.

The travel lift facility is classified as a maintenance facility.

SEPP (Transport and Infrastructure) 2021 prevails over other environmental planning instruments with the exception of clauses 2.7, 2.8 and 2.16 of SEPP (Resilience and Hazards) 2021.

As the proposed modification is for the purpose of wharf or boating facilities and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the EP&A Act. Development

consent from council is not required. The proposed modification is not located on land reserved under the *National Parks and Wildlife Act 1974.*

The proposed modification does not trigger development consent or approval under SEPP (Resilience and Hazards) 2021, or SEPP (Precincts-Regional) 2021.

State Environmental Planning Policy (Planning Systems) 2021

State Environmental Planning Policy (Planning Systems) 2021 identifies development that is State significant infrastructure and critical State significant infrastructure.

Part 2.3 of the SEPP declares development to be State significant infrastructure if the development is, by the operation of a State environmental planning policy, permissible without development consent and the development is specified in schedule 4 of the SEPP.

Schedule 4 specifies that development for the purpose of port and wharf facilities or boating facilities (not including marinas) by or on behalf of a public authority that has a capital investment value of more than $30 million is State significant infrastructure.

4.1.2 The proposed modification has a capital investment value of $7,500,000 so does not become State significant infrastructure as declared by the SEPP. Tweed Local Environmental Plan 2014 and Tweed City Centre Local Environmental Plan 2012

The Tweed LEP 2014 is the primary statutory plan for the majority of the Tweed Shire and is based on the requirements of the Standard Instrument (Local Environmental Plans) Order 2006. The site of the proposed travel lift boat facility is zoned W3 – Working Waterway and IN4 – Working Waterfront.

Land Zone W3 for Working Waterways has the following objectives:

- To enable the efficient movement and operation of commercial shipping, water-based transport and maritime industries;
- To promote the equitable use of waterways, including appropriate recreational uses;
- To minimise impacts on ecological values arising from the active use of waterways; and,
- To provide for sustainable fishing industries.

Land Zone IN4 for Working Waterfront has the following objectives:

- To retain and encourage waterfront industrial and maritime activities;
- To identify sites for maritime purposes and for activities that require direct waterfront access;
- To ensure that development does not have an adverse impact on the environmental and visual qualities of the foreshore;
- To encourage employment opportunities; and,
- To minimise any adverse effect of development on land uses in other zones.

The proposed modifications meet the objectives of the zones.

4.2 Other relevant NSW legislation

4.2.1 Protection of the Environment Operations Act 1997 (POEO Act)

Activities should be carried out in a manner which does not result in the pollution of waters. An Environmental Protection Licence (EPL) for a premises for boat construction/maintenance (refer Clause 25, Schedule 1 of *POEO Act*) is required if the facility has the capacity to handle more than

5 vessels longer than 5 meters (excluding rowing boats, dinghies and other small craft) at any time. The preferred Stage 1 concept design as described in the Project REF is not expected to provide for capacity to handle more than 5 vessels longer than 5 m, and hence an EPL for the premises is not required for Stage 1. The proposed modifications do not trigger the need for an EPL.

4.2.2 Fisheries Management Act 1994 (FM Act) –

Permits under Part 7 of the Act are required for dredging and reclamation, temporarily or permanently obstructing fish passage, and harming marine vegetation.

A Fisheries Part 7 permit may be required for dredging/reclamation due to disturbance of the seabed, placement of fill over portion of the slipway, and placement of rock. A permit is not required if the works will be licenced under a Crown Lands licence negating the need for a permit. However, Section 199 of the Fisheries Management Act requires that the public authority must, before it carries out or authorises the carrying out of dredging work, give the relevant Minister written notice of the proposed work, and consider any matters concerning the proposed work that are raised by the Minister within 21 days after the giving of the notice.

Any temporary or permanent structures (such as a weir, causeway, dam, coffer dam etc.) that may inhibit, obstruct or block the movement of fish within a waterway either temporarily or permanently require a permit. While floating plant and a silt curtain will be present in the waterway during the works, these will be adjacent to the shoreline and the remainder of the waterway will be available for the free passage of fish. A permit under Section 219 is therefore not required.

Permits are required for any damage to, or destruction of, saltmarsh, mangroves or seagrasses growing on public water land or the foreshore of public water. As mangrove seedlings have emerged within the construction footprint, a permit under Section 205 is required for the works.

4.2.3 Crown Lands Management Act 2016

To undertake activities and work on crown land, a licence is required from the Department of Planning, Industry and Environment (DPIE) – Lands (Crown Land).

4.2.4 Biodiversity Conservation Act 2017

The potential impact of the modifications on threatened species has been assessed. The assessment for this REF determined that there is not likely to be a significant effect on threatened species, populations and/or ecological communities listed in the NSW Fisheries Management Act or NSW Biodiversity Conservation Act, or their habitats from the proposed modifications. Therefore, a species impact statement is not required.

4.2.5 Water Management Act 2000

Under the Water Act, approval is required to undertake controlled activities on waterfront land. However, the Water Management Regulation 2011 outlines a number of exemptions for controlled activities. Where a public authority is carrying out the controlled activity on or in waterfront land, approval from the Office of Water is not required.

4.2.6 National Parks & Wildlife Act 1974

Under s86, it is an offence to harm or desecrate an Aboriginal object or place. Assessment for this REF determined there are no known sites or places of Aboriginal significance nearby to the site. In addition, the project is not located on land reserved under the National Parks and Wildlife Act 1974.

4.2.7 Native Title Act 1994

No native title claims have been identified at or near the site.

4.2.8 Heritage Act 1977

No heritage sites, areas or items identified within vicinity of the proposed works area.

4.3 Commonwealth legislation

4.3.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land'. These are considered in Appendix C and chapter 6 of the REF.

The assessment of the impact of the proposed modification on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Agriculture, Water and Environment under the EPBC Act.

4.4 Confirmation of statutory position

The proposed modification is categorised as development for the purpose of wharf or boating facilities and is being carried out by or on behalf of a public authority. Under clause 2.10 of SEPP (Transport and Infrastructure) the proposed modification is permissible without consent. The proposed modification is not State significant infrastructure or State significant development. The proposed modification can be assessed under Division 5.1 of the EP&A Act. Consent from Council is not required.

5 Consultation

5.1 Consultation strategy

Stakeholder community consultation was undertaken by TfNSW as part of the project REF.

Statutory consultation is not required in accordance with Clause 3.12 of SEPP (Transport and Infrastructure).

Engagement with NSW EPA and an accredited auditor has been undertaken as part of the RAP development and is described below.

Engagement with DPI Fisheries has also been undertaken as part of the harm to marine vegetation permit application process.

5.2 Agency Consultation

5.2.1 NSW EPA

TfNSW engaged a NSW EPA accredited site auditor to act as site auditor for this project.

Consultation has been undertaken with the auditor regarding the required sampling and testing for the Detailed Site Investigation (DSI) to support the RAP development. Interim advice has been provided by the auditor on the draft DSI and RAP. Currently the auditor has no further comments on the DSI and RAP, and otherwise considers all previous comments have been adequately addressed.

The auditor will in due course deliver a site audit statement (SAS) and associated site audit report (SAR).

5.2.2 DPI Fisheries

Permits are required for any damage to, or destruction of, saltmarsh, mangroves or seagrasses growing on public water land or the foreshore of public water. As mangrove seedlings have emerged within the construction footprint, a permit under Section 205 is required for the works. DPI Fisheries was consulted regarding the permit and an application submitted to DPI Fisheries on 13/07/22. DPI Fisheries has processed the application and issued a permit to harm marine vegetation on 10/08/22. A copy of the permit is included in Appendix B.

6 Environmental assessment

This section of the addendum REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposed modification of the Tweed Heads Travel Lift Boat Facility. All aspects of the environment potentially impacted upon by the proposed modification are considered. This includes consideration of the (DUAP, 1995/1996) guideline, the factors specified in section 171 of the Environmental Planning and Assessment Regulation 2021 and the *Marinas and Related Facilities Guideline* (DUAP, 1996). The factors specified in section 171 of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix C.

Site-specific safeguards and management measures are provided to ameliorate the identified potential impacts.

6.1 Sediment and Soil Quality

6.1.1 Existing environment

Since completion of the project REF, Royal HaskoningDHV commissioned JK Environments (JKE) to undertake:

- Preliminary Site Investigation (PSI); and
- Detailed Site Contamination Investigation (DSI).

For the DSI, soil/sediment samples were collected from 12 boreholes and three surface soil locations. Groundwater samples were obtained from four monitoring wells. River water samples were collected at three monitoring locations at mid ebb and mid flow tides either side of the high tide over three high tide events. Two river water samples were collected from nearby areas to assess background concentrations.

Testing of soils, sediment, groundwater, and leachates from TCLP testing and LEAF testing using seawater was undertaken. Water quality was also studied in the adjacent waterbody of Terranora Inlet.

Contamination in soil/sediment and groundwater was encountered. Total Polychlorinated Biphenyls (PCB) in fill/sediment exceeded the human health Site Assessment Criteria (SAC). Asbestos in the form of bonded Asbestos Containing Materials (ACM) and friable asbestos was detected within the fill. Tributylitin (TBT), copper, zinc, nickel and Total Recoverable Hydrocarbons (TRH) results in soil/sediment exceeded the ecological SAC. TBT exceeded the marine ecological SAC in the groundwater samples collected at one location. Perfluorooctanesulfonic Acid (PFOS) exceeded the marine ecological SAC in all groundwater samples and one river water sample.

The primary contamination issues identified were potential asbestos and PCB risks to human health; TBT, copper and zinc risk to ecological receptors.

6.1.2 Potential impacts

The modifications to the design being assessed by this addendum REF (i.e. inclusion of a high visibility geotextile fabric marker layer and geogrid placed) are part of the proposed remediation of the site. A RAP is required and has been prepared by JKE to manage the risks posed by the contamination to human and environmental receptors. Specifically, asbestos and PCB's were identified at the site and are considered to pose a potential risk and source-pathway-receptor linkage (SPR-linkage) to human receptors at the site including construction workers and future commercial/industrial users. The asbestos and PCB soil contamination are addressed in the RAP, including a description of measures to protect construction workers from exposure.

Based on the PSI and DSI results Royal HaskoningDHV engaged Dr Graeme Batley of CSIRO Land and Water to review the results and provide expert opinion on TBT and metals. A full copy of Dr Batley's advice is included in Appendix K of the DSI report. Key findings were that:

- Detailed river water sampling and analysis showed that measured TBT concentrations were below the detection limit of 2 ng Sn/L in all samples. DBT and MBT were also below detection limits except for minor amounts of DBT (<7 ng Sn/L) on two occasions. These were considered to be significant findings as they indicated that TBT is not reaching the river system at concentrations of environmental concern.
- Several river water samples showed evidence of copper and zinc mobility, with elevated concentrations being restricted to site RW4.1 closest to the bottom of the slipway. The high zinc concentration was close to the water quality guideline value of 15 µg/L so was not considered to be a concern, however, the highest copper value was almost 10 times the guideline value. Given that there was barely detectable copper (and zinc) at 15 m from the shore, coupled with the fact that elevated concentrations were only seen on one of the four sampling occasions, it was concluded that any released copper is being readily diluted. Copper is also likely to bind to both dissolved organic matter and to suspended particulates, reducing any bioavailability.
- Under the framework of the RAP, the exposed sediments on the slipway are proposed to be effectively capped and covered by the proposed works, comprising the placement of geotextile fabric, construction of a rock bund/revetment, backfilling over the ramp, and installation of a reinforced concrete hardstand. As such, the exposure pathway will be limited to contaminants leaching through groundwater/tidal water movement through the rock bund/revetment. **The river water sampling indicated that it is not likely that TBT, copper and zinc in contaminated soils/sediments at this site and others in the hardstand areas will pose a significant impact on the health of the aquatic ecosystem after capping if left undisturbed**.

Based on the DSI results, the marine alluvial soils identified acidic conditions above the action criteria presented in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018). These results are considered to be indicative of acidic soils associated with PASS as significant concentrations of oxidisable sulfur were encountered in natural marine soil samples.

These findings support the conclusion that the contamination present on the Site will be effectively managed by the implementation of the RAP, and that the contamination will not, as a result of the project works pose a significant risk to off-site ecological receptors or a significant risk to on or offsite human receptors.

However, it is notable that JKE, in the executive summary of the RAP, included an ambiguous statement regarding the findings in relation to contamination. That statement was:

> *The DSI demonstrated that under the current site conditions the soil/sediment leachate and groundwater contamination was not migrating off-site at significant concentrations that posed a risk to off-site ecological receptors or a risk to on or offsite human receptors.* ***However, significant alteration of site conditions and disturbance of the contaminated soil/sediment may impact on these findings****.*

On its face, that statement could be read as suggesting that the works to be undertaken in the implementation of the project would negate the findings as to risks posed by the contamination. As a result, a third party expert, Jason Clay of Senversa, was appointed to undertake an independent review of the RAP and to give an expert opinion on whether the remediation works described in the RAP would reasonably be expected to mitigate the risk posed by the contamination on the site. Mr Clay's opinion (letter report 17.08.22) confirmed that:

"In our opinion, remediation works described in the RAP can reasonably be expected to mitigate the identified risks posed by the Existing Contamination, subject to implementation of the Long Term Environmental Management Plan (LTEMP). "

This is on the basis that:

- The report concluded that there is an existing low risk and off-site migration potential.
- The nature of the potential risk to site workers/users and river ecology – these principally relate to potential future adverse changes in site conditions or use (e.g. exposure of contaminated fill).
- The Project appears to comprise an increased extent and improved quality of pavement and drainage – this would likely result in a lower environmental risk.

6.1.3 A LTEMP is proposed to manage the residual contamination under the capping into the future. Safeguards and management measures

JKE considers that the site can be made suitable for the proposed travel lift facility provided the following recommendations are implemented:

- Prepare and implement a Remediation Action Plan (RAP);
- Prepare and implement an Asbestos Management Plan (AMP);
- Prepare and implement an Acid Sulfate Soil Management Plan (ASSMP);
- Undertake a hazardous building materials (HAZMAT) assessment prior to demolition of the existing buildings/structures at the site; and
- Prepare a Validation Assessment report at the completion of remediation works.

The integrity of the proposed capping will be maintained by the implementation of a Long Term Environmental Management Plan (LTEMP) and will require site identification documentation to note the presence of the contamination

Impact	Environmental safeguards	Responsibility	Timing
Contamination	Preparation and implementation of RAP and AMP	TfNSW Project Manager and Remediation Contractor	Pre-construction and construction
	Preparation of a Validation Assessment report	Validation consultant	During and post construction
	HAZMAT assessment	TfNSW Project Manager and Remediation Contractor	Prior to building/structure demolition
	Preparation and implementation of LTEMP	TfNSW Project Manager	During and post construction
ASS	Preparation and implementation of ASSMP	TfNSW Project Manager and Remediation Contractor	Pre-construction and construction

6.2 Waste Management

6.2.1 Existing environment

Infrastructure at the Tweed Heads Slipway is ageing and some parts require significant maintenance or replacement. In particular, environmental controls at the current slipway are poor and the site is contributing to contamination of surrounding sediments.

6.2.2 Potential Impacts

The project REF noted that the proposed construction works may generate excavated fill material unsuitable for reuse and that the materials that are unsuitable for reuse would be tested, classified and transported offsite to a licensed waste facility.

Since the completion of the project REF, a PSI, DSI and RAP have been prepared for the site. The RAP notes that surplus material may result from excavations required to construct the new concrete hardstand in the upper (north) section of the slipway, the settlement tank associated with the new washdown water treatment system, and other underground services.

The surplus soils from these areas cannot be placed in a containment cell in the lower section of the slipway in the south-west section as this area is impacted by tides. Such major alteration/disturbance to the existing site conditions could result in offsite leachate impacts to Terranora Creek which have been assessed as a low risk to the marine ecology provided that the site is largely undisturbed.

The surplus soil cannot remain onsite by raising the proposed development surface levels as this could have significant impacts on surface water drainage and flooding potential.

Based on the results of the DSI, the fill material has been assigned a preliminary waste classification of General Solid Waste (non-putrescible) containing Special Waste (asbestos).

Due to the presence of PCBs, TBT and ACM in the fill, the transport of waste off-site is to be managed, transported and disposed of in accordance with the requirements under the Protection of the Environment Operations (POEO) Act (1997)32 and the Hazardous Chemicals Act 1985, including the respective PCB and Organotin Chemical Control Order's (CCO) made under the Hazardous Chemicals Act 1985. As noted above, the RAP has been prepared to manage the risks posed by the site contamination to human and environmental receptors.

Section 5.3.2 the RAP sets out in detail the process for the removal of surplus contaminated soil.

6.2.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Removal of surplus contaminated soil	Preparation and implementation of RAP and AMP	TfNSW Project Manager and Remediation Contractor	Pre-construction and construction

6.3 Water Quality

6.3.1 Existing environment

As described in the project REF, the site is located adjacent to Terranora Creek, within the lower Tweed River estuary and receives diurnal tidal flushing but is locally influenced by harbour operations. Water quality is expected to be generally consistent with a healthy estuarine

environment although there is likely to be ongoing impacts associated with the existing facility associated with boat related resuspension of contaminated sediments as well as potential small scale hydrocarbon slicks, harbour debris, and the like.

GHD (2017) reported that runoff from the slipway ramp is directed into a narrow catch drain (at the southwestern end of the concrete ramp), flowing into a pit at the north-western of the drain, then pumped via an underground pipe into an oil-water separator (at the northern corner of the winch house), before being discharged into the Council sewerage system. However, the catch drain for the slipway works area is often inundated during high tides (GHD, 2017), as is the lower portion of the work area, resulting in the discharge of stormwater into the waterway.

As noted in Section 6.1.2, recent detailed river water sampling and analysis indicated that TBT from the site is not reaching the river system at concentrations of environmental concern. Any metals being released are being readily diluted and also likely to bind to both dissolved organic matter and to suspended particulates, reducing any bioavailability.

6.3.2 Potential Impacts

Water quality impacts are not expected due to the modifications to the design being assessed by this addendum REF. As described in Section 6.1.2, expert advice indicated that under the framework of the RAP, the exposed sediments on the slipway are proposed to be effectively capped and covered by the proposed works, comprising the placement of geotextile fabric, construction of a rock bund/revetment, backfilling over the ramp, and installation of a reinforced concrete hardstand. As such, the exposure pathway will be limited to contaminants leaching through groundwater/tidal water movement through the rock bund/revetment. The river water sampling indicated that it is not likely that contaminated soils/sediments will pose a significant impact on the health of the aquatic ecosystem after capping if left undisturbed.

Water quality impacts are also not expected due to the possible need for dewatering due to groundwater egress during high tides to excavations for the wastewater storage tank, associated wastewater junction pit and drainage infrastructure. If dewatering is required, a Dewatering Management Plan (DMP) will be prepared. The DMP will outline effective management procedures and treatment requitements to prevent environmental harm resulting from the discharge of extracted groundwater from the site.

6.3.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Contamination leaching from the site	Preparation and implementation of RAP	TfNSW Project Manager and Remediation Contractor	Pre-construction and construction
Contamination of the adjacent water body due to extracted groundwater from dewatering activities	Preparation and implementation of DMP	TfNSW Project Manager and Contractor	Pre-construction and construction

6.4 Estuarine Vegetation

6.4.1 Existing environment

DPI habitat mapping (2022) shows large areas of estuarine vegetation (seagrass, mangroves, saltmarsh) are located through the broader lower Terranora Inlet and Tweed River estuary. No seagrass, mangroves or saltmarsh are mapped within the proposed works areas (refer Figure 6-1). The nearest seagrass meadows are located approximately 40 m from the site. The seagrass is likely to be Zostera capricorni based on the DPI mapping. Mature mangroves are also located on the opposite foreshore approximately 50 m south of the works area.

No threatened flora or threatened ecological communities were identified within the study area. Up to twenty four mangrove seedlings have emerged along the eastern and western edge of the existing slipway (refer Figure 3-1 and Figure 3-2). The seedlings fall within the footprint of the construction works where remediation activities are proposed.

Figure 6-1: DPI habitat mapping showing mangroves (green shaded area) and seagrass (blue shaded area) with location of mangrove seedlings circled in red.

6.4.2 Potential Impacts

Removal of the mangrove seedlings that have emerged along the eastern and western edge of the existing slipway will be required as they fall within the footprint of the construction works where remediation activities are proposed. As there are large areas of estuarine vegetation (seagrass, mangroves, saltmarsh) located through the broader lower Terranora Inlet and Tweed River estuary including a large stand of mangroves located on the opposite foreshore approximately 50 m south of the works area, the impact on mangrove habitat due to the removal of the mangrove seedlings is considered negligible.

Under Section 205 of the Fisheries Management Act, a permit is required to harm marine vegetation.

6.4.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Removal of mangrove seedlings	Application for a DPI Permit for Harm to Marine Vegetation	TfNSW Project Manager	Pre-construction

6.5 Terrestrial Vegetation

6.5.1 Existing environment

Marina Park is located along the western boundary of the travel lift site adjacent to the existing slipway. The park is Council owned and maintained and consists of two large *Ficus benjamina* in the centre and a row of 22 trees planted close to the chainmesh fence on the eastern boundary of Marina Park which separates the park from the slipway.

Specialist advice from an arborist indicated that all the trees planted along the fence line are poor examples of their species due to a combination of reasons including rootstock, planting depths and site conditions (refer Figure 6-2). The two *Ficus benjamina* are in very good condition and are heavily utilised by the public visiting the café and for leisure. A list of tree species is included in the arborist's report. None of the trees are protected species. A copy of the arborist's report is included in Appendix E.

Figure 6-2: Trees in Marina Park along the eastern boundary of the park adjacent to the existing slipway

6.5.2 Potential Impacts

All excavation work will take place within the project site and not extend beyond the boundary fence line into Marina Park.

The arborist concluded that where excavations by the contractor do not extend beyond the Marina Park boundary fence (existing fence line) from the slipway construction zone then the impact to the row of trees along the boundary will be minimal.

The arborist also notes that where excavations by the contractor do not extend beyond the Marina Park boundary fence (existing fence line), impacts on the two large *Ficus benjamina* in the centre of the park will be minimal.

A number of tree protection measures are recommended by the arborist.

6.5.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Harm to trees in Marina Park	• Roots discovered in the excavation trench are to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs. • All significant roots (>40mm diameter) are to be recorded, photographed and should be pruned by a qualified arborist.	Contractor	During excavation

6.6 Other impacts

No other environmental factors are assessed to be impacted by the modifications.

6.7 Cumulative impacts

The proposed travel lift facilities will be constructed on the site of an existing slipway. As described by Hydrosphere (2019), in the Tweed River there is one other facility similar to the slipway located at Chinderah and similar slipway facilities are located at Gold Coast, Sunshine Coast, Brisbane, Iluka, Yamba, Ballina and Moreton Bay. There are no other marine travel lifts in the nearby region.

6.7.1 Potential impacts

Although the travel lift is a significant improvement in infrastructure, the overall type of use of the site (boat repair and maintenance) is not expected to significantly change. As described by Hydrosphere (2019), there is potential for increased boat movements into and out of the facility and that the number of boats able to be serviced will be increased. However, the net result will be improvement in environmental management of the facility and a reduction in the need for vessels to travel to (or be trucked to) other facilities to get the same work undertaken. The proposal is not anticipated to intensify or otherwise significantly modify long-term use of the harbour.

7 Environmental management

7.1 Environmental management plans

A number of safeguards and management measures have been identified to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposed modification. These management measures will be incorporated into the Contractors Environmental Management Plan (CEMP) and applied during the construction and operation of the proposed modification.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures for the Tweed Heads Travel Lift Boat Facility are summarised in Table 7-1. Additional safeguards and management measures identified in this addendum REF are included in bold and italicised font. The safeguards and management measures will be incorporated into the CEMP and implemented during construction and operation of the proposed modification, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment.

Table 7-1: Summary of site specific safeguards

Environmental Safeguard and/or Mitigation Measure
Water and Sediment Quality (Stage 1 only)
1. Deployment of floating silt curtains (two). **A single silt curtain across the revetment and one around the piling rig on the barge.** ~~These silt curtains would later be extended further into the waterway to enclose the overwater work area required for pile driving.~~The silt curtains shall be weighted and extend all the way to the seabed in all tidal conditions.
2. Daily inspections for turbidity and effectiveness of the silt curtains.
3. ***Preparation and implementation of a RAP and AMP***
4. ***Preparation of a Validation Assessment report***
5. ***Completion a HAZMAT assessment***
6. Adoption of remediation ***as per the RAP including a high-visibility (orange) geofabric visual marker layer placed over the contaminated soil ground surface, followed by geogrid mechanical barrier placed directly over the geofabric, followed by construction of the rock bund/revetment in the lower section of the existing slipway ramp*** to cap the contaminated sediments on the slipway ramp and provide an effective environmental control for containment of any sediment disturbance by land-based demolition activities and/or tidal water level variations at the site during construction.
7. ***Preparation and implementation of a DMP***
8. Rock used in the works to be free of fines (washed).
9. If excavation of sediments is required, an ASS Management Plan is to be prepared.
10. Preparation and implementation of a LTEMP
Water and Sediment Quality (Stage 1 and Stage 2)
11. Replacement of the trade waste system and approval from Tweed Shire Council for the discharge of trade waste to the Council sewerage system. The trade waste oil separator should be double bunded.
12. Industry standards and pollution prevention regulations to be adhered to during refuelling, transfer, storage and handling of hazardous materials.

Environmental Safeguard and/or Mitigation Measure
13. Contractor to ensure that all plant is maintained in good working order with regular servicing.
14. No major maintenance of equipment shall be undertaken on-site.
15. Weather and tide forecasts to be checked regularly during construction. Where flooding or inundation is forecast to the any work area, all equipment and materials to be removed from the landside construction zone or appropriately secured above expected flood levels in the area. These procedures should be documented in a Flood Management Plan.
16. Stockpiles shall be located on flat ground at least 5 metres away from areas subject to run-off and away from established flow paths (e.g. drains, gutters, etc.). The height of the stockpiles shall not exceed 2 metres unless stockpiles are suitably protected from wind erosion. The Contractor shall protect temporary stockpiles in accordance with 'Blue Book' requirements.
17. Any machinery working on the waterway is to carry a full spill containment kit including hydrocarbon booms to reduce the impact of any spill.
18. Appropriate site and project inductions/training detailing potential water quality impacts and relevant construction measures and spill and emergency response procedures to be used.
19. Daily inspections of plant, minimisation of fluids on site, and proper procedures for refuelling and maintenance need to be observed.
20. Preparation and implementation of a site Stormwater Management Plan for the operation of the site. The plan should consider stormwater runoff and flow from the site and potential contamination sources.
Water and Sediment Quality (Stage 2 only)
21. Above ground oil storage tank should be double bunded.
Contaminated Land (Stage 1 and Stage 2)
22. ***Removal of surplus contaminated soil in accordance with the RAP*** ~~Excavated existing subgrade beneath the hardstand to be stockpiled onsite for testing to characterise the material and assess it for beneficial reuse as fill onsite or for offsite disposal at a licensed waste facility.~~
23. Operation of the Travel Lift Facility is to be managed according to best management practice procedures including Environmental Action for Marinas, Boatsheds and Slipways (DECC, 2007).
24. To prevent contaminated material being placed on the site, imported material shall be either virgin excavated natural material as defined in the Protection of the Environment Operations Act or be excavated natural material that has been tested in accordance with the 'excavated natural material exemption 2014'.
Estuarine Processes (Stage 1 and Stage 2)
25. Construction and operational flood management plans to be prepared.

Environmental Safeguard and/or Mitigation Measure
Landscape and Visual (Stage 1 and Stage 2)
26. Impacted areas (i.e. for access, storage and site works) be returned to pre-construction conditions where possible.
27. The construction site to be kept tidy and an in an orderly fashion at all times to minimise visual impacts to local residents.
Ecology (Stage 1 and Stage 2)
28. The water and sediment quality protection measures outlined above to be installed for protection of ecology.
29. ***Application for a DPI Permit for Harm to Marine Vegetation***
30. Roots discovered in the excavation trench to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs.
31. All significant roots (>40mm diameter) to be recorded, photographed and should be pruned by a qualified arborist.
Ecology (Stage 2 only)
32. Appropriate fencing should be installed to protect the tree to be retained adjacent to the proposed new road entry during construction.
Air Quality (Stage 1 and Stage 2)
33. Material and rock transported to and from the sites to be covered.
34. Dust suppression measures to be employed by construction crews during dry and windy periods or when required. Water sprays for dust suppression will be minimised to practicable levels.
35. Operating air quality to be managed in accordance with industry best management practice including Environmental Action for Marinas, Boatsheds and Slipways (DECC, 2007).
Noise and Vibration (Stage 1 and Stage 2)
36. All works to be undertaken in accordance with construction noise guidelines.
37. Nearby sensitive receivers (residences and businesses within 200 m) to be notified prior to commencement of works regarding the timing and expected noise levels of the construction works and to be made aware of the details of the complaints handling system including site manager contact details.
38. All works to be undertaken during the standard work hours. No works to be undertaken outside standard hours without consultation with TfNSW.
39. Construction vehicles and equipment to be suitably serviced prior to and appropriately maintained during construction activities.
40. Plant that is not being used to be turned off.
41. Where feasible and reasonable, alternative work practices which minimise noise to be implemented.

Environmental Safeguard and/or Mitigation Measure
42. High vibration methods to be substituted with lower vibration methods where possible.
43. The work site to be set up to minimise the requirement for movement alarms on vehicles and mobile plant.
44. All employees and contractors to receive an environmental induction prior to commencement of works. The induction to include: - Relevant project specific and standard noise mitigation measures. - Permissible hours of work. - Location of nearest sensitive receivers.
45. Further measures to be negotiated with the operator of Ancora, where required, to minimise impacts on their patrons. Such further measures may include alternative timing of noisy works such as no piling during peak trading hours.
Traffic Management (Stage 1 and Stage 2)
46. Public and commercial access to the jetty access road and Terranora Terrace to be maintained. The Contractor may temporarily restrict access along the jetty access road and Terranora Terrace for public safety or operational reasons with the prior approval of the Superintendent and Tweed Shire Council, but such restrictions shall be kept to a minimum.
47. The public and commercial operators to be notified of all changes and restrictions to access along the jetty access road and Terranora Terrace.
48. To manage heavy vehicle movements during construction, a traffic management plan to be developed and implemented.
49. All precautions to be taken to ensure that public roads, thoroughfares, accessways and haulage routes are not obstructed or damaged as a result of the construction Works or transport of equipment and materials. In the event of any damage, the Contractor shall take all necessary and immediate steps to repair the damage.
Navigation (Stage 1 only)
50. Vessel traffic management plan to be prepared and implemented. The plan is to identify potential hazards to boating traffic and harbour users during the construction and operation of the travel lift and provide mitigation actions and controls.
51. Any works impacting on navigation during the construction phase must seek TfNSW support 21 days prior to works commencing.
52. Any vessels or obstructions located within the waterway to be moored securely, and marked appropriately (for both day and night) in accordance with the requirements of TfNSW to ensure that no problems are created to vessels navigating within the area.
Existing Users, Access and Safety (Stage 1 and Stage 2)
53. Prior to commencement of works, boundaries of the construction and access areas to be marked with temporary barrier fencing. The fencing to be monitored daily by the site supervisor and immediately repaired or replaced if necessary and removed when construction is completed.

Environmental Safeguard and/or Mitigation Measure
54. Slipway users to be notified of works prior to commencement.
55. Fishermen's Co-Op should be notified of works prior to commencement.
56. Access to jetties and harbour operations to be maintained to the maximum extent possible.
Waste Management (Stage 1 and Stage 2)
57. The handling, transport and disposal of waste materials to be undertaken in accordance with relevant regulatory and statutory requirements.
58. All litter and waste to be removed from site and disposed of at appropriate waste management facilities.
59. Waste material (for example packaging, strapping, off-cuts) to be contained within the land-based site during construction and then be removed to an authorised waste disposal facility. No material to be placed in any location or in any manner that would allow it to enter the waterway or escape from the site.
60. Waste materials from the project to be managed in accordance with the waste hierarchy outlined in the NSW Waste Avoidance and Resource Recovery Strategy 2014-21. All waste/excess materials to be reused (preferable) or recycled and diverted from landfill where practicable. Where these materials cannot be effectively re-used onsite or by other operations the material is to be classified, transported and recycled or disposed of in accordance with relevant waste guidelines.
61. ***Removal of surplus contaminated soil in accordance with the RAP*** ~~Excess excavated materials to be disposed of to a licensed waste facility.~~
Waste Management (Stage 2 only)
62. Decommisioning and removal of fuel and oil storage tanks and associated infrastructure should be undertaken in accordance with relevant guidelines and standards including: - Underground Petroleum Storage Systems Technical Note: Decommisioning, Abandonment and Removal of UPSS (DECCW, 2010); - AS4976-2008: Removal and disposal of underground petroleum storage tanks; - AS1940-2004: Storage and handling of flammable and combustible liquids; and, - SafeWork NSW WHS codes of practice.
63. Contaminated solid and liquid waste generated from decommisioning and removal of fuel and oil storage tanks and associated infrastructure should be classified and disposed offsite at a licenced waste facility.
Aboriginal Heritage (Stage 1 and Stage 2)
64. All persons working on site to be made aware that it is an offence under Section 86 of the National Parks and Wildlife Act 1975 to harm or desecrate an Aboriginal object unless that harm or desecration is the subject of an approved Aboriginal Heritage Impact Permit (AHIP).
65. If Aboriginal heritage items are uncovered during the work, all work in the vicinity of the find must cease and the Roads and Maritime's Aboriginal cultural heritage

Environmental Safeguard and/or Mitigation Measure
advisor and the senior regional environmental officer contacted immediately. Steps in the TfNSW *Standard Management Procedure: Unexpected Archaeological Find July 2012* must be followed.
66. In the unlikely event that an Aboriginal object is identified whilst carrying out works within the study area, all activities in the immediate vicinity of the identified Aboriginal object to cease and a suitably qualified archaeologist to be contacted to confirm the validity of the object. Should the object be confirmed to be of Aboriginal cultural origin, the contractor must notify DPIE and may need to apply for an AHIP prior to the recommencement of further ground disturbance works in proximity to the object.
Non-Aboriginal Heritage (Stage 1 and Stage 2)
67. If unexpected archaeological remains are uncovered during the work, all work must cease in the vicinity of the material/find and the steps in TfNSW's Standard Management Procedure: Unexpected Archaeological Finds July 2012 must be followed. TfNSW Senior Regional Environmental Officer must be contacted immediately.
68. If any items defined as relics under the NSW Heritage Act 1977 are uncovered during the works, all work must cease in the vicinity of the find and the TfNSW Senior Regional Environmental Officer contacted immediately.
69. If during the course of proposed works previously unknown historical archaeological material or heritage items are discovered, all work in the area of the item(s) to cease immediately. The Project Manager is to engage the Heritage Division, DPIE and a qualified heritage consultant, in accordance with Section 146 of the Heritage Act, to determine an appropriate course of action prior to the recommencement of work in the area of the item.

7.3 Licensing and approvals

All relevant licenses, permits, notifications and approvals needed for the Tweed Heads Travel Lift Boat Facility and when they need to be obtained are listed in Table 7-2. Additional or changed licenses and approval requirements identified in this addendum REF are indicated by underlined and/or struck out font.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Fisheries Management Act 1994 (S199)	Written notice of the proposed work to the relevant Minister, and consider any matters concerning the proposed work that are raised by the Minister within 21 days after the giving of the notice ***DPI Permit for Harm to Marine Vegetation***	A minimum of 28 days prior to start of Stage 1 works.
Crown Land Management Act 2016 (Division 5.5 and 5.6)	Lease or Licence to occupy Crown Land	Prior to start of Stage 1 and Stage 2 works.
Protection of the Environment Operations Act 1997 (POEO Act)	An Environment Protection Licence (EPL) for a premises for boat construction/maintenance (refer Clause 25, Schedule 1 of *POEO Act*) - facility has the capacity to handle more than 5 vessels longer than 5 meters (excluding rowing boats, dinghies and other small craft) at any time.	Prior to the completion of the Stage 2 works.

8 Justification and conclusion

8.1 Justification

Infrastructure at the Tweed Heads Slipway is ageing, and some parts require significant maintenance or replacement. The slipway rails and joins are corroded, the fall of the rails is uneven along the length of the rails, the sleepers are uneven in size with some broken, and areas of concrete support are crumbling. In addition, environmental controls at the current slipway are poor and the site is contributing to contamination of surrounding sediments. The upgrade is required to include remediation and environmental controls to minimise ongoing contamination of the river and sediments.

The current slipway has restricted capacity and is able to service only a relatively small number and range of vessels. Consultation with the local boating community indicates that there are a considerable number of non-seagoing vessels including house boats, charter boats, recreational boats and fishing boats that are based on the Tweed waterways that require a boat maintenance facility.

The proposed activity is permissible without consent under SEPP (Transport and Infrastructure) 2021. An environmental assessment of the proposed activity has been carried out in accordance with s111 of the EP&A Act (1979) and Part 8 s171 of the EP&A Regulation (2021) and Clause 3.12 of SEPP (Transport and Infrastructure 2021).

The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity and has found the proposed activity would have minimal impacts on the surrounding environment. The identified impacts would not significantly affect the environment and therefore an EIS or a Species Impact Statement (SIS) or a 'major project' application under Part 3A of the Act is not required.

8.2 Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	The social and economic welfare of the community and a better environment are the key objectives of the project (the replacement of the existing deteriorated slipway with the upgraded travel lift facility)
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	The principles of ESD have been an integral consideration throughout the development of the project
1.3(c) To promote the orderly and economic use and development of land.	This project forms part of the NSW Government's commitment to providing maritime infrastructure along the NSW coast and aligns with outcomes in the *NSW Maritime Infrastructure Plan 2019-2024*

Object	Comment
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the project
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The works will be undertaken in accordance with a CEMP to protect the environment
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	No impacts are expected from the proposed works as there were no Aboriginal or non-Aboriginal heritage sites identified in the vicinity of the works
1.3(g) To promote good design and amenity of the built environment.	Qualified and experienced design engineers have been engaged by TfNSW
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Qualified and experienced Contractors have been engaged by TfNSW
1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	Not relevant to the project
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Consultation has been undertaken as part of the REF process

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Intergenerational equity

Intergenerational equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for

the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

Conservation of biological diversity and ecological integrity

The principle of conservation of biological diversity and ecological integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for the proposed activity.

Improved valuation, pricing and incentive mechanisms

The principle of improved valuation, pricing and incentive mechanisms deems that environmental factors should be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource.

8.3 Conclusion

This addendum REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. This has included consideration, where relevant, of conservation agreements and plans of management under the NPW Act, stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the EPBC Act.

A number of potential environmental impacts from the proposed modification have been avoided or reduced during the design development and options assessment. The proposed modification as described in the addendum REF best meets the project objectives but would still result in some impacts on marine vegetation. Safeguards and management measures as detailed in this addendum REF would ameliorate or minimise these expected impacts. The proposed modification would manage the risks posed by site contamination to human and environmental receptors. On balance the proposed modification is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposed modification would be unlikely to cause a significant impact on the environment. Therefore it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Urban Spaces under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposed modification is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposed modification is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and Environment is not required.

9 Certification

This addendum review of environmental factors provides a true and fair review of the proposed modification in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposed modification.

Ali Watters

Principal Environmental Engineer

Royal HaskoningDHV

Date: 17.08.2022

I have examined this addendum review of environmental factors and accept it on behalf of Transport for NSW.

Andrew Dooley

[Snr Project Manager

[Maritime Infrastructure Delivery Office, Greater Sydney

Date: 18.08.2022

10 References

GHD (2017), *Tweed Heads Slipway Contamination Investigation*. Report prepared on behalf the Department of Industry – Lands, December 2017.

Hydrosphere Consulting (2019), *Tweed Heads Slipway Travel Lift REF*.

Hydrosphere Consulting (2019), *Sediment Investigation Report - Southern Boat Harbour, Tweed Heads Maintenance Dredging*. Prepared for NSW Department of Industry – Lands and Water

JK Environments (1 July 2022) *Detailed (Stage 2) Site Contamination Investigation, Proposed Travel Lift Boat Facility, 8 Terranora Terrace, Tweed Heads NSW* (Ref: E34453UBDrpt2).

JK Environments (30 June 2022) *Remediation Action Plan, Proposed Travel Lift Boat Facility, 8 Terranora Terrace, Tweed Heads NSW* (Ref: E34453UBDrpt3-RAP).

Terms and acronyms used in this REF

Term/ Acronym	Description
AHD	Australian Height Datum
AMP	Asbestos Management Plan
AS	Australian Standard
BC Act	*Biodiversity Conservation* Act *2016* (NSW).
BCA	Building Code of Australia
Berthing	
CCTV	Close circuit television
CEMP	Construction environmental management plan
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
DDA	*Disability Discrimination Act* 1992 (Cth)
DMP	Dewatering Management Plan
EIA	Environmental impact assessment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
Fetch	An area where ocean waves are being generated by the wind.
FM Act	*Fisheries Management Act 1994* (NSW)
Gangway	A landing used by passengers to board or exit ships/vessels
Heritage Act	*Heritage Act 1977* (NSW)
SEPP (Transport and Infrastructure)	State Environmental Planning Policy (Transport and Infrastructure) 2021
Jetty	A structure extending into the harbour as part of a wharf
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
MHWM	Mean high water mark
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
Piles	Foundations used to support marine structures and offshore platforms

Term/ Acronym	Description
Pontoon	A floating structure serving as a dock
RAP	Remediation Action Plan
Roads and Maritime	NSW Roads and Maritime Services
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
TSC Act	*Threatened Species Conservation Act 1995 (NSW)* (repealed)
QA Specifications	Specifications developed by Transport for NSW for use with road work and bridge work contracts let by Transport for NSW.
Wharf	A landing place or pier where ships may tie up and load or unload.
ZFDTG	Zero of Fort Denison Tide Gauge

Appendix A
RAP

REPORT TO

HASKONING AUSTRALIA PTY LTD

ON

REMEDIATION ACTION PLAN

FOR

PROPOSED TRAVEL LIFT BOAT FACILITY

AT

8 TERRANORA TERRACE, TWEED HEADS, NSW

Date: 30 June 2022
Ref: E34453UBDrpt3-RAP

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DOCUMENT REVISION RECORD

Report Reference	Report Status	Report Date
E34453UBDrpt3-RAP	Draft Report	22 June 2022
E34453UBDrpt3-RAP	Final Report	30 June 2022

Executive Summary

Haskoning Australia Pty Ltd commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed travel lift boat facility development at 8 Terranora Terrace, Tweed Heads, NSW. The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in the appendices.

This RAP has been prepared to support the design and planning for Transport for New South Wales (TfNSW) for the proposed travel lift boat development, with regards to State Environmental Planning Policy (Resilience and Hazards) 2021 (formerly known as SEPP55)[1].

Mr Ben Wackett (NSW EPA Accredited Site Auditor) of Cavvanba Consulting Pty Ltd has been engaged by TfNSW to undertake an independent audit of the project and prepare a Site Audit Report (SAR) and Site Audit Statement (SAS) for the site, with regards to the *Contaminated Land Management Act 1997* (NSW)[2]. JKE understand that the SAS is a non-statutory audit with reference to the CLM Act.

We understand that the proposed development includes the demolition of the existing building and site infrastructure followed by the construction of a new boat travel lift structure with a new rock revetment wall and landward hardstand area formed over the existing footprint of the slipway. A new trade waste management system is proposed including an underground first flush diversion pit, a new settlement pit and above ground Fox Environment Treatment system which is to be connected to the local sewer.

Investigations at the site by JKE and others identified that the primary contamination issues at the site were potential Asbestos in the form of bonded Asbestos Containing Materials (ACM) and friable asbestos, total Polychlorinated Biphenyls (PCB) risks to human health; Tributyltin (TBT), copper and zinc risk to ecological receptors. The JKE Detailed Site Investigation (DSI) The DSI demonstrated that under the current site conditions the soil/sediment leachate and groundwater contamination was not migrating off-site at significant concentrations that posed a risk to off-site ecological receptors or a risk to on or offsite human receptors. However, significant alteration of site conditions and disturbance of the contaminated soil/sediment may impact on these findings.

The goal of the remediation is to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to reduce the human health and environmental risks posed by site contamination to an acceptable level.

The objectives of the RAP are to:

- Provide a methodology to remediate and validate the site based on the information available at the date of this report;
- Provide a contingency plan for the remediation works;
- Outline site management procedures to be implemented during remediation work; and
- Provide an unexpected finds protocol to be implemented during the development works.

The proposed primary remediation strategy includes is cap and containment of contaminated soil/sediment. The secondary remediation option is offsite disposal of the surplus contaminated soil/sediment. The proposed remediation is considered feasible and the proposed development design itself leads towards the capping approach for remediation.

JKE are of the opinion that the preferred remedial approaches will:

- Minimise public risk;
- Minimise significant disposal of contaminated material/soil moved to landfill;
- Isolate the soil on-site by containment within a properly designed barrier, thus reducing the potential exposure pathway and risks to site receptors;
- Provide an effective and robust low maintenance capping solution and a passive long term management procedure; and
- Once constructed the cap will be incidental to the maintenance of the facility in general.

[1] *State Environmental Planning Policy (Resilience and Hazards) 2021 (formerly known as SEPP55)* (referred to as SEPP2021)

[2] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

The integrity of the cap will be maintained by the implementation of a Long-Term Environmental Management Plan (LTEMP). Public notification and enforcement mechanisms for the LTEMP are required and should be arranged by the site owner/project manager. JKE recommend that legal advice and early engagement be undertaken with the site owner, consent authority and any other relevant stakeholders so that the LTEMP can be publicly notified and enforceable. Once the public notification and enforcement mechanisms for the LTEMP have been confirmed an addendum letter to this RAP should be prepared and issued to the Auditor.

The remediation capping feasibility assessment demonstrated that the capping approach for remediation was suitable to address the identified site contamination. JKE is of the opinion that the site can be made suitable for the proposed development via remediation and the implementation of this RAP. Site validation reporting is to occur as specified in this RAP to document that the procedures have been followed and to demonstrate that the site is suitable on completion of the remediation subject to implementation of the LTEMP.

Under SEPP2021, site remediation can fall under Category 1 or Category 2 remediation works. JKE recommend the client consult the project planner to determine the remediation category prior to commencement of works.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of this report.

Table of Contents

List of Tables

Attachments

Abbreviations

Asbestos Fines/Fibrous Asbestos	**AF/FA**
Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Australian Standard Leaching Procedure	**ASLP**
Australian Drinking Water Guidelines	**ADWG**
Australian Standard Leaching Procedure	**ASLP**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Above-Ground Storage Tank	**AST**
Below Ground Level	**BGL**
Benzo(a)pyrene Toxicity Equivalent Factor	**BaP TEQ**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Chemical Control Orders	**CCOs**
Conceptual Site Model	**CSM**
Development Application	**DA**
Department of Environment and Science	**DES**
Dial Before You Dig	**DBYD**
Dibutyltin	**DBT**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Environment Protection Authority	**EPA**
Environmental Site Assessment	**ESA**
Fibre Cement Fragment(s)	**FCF**
General Approval of Immobilisation	**GAI**
Health Investigation Level	**HILs**
Health Screening Level	**HSL**
Health Screening Level-Site Specific Assessment	**HSL-SSA**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
Lab Control Spike	**LCS**
Leaching Environmental Assessment Framework	**LEAF**
Light Non-Aqueous Phase Liquid	**LNAPL**
Map Grid of Australia	**MGA**
Monobutyltin	**MBO**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Potential ASS	**PASS**
Polychlorinated Biphenyls	**PCBs**
Per-and Polyfluoroalkyl Substances	**PFAS**
Perfluorooctanoic Acid	**PFOA**

Perfluorooctanesulfonic Acid	**PFOS**
Perfluorohexane Sulfonate	**PFHxS**
Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Quality Assurance	**QA**
Quality Control	**QC**
Remediation Action Plan	**RAP**
Remediation Works Plan	**RWP**
Relative Percentage Difference	**RPD**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Site Specific Assessment	**SSA**
Source, Pathway, Receptor	**SPR**
Specific Contamination Concentration	**SCC**
Standard Penetration Test	**SPT**
Standing Water Level	**SWL**
Trip Blank	**TB**
Tributyltin	**TBT**
Total Organic Carbon	**TOC**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Recoverable Hydrocarbons	**TRH**
Trip Spike	**TS**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Underground Storage Tank	**UST**
Virgin Excavated Natural Material	**VENM**
Volatile Organic Compounds	**VOC**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millivolts	**mV**
Millilitres	**ml or mL**
Milliequivalents	**meq**
micro Siemens per Centimetre	**µS/cm**
Micrograms per Litre	**µg/L**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Parts Per Million	**ppm**
Percentage	**%**
Percentage weight for weight	**%w/w**

1 INTRODUCTION

Haskoning Australia Pty Ltd commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed travel lift boat facility development at 8 Terranora Terrace, Tweed Heads, NSW. The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in the appendices.

This RAP has been prepared to support the design and planning for Transport for New South Wales (TfNSW) for the proposed travel lift boat development, with regards to State Environmental Planning Policy (Resilience and Hazards) 2021 (formerly known as SEPP55)[3].

JKE have previously undertaken a Preliminary Site Investigation (PSI)[4] and a Detailed Site Investigation (DSI)[5] at the site. The PSI and DSI identified potential asbestos risks to human health; Tributyltin (TBT), copper and zinc risks to ecological receptors. On this basis, preparation of a RAP was recommended with reference to SEPP2021. Key information from the PSI, DSI and report by others are summarised in Section 2.1 and throughout this report where relevant.

Mr Ben Wackett (NSW EPA Accredited Site Auditor) of Cavvanba Consulting Pty Ltd has been engaged by TfNSW to undertake an independent audit of the project and prepare a Site Audit Report (SAR) and Site Audit Statement (SAS) for the site, with regards to the *Contaminated Land Management Act 1997* (NSW)[6]. JKE understand that the SAS is a non-statutory audit with reference to the CLM Act.

JKE recommend the head contractor to prepare a detailed Construction Environmental Management Plan (CEMP) for the construction works, which will include details of general soil, water, tide, erosion, noise management during construction. The final CEMP should make reference to this RAP.

1.1 Proposed Development Details

The proposed travel lift boat facility development includes the upgrade of the existing slipway. We understand that the proposed development will be staged.

The proposed development plans provided to JKE for the Stage 1 development are attached in the appendices. The Stage 1 development (of the site area applicable to this RAP) includes the demolition of the existing building, retaining walls, hardstands and flush control system (including the settlement pit and associated grated box catch drain) followed by the construction of a new boat travel lift structure with a new landward hardstand area formed over the existing footprint of the slipway. A new trade waste management system is proposed including an underground first flush diversion pit, a new settlement pit and above ground Fox Environment Treatment system which is to be connected to the local sewer. The exposed sediments,

[3] *State Environmental Planning Policy (Resilience and Hazards) 2021 (formerly known as SEPP55)* (referred to as SEPP2021)

[4] JKE, (2022a). *Report to Haskoning Pty Ltd on Preliminary (Stage 1) Site Contamination Investigation at 8 Terranora Terrace, Tweed Heads, NSW.* (referred to as PSI report) (Ref: E34453UBDrpt, Draft report, dated 31 January 2022)

[5] JKE, (2022b). *Report to Haskoning Pty Ltd on Detailed (Stage 2) Site Contamination Investigation at 8 Terranora Terrace, Tweed Heads, NSW.* (referred to as PSI report) (Ref: E34453UBDrpt2, Draft report, dated 8 June 2022)

[6] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

dilapidated concrete, slip rails and timber sleepers on the lower portion of the slipway are not proposed to be disturbed and are to effectively be capped and covered by the proposed works, comprising the placement of suitable geotextile fabric, construction of a rock bund/revetment, backfilling over the ramp, and installation of a reinforced concrete hardstand. Minor excavations of approximately 0.2-0.3m Below Ground Level (BGL) will be required to construct the new concrete hardstand in the upper (north) section of the slipway. Deeper excavations of approximately 2mBGL are assumed for the settlement tank associated with the new washdown water treatment system and approximately 0.5mBGL for other services. As part of the Stage 1 development, a new gangway and floating pontoon supported on piles is proposed to extend towards the seaward side of the site to the south-west from the new hardstand.

JKE understand that there may be a future expansion of the slipway to the east, identified as the Stage 2 development area. Should the Stage 2 development proceed it will include the demolition of the existing driveway and bunded storage yard, followed by construction of a new concrete slab to be linked with the Stage 1 concrete slab. The storage yard will be reconstructed in the east section of the Stage 2 development area, with an above ground oil storage tank located in a new bunded area under shelter.

This RAP applies to the Stage 1 development area only. Consideration for potential future Stage 2 development are discussed in Section 3.1.

1.2 Remediation Goal, Aims and Objectives

The goal of the remediation is to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to reduce the human health and environmental risks posed by site contamination to an acceptable level.

The objectives of the RAP are to:

- Provide a methodology to remediate and validate the site based on the information available at the date of this report;
- Provide a contingency plan for the remediation works;
- Outline site management procedures to be implemented during remediation work; and
- Provide an unexpected finds protocol to be implemented during the development works.

1.3 Scope of Work

The RAP was prepared generally in accordance with a JKE proposal (Ref: EP54912UB2) of 19 October 2021 and written acceptance from the client of via sub-consultancy agreement of 25 October 2021. The scope of work included a review of the JKE reports and report by others (summarised in Section 2.1), review of the Conceptual Site Model (CSM), review of the proposed development details and preparation of the RAP.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[7], other guidelines made under or with regards to the Contaminated Land Management Act (1997)[8] and SEPP2021.

A list of reference documents/guidelines is included in the appendices.

[7] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

[8] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

2 SITE INFORMATION

2.1 Background

2.1.1 Tweed Heads Slipway Contamination Investigation (GHD, April 2018)

A contamination investigation of the wider Tweed Heads marina and slipway (part of the site) was undertaken by GHD in April 2018[9]. The GHD investigation included a review of site information, site walkover inspection and sediment sampling from nine locations within the vicinity of the slipway and the wider Tweed Heads marina. The GHD sediment assessment criteria exceedances figure, sediment core logs and analytical results summary tables are attached in appendices.

The GHD sampling locations are shown on GHD Figure 4 to 5 attached in the JKE DSI report. GHD sampling location THSC1 was located at the lower south end of the slipway and within the intertidal area of the site, while GHD sampling locations THSC3, THSC4 and THSC5 were located within the over water portion of the Stage 1 development area.

Tributyltin (TBT) normalised to 1% total organic content (TOC) was detected by the GHD investigation above the Site Assessment Criteria (SAC) in all sediment sampling locations and were significantly above the upper guideline SAC of 70µg/kg at sampling location THSC1, with maximum concentration of 15,700µg/kg encountered in the sediment soil sample THSC1_0.1-0.4m. Additionally, copper, lead, zinc, Total Petroleum Hydrocarbons and polychlorinated biphenyls (PCBs) concentrations encountered in the sediment soil sample THSC1_0.1-0.4m also exceeded the upper guideline SAC.

The GHD investigation identified potential acid sulfate soil (PASS) conditions within the sediment material and recommended that an ASS management plan (ASSMP) be prepared if the sediment material is to be disturbed.

GHD recommended that additional sampling and analysis be undertaken to further characterise the Contaminants of Potential Concern (CoPC) identified at the site and passive management strategies be implemented to mitigate the TBT contamination and an environmental management plan (EMP) be prepared for the management of future site users of the slipway. GHD also recommended that the TBT and heavy metal sediment contamination be discussed with the NSW EPA. Based on the information available to JKE, it could not be confirmed if the GHD recommendations had been addressed.

2.1.2 Sediment Investigation Report (Hydrosphere, February 2019)

A sediment investigation of the wider Tweed Heads marina and slipway was undertaken by Hydrosphere in February, 2019[10]. The Hydrosphere investigation included sediment sampling from six locations within the vicinity of the slipway and the wider Tweed Heads marina. None of the sampling location were located in the

[9]GHD, (2018). *Report to Department of Industry – Lands on Tweed heads Slipway Contamination Investigation at Tweed Heads Slipway, Tweed Heads, NSW.* (referred to as GHD 2018 investigation)

[10]Hydrosphere, (2019). *Report to NSW Department of Industry – Lands and Water on Sediment Investigation Report Southern Boat Harbour, Tweed Heads Maintenance Dredging.* (referred to as Hydrosphere investigation)

JKE DSI site area. The objectives of the investigation were to assess the properties of the sediments, including potential for contamination and ASS for the NSW Department of Industry – Lands and Water dredging works.

The Hydrosphere investigation identified PASS conditions within the sediment material and recommended that an ASSMP be prepared if the proposed dredging works. TBT normalised to 1% TOC was detected above the upper guideline SAC of 70µg/kg at concentration of 2,474µg/kg in the sediment soil sample BH1_ENM (0-0.65m), which was collected nearest to the site.

Hydrosphere recommended the dredging is undertaken to remove the contaminated sediments and the NSW EPA consulted prior to disposal of the contaminated dredged material to a suitable landfill facility.

2.1.3 PSI (JKE, January 2022)

A PSI of the site and the wider site was undertaken by JKE in January 2022. The PSI included a site inspection, review of available site history/site information and soil sampling from 10 boreholes (BH1 to BH10). The PSI soil sampling locations are shown on Figures 4 and 5 attached in the appendices. The PSI borehole logs and laboratory summary result tables are also attached in the appendices.

Review of historical site information indicated that the site has been used for fisheries processing, boat mooring and maintenance activities since at least 1964, with the slipway constructed prior to 1979. The site had been used as a boat maintenance and repair slipway until October 2021. Prior to 1964, the site was Crown Land with permissive site occupancies granted by the Crown, however the specific activities associated with the permissive site occupancies were unknown.

Based on the scope of work undertaken for the PSI, JKE identified the following potential contamination sources/Areas of Environmental Concern (AEC):

- Fill material (across the entire site);
- Fuel storage (former onsite Above Ground Storage Tank (AST) and current waste oil collector);
- Boat maintenance slipway and marina land use;
- Use of pesticides (across the entire site); and
- Hazardous building materials within current buildings/structures and within the fill as a result of former building demolition activities.

The boreholes drilled for the PSI generally encountered fill to depths of approximately 0.25m below ground level (BGL) and 1.5mBGL, underlain by natural sand, clayey sand and silty clay soils and phyllite bedrock to the termination of the boreholes at a maximum depth of approximately 3.95mBGL. A fibre cement fragment (FCF) was encountered within the fill at borehole BH7. Groundwater seepage was encountered within the boreholes at depths of approximately 1mBGL to 2mBGL.

The PSI included soil sampling and laboratory analysis of selected soil samples for a range of CoPC identified in the CSM. The FCF encountered in the fill in borehole BH7 was confirmed to be Asbestos Containing Material (ACM). The ACM detection is shown of Figure 4 attached in the appendices.

The PSI soil results encountered TBT normalised to 1% TOC were detected above the ecological SAC in in four boreholes (BH6, BH7, BH8 and BH10) all located within the slipway portion of the site. The maximum TBT concentration of 5,000µg/kg was encountered in the soil/sediment sample BH8 (0.19-0.3m). Additionally, copper, zinc, nickel and >C_{16}-C_{34} (F3) concentrations were encountered in some of the soil samples above the ecological SAC. The PSI soil/sediment results above the ecological SAC are shown of Figure 5 attached in the appendices.

Subsequent leachate analysis using the Australian Standard Leaching Procedure (ASLP) (AS4439.2 and AS44396.3) was undertaken on one selected fill sample with the highest TBT concentrations (BH8 (0.19-0.3m)) to make a preliminary assessment of TBT leachate impacts to Terranora Creek. The maximum TBT ASLP result of 2,000µg/L was significantly above the adopted ecological SAC for marine water of 0.006µg/L.

Based on the soil analytical results and site observations, the PSI concluded that TBT elevations within the soil/sediment at the site could present a risk to marine ecology via contaminant leaching as demonstrated from the ASLP TBT analysis. As a result, the PSI recommended further sampling and analysis including the USEPA leachate test methods for TBT under the Leaching Environmental Assessment Framework (LEAF) to assess site specific leaching potential.

Based on the results, the PSI recommended the following to further characterise the risks associated with known and potential contamination sources at the site:

- Undertake a DSI to further assess the soil contamination conditions, particularly in relation to asbestos and TBT and to address the data gaps identified in the PSI;
- Undertake a hazardous building materials (HAZMAT) assessment of the onsite building and structures prior to demolition;
- Prepare and implement a RAP based on the PSI and DSI datasets; and
- Prior to commencement of works associated with the proposed development, any persons undertaking intrusive works (i.e. works that require disturbance of soil) must consider the presence of asbestos in the fill and manage the works according to an Asbestos Management Plan (AMP) prepared for the site.

2.1.4 DSI (JKE, June 2022)

A DSI of the site was undertaken by JKE in June 2022. The DSI included a site inspection, review of available site history/site information (including the JKE PSI), soil sampling from 13 boreholes (BH101 to BH106 and BH201 to BH207), soil sampling from three surface locations (SS1 to SS3), groundwater sampling from four groundwater monitoring wells (MW101 to MW104) and sampling of the river water from Terranora Creek. The DSI sampling locations are shown on the Figures 4 to 7 attached in the appendices. The DSI borehole logs and laboratory summary result tables are also attached in the appendices.

As part of the DSI scope of works, additional river water sampling was undertaken to assess the concentrations of TBT, heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) and PCBs within the river water on and off-site from the slipway area to support predicted concentrations by Dr Graeme Batley of the CSIRO Land and Water.

During the DSI site inspection, a number of fibre cement fragments (FCF) were identified on the surface in in the exposed soil areas below the catch drain in the south-west section of the site and above the retraining wall in the west section of the site. Additionally, shell/shell fragments and paint flakes were also observed in these exposed soil areas.

The DSI results encountered contamination in soil/sediment, groundwater and river water including:

- Total PCBs in fill/sediment sample BH105 (0-0.1m) exceeded the human health SAC;
- Asbestos in the form of bonded ACM in fill sample BH7 (0.17-0.3m) which was considered to exceeded the human health SAC. Additionally, friable Asbestos Fines/Fibrous Asbestos (AF/FA) were detected within the fill sample BH104 (0-0.05m) and multiple FCF (presumed ACM) were the exposed soil areas below the catch drain in the south-west section of the site and above the retraining wall in the west section of the site;
- A number of the fill sample results for TBT (normalised to 1% TOC), copper and zinc, significantly exceeded the ecological SAC;
- The TBT groundwater results for MW104 exceeded the marine ecological SAC;
- The arsenic, copper, nickel and zinc groundwater results for MW102 exceeded the marine ecological SAC;
- The Perfluorooctanesulfonic Acid (PFOS) groundwater results for all of the groundwater monitoring wells and the river water sample RW4.1.5 exceeded the marine ecological SAC; and
- Some of the copper results and a single zinc result for the river water samples exceeded the marine ecological SAC.

The DSI contamination data is shown on the Figures 3 to 7 attached in the appendices.

The PSI and DSI results were provided to Dr Batley, whom has updated his letter, dated 6 June 2022. Dr Batley recommended and concluded that "*the latest experiments by JKE indicate that it is not likely that TBT, copper and zinc contaminated soil/sediments at this site and others in the hardstand areas will pose a significant impact on the health of the aquatic ecosystem after capping if left undisturbed*".

The DSI Tier 1 risk assessment and review of the CSM identified that the primary contamination issues identified at the site requiring remediation were the presence of asbestos and PCB risks to human health; TBT, copper and zinc risk to ecological receptors. The DSI demonstrated that under the current site conditions the soil/sediment leachate and groundwater contamination was not migrating off-site at significant concentrations that posed a risk to off-site ecological receptors or a risk to on or offsite human receptors. However, significant alteration of site conditions and disturbance of the contaminated soil/sediment may impact on these findings. Groundwater remediation was not considered necessary.

Based on the results, the DSI report concluded that the site could be made suitable for the proposed development provided the following recommendations were implemented:

- Prepare and implement a RAP for the proposed development;
- Prepare and implement an AMP for the proposed development;
- Prepare and implement an Acid Sulfate Soil Management Plan (ASSMP) for the proposed development;
- Undertake a hazardous building materials (HAZMAT) assessment prior to demolition of the existing buildings/structures at the site; and

- Prepare a Validation Assessment report at the completion of remediation works.

2.2 Site Identification

Table 2-1: Site Identification

Current Site Owner (certificate of title):	The State of New South Wales
Site Address:	8 Terranora Terrace, Tweed Heads, NSW
Lot & Deposited Plan:	Lot 717 in DP 729484, part of Lot 5 in DP1243139 and part of Lot 18 in DP909040
Current Land Use:	Vacant, formerly used as boat maintenance and repair slipway
Proposed Land Use:	Boat maintenance and repair slipway
Local Government Authority:	Tweed Shire Council
Current Zoning:	IN4 – Working Waterfront
Site Area (m^2) (approx.):	See Figure 2 in Appendix A: • Area A = 1,050 • Area B = 5 • Area C = 1 • Area D = 15 • Area E = 845 • Approximate total site area = 1,916
RL (AHD in m) (approx.):	0.3-1.75 (land based portion from survey plan)
Geographical Location (decimal degrees) (approx.):	Latitude: -28.18058 Longitude: 153.54122
Site Plans:	See Appendix A

2.3 Site Location, Topography and Regional Setting

The site is located in a predominantly residential area of Tweed Heads and is bound by Terranora Terrace to the north as shown on Figure 1. The site is located on the northern bank of the Terranora Creek which it adjoins to the sediments of the Terranora Creek within the south-western portion of the site.

The regional topography is characterised by a steep south facing hillside that falls towards Terranora Creek. The site is located towards the toe of the hillside and has a gentle slope towards the south-west at approximately 2° to 3°. The slipway itself slopes to the south-west at approximately 8°to 9°. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

2.4 Summary of Site Inspection

A summary of the findings of the site walkover inspection at the time of the DSI applicable to the site remediation area are provided below:

- At the time of the inspection, the site was vacant however occupied by the infrastructure of a boat maintenance/repair slipway;
- A small building of cinder block construction was located in the north-west section of the site. The building appeared to be used as the boat winch house and for amenities purposes. We note that access to the winch house portion of the building was not possible. External of the building, on the western façade was a settlement pit flush control system, which was connected to pipework which likely was connected to the settlement pit (shown on Figure 2) and the associated grated box catch drain in the mid to lower portion of the slipway in the south-west section of the site;
- The majority of the site was paved by concrete, with paint spill marks were observed at the surface of the concrete pavement in upper portion of the slip way;
- The lower portion of the slipway in the south-west section of the site was retained by timber, cinder block, boulder rock retaining walls were located along either side of the slipway. The onsite retaining walls were approximately 0.5m to 1.5m high above the surface level of the slipway. Selected sections of the timber retaining wall lengths appeared in poor condition with areas of external defect observed;
- Exposed soil/sediments were observed in the south-west section of the site, below the catch drain, along with extremely dilapidated concrete, slipway metals rails and timber sleepers. Exposed soil was also evident above the retraining wall in the west section of the site;
- Paint flakes and FCF (presumed ACM) were observed in the exposed soil areas below the catch drain in the south-west section of the site and above the retraining wall in the west section of the site;
- The majority of the site was fenced by steel mesh fencing of approximately 2m in height, with the exception of a small area to the south-east. The area in the south-east was also surface by asphaltic concrete; and
- The surrounding land to the north was occupied for low density residential purposes;
- The surrounding land to the east was occupied by the Tweed Heads Marina including the Tweed Heads and Coolangatta Professional Fisherman's Association. A 5,000L waste oil collection tank within bunded area which was confirmed to have been formerly occupied by a diesel Aboveground Storage Tank (AST). The JKE PSI site inspection identified an in-filled trench (presumably former fuel delivery infrastructure) within the paved carpark to the east of the site which extended from former AST area to an area in the south-west section of the site were a former bowser may have resided (see Figure 2 provided in the JKE DSI);
- Terranora Creek was located immediately the south of the slipway; and
- The surrounding land to the east was occupied by Marina Park and café/restaurant.

2.5 Summary of Geology and Hydrogeology

Regional geological information was reviewed for the PSI and DSI indicated the following:

- Regional geological information was reviewed for the JKE PSI indicted that the site is underlain by transgressive tidal delta and channel sands, muddy sands, central basin muds and fluvial shoreline deposits of silty sands with rare shells of the Cainozoic age;

- ASS information reviewed for the JKE PSI indicated that the land-ward portion of the site is located within a Class 5 ASS risk area. The sea-ward potion of the site (within Terranora Creek) is located within a Class 1 ASS risk area. The JKE DSI encountered acidic conditions above the action criteria in a number of the marine alluvial soils analysed. The results were considered to be indicative of acidic soils associated with PASS as significant concentrations of oxidisable sulfur were encountered in natural marine soil samples;
- The JKE PSI and DSI identified fill to depths of approximately 0.05mBGL (BH104) to 0.7mBGL (BH103), underlain by natural alluvial sandy and residual clayey soils. Phyllite bedrock was encountered beneath natural silty clay soil in BH5 and extended to the termination of the borehole at a maximum depth of approximately 3.95mBGL;
- Hydrogeological information reviewed for the JKE PSI indicated that the regional aquifer on-site and, in the areas, immediately surrounding the site includes fractured or fissured, extensive aquifers of low to moderate productivity. There was a total of 46 registered bores within the report buffer of 2,000m. In summary, the nearest bore registered for domestic purposes was located approximately 110m to the east of site and beyond Terranora Creek. The majority of the bores were registered for domestic purposes;
- Groundwater seepage was encountered during the JKE PSI and DSI within a number of the boreholes. Standing Water Level (SWL) measured in the monitoring wells installed at the site ranged from inundation of MW104 by river water on an observed high tide prior to sampling development at 0.19mBGL (on 17 December 2021) to 1.21mBGL (on 13 January 2022) during sampling on an observed low tide. Groundwater levels data loggers installed in monitoring wells MW102, MW103 and MW104 as part of the DSI showed that the groundwater levels were influenced by tide and to a lesser extent rainfall. Further information regarding groundwater levels is provided in the DSI;
- A detailed assessment of groundwater flow directional was not undertaken. However, based topography, geology and proximity to Terranora Creek, groundwater is expected to flow onto the site from the north and offsite to the south and to Terranora Creek; and
- The lower portion of the slipway in the south-west of the site was completely inundated by river water on an observed high tide during the JKE DSI; and
- The site is subject to flooding and was completing inundated by flood waters from the river in late February/early March 2022.

3 REVIEW OF CONCEPTUAL SITE MODEL/SITE CHARACTERISATION

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors.

The JKE PSI and DSI encountered total PCBs in fill/sediment exceeding the human health SAC. Asbestos in the form of bonded ACM and friable AF/FA were detected within the fill. TBT (normalised to 1% TOC), copper, zinc, exceeded the ecological SAC. Arsenic, copper, nickel and zinc groundwater results for MW102 exceeded the marine ecological SAC. TBT exceeded the marine ecological SAC in the groundwater samples collected from MW104. PFOS exceeded the marine ecological in all groundwater samples collected. The contamination data is shown on Figures 3 to Figure 7 attached in Appendix A.

The table below includes a review of the CSM which has been used to design the remediation strategy. The CSM will require further review when additional site data becomes available.

Table 3-1: CSM Review

Contaminant source(s) and contaminants of concern	The DSI Tier 1 risk assessment and review of the CSM identified that the primary contamination issues identified requiring remediation were potential asbestos and PCB risks to human health; TBT, copper and zinc risk to ecological receptors. The source of the asbestos is considered likely to be associated with historical demolition, construction and boat repair activities at the site. The source of the PCBs is considered likely to associated with the slipway vessel maintenance activities, as PCBs were historically added to marine paints from the 1940s as an adhesive agent which provided anti-corrosion from moisture, chemicals and fire[11]. The source of TBT, copper and zinc is considered to be associated with the historical use of marine anti-fouling compounds as part of boat/vessel maintenance operations at the site. This could be associated with accidental spills, scraping of boat hulls and inadequate operation of waste collection systems including the catch drain, which is covered at time by high tides.
Affected media	At this stage, soil/fill/sediment has been identified as the affected medium for remediation purposes. The DSI identified that the groundwater and river water (Terranora Creek) has slightly been impacted by selected Contaminates of Potential Concern (CoPC) as shown on Figure 6 and 7. However, the DSI demonstrated that under the current site conditions the soil/sediment leachate and groundwater contamination was not migrating off-site at significant concentrations that posed a risk to off-site ecological receptors or a risk to on or offsite human receptors. However, significant alteration of site conditions and disturbance of the contaminated soil/sediment may impact on these findings. Remediation of groundwater is not proposed at this stage and hence not included in the RAP.

[11] M.E. Martin and M.J. Richards (1999). *PCB and heavy metal soil remediation, former boat yard, south Dartmouth, Massachusetts.* Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy: Vol. 14, Article19.

Receptor identification	Human receptors include site users (mainly adults in a commercial setting), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users. Ecological receptors include the marine ecology in Terranora Creek. The site is to be completely capped by hardstand, therefore exposure to Terrestrial organisms and plants is unlikely. The risk to marine ecology was assessed as part of the DSI. The risk to the aquatic ecosystem post remediation is considered to be low. Risks to the marine ecological as a result of runoff/leachate to the surface water body during construction works are to be managed by site controls under the remediation contactors CEMP and site management plan for remediation outlined in Section 8 of the RAP including but not limited to Section 8.8, which outlines the requirement for surface water monitoring.
Exposure pathways and mechanisms	The COPC relevant to the human receptors during soil disturbance include Asbestos and PCBs. The exposure pathway associated the identified COPC are ingestion, dermal absorption, inhalation of dust and inhalation of airborne fibres. The COPC relevant to ecological receptors of Terranora Creek include TBT, copper and zinc. The exposure pathway associated the identified COPC include uptake by marine organisms primarily via ingestion and dermal adsorption.

3.1 Remediation Extent

The results of the PSI and DSI indicate that the fill at this site has been impacted by asbestos, PCBs, TBT, copper and zinc. The COPC impacts appear to be greater in the intensive slipway use area, particularly at the lower end of the slip way and below the catch drain where a concrete slab appears not to be present since the slipway operation.

For the purpose of this RAP, remediation will be limited to: contaminated fill, validation of imported materials and validation of unexpected finds within the site Stage 1 development area shown on Figure 2.

Should the Stage 2 development to the east of the site (described in Section 1.1) be procured in the future, a standalone DSI should be undertaken and a standalone RAP developed and implemented.

4 REMEDIATION OPTIONS

4.1 Soil Remediation

The NSW EPA follows the hierarchy set out in NEPM 2013 for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

1. On-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated material so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

Or if the above are not practicable:

3. Consolidation and isolation of the soil by on-site containment within a properly designed barrier; and
4. Removal of contaminated material to an approved site or facility, followed where necessary by replacement with clean material; or
5. Where the assessment indicates that remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

For simplicity herein, the above hierarchy are respectively referred to as Option 1, Option 2, Option 3 etc.

The NEPM 2013 and the WA DoH 2021 guidelines prefer the following asbestos remediation hierarchy:

1. Minimisation of public risk;
2. Minimisation of contaminated soil disturbance; and
3. Minimisation of contaminated material/soil moved to landfill.

The NSW EPA Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition) (2017)[12] provides the following additional requirements to be taken into consideration:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed; and
- Where there are large quantities of soil with low levels of contamination, alternative strategies should be considered or developed.

[12] NSW EPA, (2017). *Contaminated land Management, Guidelines for the NSW Site Auditor Scheme (3rd ed.).* (referred to as Site Auditor Guidelines 2017)

4.2 Soil Remediation Options Assessment

The table below discusses and assesses a range of soil remediation options:

Table 4-1: Consideration of Remediation Options

Option	Discussion	Assessment/Applicability
Option 1 **On-site treatment of contaminated soil**	On-site treatment can provide a mechanism to reuse the processed material, and in some instances, avoid the need for large scale earthworks. Treatment options are contaminant-specific and can include bio-remediation, soil washing, air sparging and soil vapour extraction, thermal desorption. Depending on the treatment option, licences may be necessary for specific individual waste streams due to the potential for air pollution and the formation of harmful by-products during incineration processes. Licences for re-use of treated material/waste may also be required.	Not applicable based on the combination of COPC encountered at the site.
Option 2 **Off-site treatment of contaminated soil**	Contaminated soils are excavated, transported to an approved/licensed treatment facility, treated to remove/stabilise the contaminants then returned to the subject site, transported to an alternative site or disposed to an approved landfill facility. This option is also contaminant-specific. The cost per tonne for transport to and from the site and for treatment is considered to be relatively high. The material would also have to be assessed in terms of suitability for reuse as part of the proposed development works under the waste and resource recovery regulatory framework.	Not applicable based on the combination of COPC encountered at the site.
Option 3 **Consolidation and isolation of impacted soil by cap and containment**	This would include the consolidation of contaminated soil within an appropriately designed cell, or capping contaminated soils in-situ beneath appropriate clean capping materials (such as pavement and/or clean soil) to reduce the potential for future exposure. The capping and/or containment must be appropriate for the specific contaminants of concern. An ongoing Long Term Environmental Management Plan (LTEMP) would be required and an LTEMP would need to be publicly notified and made to be legally enforceable.	This option is suitable to address risks associated with the COPC for the following reasons: • It minimises waste disposal to landfill which is sustainable; • Element of capping were already proposed as part of the proposed development; and • The DSI identified that the TBT, copper and zinc contamination was unlikely to pose a significant impact to the site if left undisturbed. In contrast major soil disturbance would be necessary with the majority of other remediation options.

Option	Discussion	Assessment/Applicability
		However, LTEMPs may be onerous for site owners.
<u>Option 4</u> Removal of contaminated material to an appropriate facility and reinstatement with clean material	Contaminated soils would be classified in accordance with NSW EPA guidelines for waste disposal, excavated and disposed of off-site to a licensed landfill. The material would have to meet the requirements for landfill disposal. Landfill gate fees (which may be significant) would apply in addition to transport costs. Contaminated soil could also be disposed of interstate (likely Queensland, due to the proximity of the site to the Queensland boarder) under appropriate approvals.	Applicable, minor excavations required to construct the new concrete hardstand in the upper (north) section of the slipway. Deeper excavations may also be required for the settlement tank associated with the new washdown water treatment system and other underground services. The surplus soils cannot be placed in a containment cell in the lower section of the slipway in the south-west section as this area is impacted by tides. Such major alteration/disturbance to the existing site conditions could result in offsite leachate impacts to Terranora Creek which have been assessed as a low risk to the marine ecology provided that the site is largely undisturbed. The surplus soil cannot remain onsite by raising the proposed development surface levels. We understand that this could have significant impacts on surface water drainage and flooding potential.
<u>Option 5</u> Implementation of management strategy	Contaminated soils would be managed in such a way to reduce risks to the receptors and monitor the conditions over time so that there is an on-going minimisation of risk. This may occur via the implementation of monitoring programs, potentially also involving capping systems.	Applicable for any LTEMP prepared for the site under Option 3.

4.3 Rationale for the Preferred Option for Soil Remediation

The preferred primary option for remediation is Option 3 (cap and contain) and the preferred secondary option for remediation of surplus soil is Option 4 (excavation and off-site disposal). These options are considered to be most appropriate considering the proposed development and lack of on-site and off-site treatment options available for the CoPC. Any LTEMP developed as part of Option 3 will requirement management as outlined in Option 5.

JKE are of the opinion that the preferred remedial approaches will:

- Minimise public risk;
- Minimise significant disposal of contaminated material/soil moved to landfill;
- Isolate the soil on-site by containment within a properly designed barrier, thus reducing the potential exposure pathway and risks to site receptors;

- Provide an effective and robust low maintenance capping solution and a passive long term management procedure; and
- Once constructed the cap will be incidental to the maintenance of the facility in general.

The integrity of the cap will be maintained by the implementation of a LTEMP and will require site identification documentation to note the presence of the contamination. This could possibly include modification of the land title or other appropriate statutory documentation. An option may include the identification of the LTEMP on an NSW EPA Environmental Protection Licence (EPL), should an EPL be required for operation of the site. This may impact upon development approval conditions, place restrictions on the use of the land and limit the future potential land value. JKE recommended obtaining legal advice regarding the notification of the LTEMP.

4.4 Remediation Capping Feasibility Assessment

A feasibility assessment for the proposed capping approach to remediation at the site works has been included with regards to the CRC Care National Remediation Framework – Technology guide: Containment (2018)[13]. We note that the Auditor has prepared an initial feasibility assessment which was presented in the Table ISAA01.1 of the Interim Site Audit Advice letter (ref: 1508-2022-ISAA01, dated 29 March 2022). The JKE feasibility assessment presented in the table below has been prepared to address the Auditors comments and current understanding of site contamination conditions.

Table 4-2: Feasibility Assessment

Aspect	Comment
General parameters	
Is the risk associated with the containment system likely to be acceptable to all stakeholders?	The stakeholders have been consulted with regularly the investigation phases and prior to preparation of the RAP. JKE understand that the site is owned by Crown Land and leased to TfNSW under the Crown Land Management Act 2016. We understand that TfNSW have informed Crown Lands and Crown Land accepts the capping remediation approach and ongoing management via a LTEMP.
Is the risk that the containment might fail at some time in the future acceptable?	Future sea level rise may impact on the capping. The JKE DSI identified that the entire site is tidal and that that the groundwater concentrations of contaminants were not leaching into the surface waters of Terranora Creek at levels which posed a significant risk to the marine ecological receptors. The JKE DSI identified that tidal influences are greater in the south and lower portion of the slipway where the highest concentrations of contaminants were encountered in the currently exposed soil/sediment area. The tidal influence was far less in the north and upper portion of the slipway and concentrations of contaminants were lower in this area of the site. Therefore, it is assumed that the overall maximum leachability

[13] Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC Care), (2018). National Remediation Framework – Technology guide: Containment (version 1: August 2018)

Aspect	Comment
	potential of the antifoul associated contaminants in soil is likely to have occurred. JKE note that TBT will degrade to less toxic Dibutyltin (DBT) and Monobutyltin (MBT) over time. The site has the potential to be completely inundated with flood water during significant events. JKE note that the proposed development is to be constructed at the existing site levels. Therefore, the design has not considered sea level rise. The LTEMP prepared for the site will include management measures and the need for inspections of the capping system in the long term.
Is it likely that other stakeholders (local government or the public) will accept the use of containment as a remedial solution?	Capping and containment is an accepted method of reducing the risk of exposure to contaminated in soil. It is sustainable and recognised by the NSW EPA as an option to be considered for the reduction of material being disposed to a landfill facility. Other remediation options are considered not practical for the CoPC, unsustainable or could result in a greater risk to the environment.
Will the relevant regulatory agencies accept containment as a viable means of remediation, noting it does not involve treatment of the contamination and relies on the long-term application of institutional controls.	National guidance confirms that containment of contaminated soil is an appropriate remediation strategy. As discussed in Section 4.3, a LTEMP must be developed with appropriate public notification.
What is the length of time the soil needs to be contained for? Is it in perpetuity, or only for the life of the development after which the need for remediation will be re-evaluated?	The material will be contained for the life of the development or until there is a need to redevelop the site in future. Re-evaluation is required if a land use change or site ownership change is proposed. The design life has not been outlined. It should be understood that the proposed construction and containment is likely to make future remediation challenging.
Can it be reasonably assumed that the requirements for on-going management of the contamination are workable and will be implemented?	Once constructed, the cap will be incidental to the maintenance of the facility in general.
Are there sensitive sites/topographical issues that might not be compatible with the containment system?	Terranora Creek is located in the south section of the site and crosses southern site boundary. This surface water body is considered a sensitive site. The JKE DSI identified that the groundwater concentrations of contaminants were not leaching into the surface waters of Terranora Creek at levels which posed a significant risk to the marine ecological receptors. Significant disturbance of the current site conditions is not proposed and therefore capping considered appropriate for remediation.
Is sufficient space available at the site for the containment cell to remain accessible (for access to maintain leachate collection and removal system etc)?	Minor site disturbance/excavation is required for new underground services and subgrade preparation for a new concrete slab. Maintenance of the capping will not be required. No leachate collection is proposed.

Aspect	Comment
Has the order of cost to design, monitor, maintain and manage the containment been determined and is it preferred over alternative approaches that involve treatment and avoid the need for ongoing management?	The stakeholders have considered the alternate remediation approaches. The proposed development design itself leads towards the capping approach for remediation, irrespective of other remediation options which were considered not practical for the CoPC, unsustainable or could result in a greater risk to the environment. Ongoing groundwater and surface water monitoring is not proposed post construction.
Other Considerations	
Groundwater	The JKE DSI identified that the groundwater concentrations of contaminants were not leaching into the surface waters of Terranora Creek at levels which posed a significant risk to the marine ecological receptors. This was considered to continue into the future provided site conditions were maintained.
Physical properties	The contaminated soil/sediment at the site are permeable to tidal water and surface water runoff. The permeability of the contaminated soil/sediment will decrease as a result of the proposed development, therefore decreasing the potential for offsite migration of contamination due to leaching. Site silt and surface water runoff controls are to be implemented during construction.
Chemical composition	The JKE DSI identified that the groundwater concentrations of contaminants were not leaching into the surface waters of Terranora Creek at levels which posed a significant risk to the marine ecological receptors. JKE note that TBT will degrade to less toxic Dibutyltin (DBT) and Monobutyltin (MBT) over time.
Depth of contaminants	For the purposes of remediation, the soil/sediment contamination extends horizontally to the site boundaries shown on Figure 2 attached in the appendices. The vertical extent of contamination has not been completely assessed. The site contamination appears to mostly be associated with small antifoul paint fragments which is some area appear to have migrated through the soil pore space to the natural soils. Physical capping is not proposed in remediation Area E, instead, the disturbance of the potentially contaminated sediments in this area is to be kept to a minimum and managed under the LTEMP. Minor site disturbance/excavation is required for new underground services and subgrade preparation, after which the capping is to be installed. The surplus contaminated soil/sediments are to be disposed of to a suitably licensed landfill.
Design Parameters	
Capping layer	The proposed development design itself leads towards the capping approach for remediation.

Aspect	Comment
Drainage options	New site drainage and a waste water treatment system are proposed as part of the proposed development.
Leachate generation and collection	Not applicable.
Vapor collection and extraction/venting	Not applicable.
Vertical barriers	Not applicable.
Regulatory requirements	JKE understand that the NSW EPA has been notified of potential off-site migration. Pending feedback on regulatory intervention. The JKE DSI and this RAP should also be provided to the NSW EPA as part of the notification.
Design life	Not specified.

In summary the feasibility assessment demonstrates that the capping approach for remediation is suitable to address the identified site contamination.

5 REMEDIATION DETAILS

5.1 Roles and Responsibilities

Table 5-1: Roles and Responsibilities

Role	Responsibility
Client/Developer and Project Manager	The client and their nominated representatives. The client/project manager is required to appoint the project team for the remediation and must provide all investigation reports including this RAP to the remediation contractor, consent authority and any other relevant parties involved in the project. The project manager is required to review all documents prepared for the project and manage the implementation of the procedures outlined in this RAP. The project manager is to take reasonable steps so that the remediation contractor and others have understood the RAP and will implement it in its totality. The project manager will review the RAP and other documents required for the project (including the Asbestos Management Plan (AMP), Construction Environmental Management Plan (CEMP), Hazardous Building Material Assessment (HAZMAT) and Acid Sulfate Soil Management Plan (ASSMP)) and will update the parties involved of any changes to the development or remediation sequence (in consultation with the validation consultant and Site Auditor). Further details are outlined in the sections below.
Remediation Contractor	SMC Marine Pty Ltd Contact: Linda Miller, Authorised Person The remediation contractor is required to review all documents prepared for the project, apply for any relevant removal licences or permits and implement the remediation requirements outlined in this RAP and other management requirements for the project (including the Asbestos Management Plan (AMP), Construction Environmental Management Plan (CEMP), Hazardous Building Material Assessment (HAZMAT) and Acid Sulfate Soil Management Plan (ASSMP)). The remediation contractor is required to collect all necessary documentation associated with the remediation activities and forward this documentation onto the validation consultant, client and project manager as they become available. Further details are outlined in the sections below.
Site Auditor	Ben Wackett (NSW EPA Accredited Site Auditor) of Cavvanba Consulting Pty Ltd. The site auditor would review the information provided by the validation consultant, including (but not limited to) the site validation report. The auditor is to be engaged to review the RAP prior to commencement of the remediation. The developer, project manager and validation consultant are to consult with the auditor in the event of unexpected finds and/or deviations to the RAP.
Validation Consultant	JKE (subject to formal engagement) Contact: Mitch Delaney, Senior Associate Environmental Scientist The validation consultant is required to review the Asbestos Management Plan (AMP), Construction Environmental Management Plan (CEMP), Hazardous Building Material Assessment (HAZMAT) and Acid Sulfate Soil Management Plan (ASSMP)). The validation consultant provides consulting advice and validation services in relation to the remediation. The validation consultant is required to review any deviation to this RAP or in the event of unexpected finds if encountered during the

Role	Responsibility
	site work. The validation consultant is required to prepare the site validation report at the completion of remediation works. The validation consultant is required to liaise with the client, project manager and remediation contractor on all matters pertaining to the site contamination, remediation and validation.

5.2 Pre-commencement

The project team is to have a pre-commencement meeting to discuss the sequence of remediation, and the remediation and validation tasks. The site management plan for remediation works (see Section 8) must be reviewed by project manager and remediation contractor, and appropriate steps are to be taken to ensure the adequate implementation of the plan.

5.3 Summary of Remediation, Validation and Associated Tasks

The following general sequence of works is anticipated:

- Site establishment;
- **Hold Point -** Preparation of an Asbestos Management Plan (AMP), Construction and Environmental Management Plans (CEMP), Hazardous Building Material Assessment (HAZMAT) and Acid Sulfate Soil Management Plan (ASSMP) for the proposed development prior to proceeding with remediation;
- Installation of silt, sediment controls and capping prior to construction of the rock revetment wall in the lower section of the slipway;
- Demolition/removal of structures, with fulltime presence of validation consultant;
- Removal of surface ACM and asbestos clearance certificate to be issued by Licensed Asbestos Assessor (LAA);
- Remediation of the site by excavation and off-site disposal of surplus contaminated soils;
- Remediation (and validation) by capping of contaminated soils, and validation of this process; and
- Preparation of a LTEMP for the site.

Details in relation to the above are outlined in the following subsections.

5.3.1 Site Establishment

The remediation contractor is to establish on site as required to facilitate the remediation. Consideration must be given to the work sequence and extent of remediation/excavation so that the site establishment (e.g. site sheds, fencing, access points etc) does not inhibit the remediation works.

The validation consultant must be advised if any soil, gravel or engineering materials (e.g. DGB, roadbase etc) are to be imported for the proposed development. These must be validated by the validation consultant in accordance with Section 6 of this RAP to confirm they are suitable to be imported to site.

5.3.2 Preparation of Management Plans and HAZMAT

A HAZAMT of the building and other infrastructure at the site (e.g. electrical switch boards) should be undertaken prior to demolition in accordance with appropriate codes and standards.

Both friable and bonded asbestos has been identified within the fill soil. Asbestos containing materials may also be identified by the HAZMAT. An AMP must be prepared for the site and implemented for the site remediation and development works. The AMP should include the minimum Personal Protective Equipment (PPE), Work Health and Safety (WHS) and other requirements outlined in the documents published by Safe Work Australia, WorkCover Authority of NSW, National Occupational Health and Safety Commission, and other relevant authorities as applicable. An asbestos removal control plan (ARCP) should be prepared by the remediation contractor and issued to SafeWork if required.

An ASSMP must be prepared in accordance with the National Acid Sulfate Soil Guidance (2018) documents and the Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (1998)[14].

The CEMP must be prepared in accordance with the with appropriate codes and standards. The CEMP must reference the RAP and other management plans if necessary.

The AMP, CEMP, HAZMAT and ASSMP must be provided client/project manager, validation consultant and site auditor prior to proceeding with demolition/removal of structures and the concrete slab.

5.3.3 Demolition/Removal of Structures and Surface ACM Clearance

It is JKEs and the Auditors understanding that no disturbance to the site will occur until a floating silt curtain across the slipway ramp entrance, Eco sox, silt curtains have been deployed and the rock revetment wall and has been construed. The construction of the rock revetment wall in the lower portion of the slipway will require early capping works to be undertaken in this area. The capping is further discussed in Section 5.3.5. The capping should cover all exposed soil/sediment area below the existing catch drain and settlement pit.

Following completion of the above the demolition of the building and other infrastructure is to occur with regards to the findings of the HAZMAT and must be undertaken in accordance with the relevant codes, standards, guidelines and regulations. All structures and materials are to be removed from the site and clearance certificates are to be provided for the removal of all hazardous materials.

The concrete slab, settlement pit, catch drain associated pipework should carefully be removed. The validation consultant should be present fulltime during the removal of the concrete slab, settlement pit, catch drain associated pipework to inspect the underlying fill soil and assess for unexpected finds. During the removal of the settlement pit, catch drain and associated pipework any highly visible paint flake collection areas should be collected with hand tools and disposed of offsite to landfill with the contaminated soil.

[14] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)

Following demolition works an 'emu pick' of the demolition areas for surface fragments of ACM should be undertaken by a licensed Class A asbestos contractor.

On completion of the pick, a LAA is to undertake a surface clearance inspection for ACM across the entire site and prepare a clearance certificate.

5.3.4 Remediation – Excavation and Removal of Surplus Soil

The excavation works for the new treatment system, underground services and site levelling for new concrete slab should occur as a single exercise at the beginning of the proposed development programme, rather than in stages. This will minimise the potential for cross contamination and allow capping works to proceed. The project manager, remediation contractor and validation consultant must agree on the sequence of these works prior to the commencement of any excavation.

The proposed remediation and validation steps for excavation and removal of surplus soil are outlined in the following table. Reference is to be made to Section 6 for the validation plan.

Table 5-2: Remediation – Excavation/Removal of Surplus Contaminated Soil

Step	Primary Role/ Responsibility	Procedure
1.	Remediation contractor	<u>Site Management, PPE and WHS and Geotechnical/Stability:</u> The remediation contractor is to take steps to ensure the site management plan in this RAP is implemented for the remediation works. Check the AMP for PPE and WHS requirements prior to commencement of remediation works. The minimum PPE required for the remediation at the site includes covered clothing, gloves, dust masks and steel cap boots. Due to the presence of friable asbestos in fill, asbestos air monitoring should be undertaken during remediation works. Other site/project specific PPE will be required including hard hat, eye protection, steel toed boots etc and will be dependent on the requirements of the contractor for the site. Further PEE required for asbestos removal works are to be detailed in the AMP. Geotechnical advice must be sought prior to commencing remediation (as required) regarding the stability of the adjacent structures and excavations. Stability issues should be addressed to the satisfaction of a suitably qualified geotechnical engineer. All underground services are to be appropriately disconnected and/or rerouted to facilitate the works. The backfill around services should be check for potential contaminated fill prior to excavation works.
2.	Remediation contractor	<u>Removal of surplus contaminated soil:</u> The extent of excavation should be clearly marked out on the ground surface using spray paint and/or star pickets and tape. Excavation of surplus contaminated soil be undertaken as follows: • Submit an application to dispose the fill (in accordance with the assigned waste classification) to a landfill licensed by the NSW EPA or QLD DES to receive the

Step	Primary Role/ Responsibility	Procedure
		waste and obtain authorisation to dispose. The Remediation Constructor must consider the legal obligations relating to disposal of waste, particularly with regards to asbestos, PCBs, TBT and other COPC. Further information is provided in Sections 5.4.1 and 9.1; • The recommendations outlined in the PCB and Organotin Chemical Control Orders (CCOs) are to be implemented during the works. A summary of key requirements of the CCOs are provided below; ➢ Solid non-scheduled PCB waste must be disposed of by a method approved in writing by the NSW EPA or at landfills approved by the NSW EPA to receive such waste; and ➢ Organotin waste materials shall be disposed of in a controlled landfill in sealed containers. Under the Organotin CCO *Controlled landfill* means waste disposal at a site approved in writing by the Commission (now NSW EPA), in accordance with a preconceived plan involving dumping, compacting and covering with soil in a way that prevents or minimises any adverse effect on the environment. Asbestos related controls for asbestos removal works are to be implemented as per the AMP; • The excavated contaminated soil should be loaded directly onto truck suitably equipped to transport the waste; • The contaminated soil should be disposed of in accordance with the assigned waste classification and CCOs. The receiving licenced landfill facility should be contracted prior to disposal and required approvals obtains from the facility; • The occurrence of unexpected finds (e.g, staining/odours) during the soil removal are to be documented and addressed with regards to Section 7; • If any temporary backfilling/reinstatement is required, the imported materials must be validated in accordance with the Validation Plan in Section 6; and • All documents including landfill disposal dockets and waste transport certificate should be retained by the remediation contractor and forwarded to the client and validation consultant. This documentation forms a key part of the validation process and is to be included in the validation report.
3.	Validation Consultant	<u>Inspection of excavation areas:</u> Following completion of the surplus contaminated excavation/removal, the validation consultant is to inspect the site, assess for unexpected finds and document the excavation area and site conditions. No formal validation requirements are proposed following the excavation and offsite disposal of the surplus contaminated fill. However, the validation consultant is to review and present the remediation documentation provided by the remediation contactor as discussed in Section 5.4.1.

5.3.5 Remediation - Capping of Contamination Soil

Remediation is primarily based around the installation of an appropriate capping system over the contaminated soil in remediation Area A. The existing pavements in minor area of the site (Area's B, C and D) are not proposed to be disturbed and therefore capping is to comprise of the existing hardstand pavements only. The remediation areas are shown on Figure 2 attached in Appendix A.

The capping of remediation Area A is to be undertaken in two stages. The first stage of capping required is required in the lower section of the slipway to cover the exposed soil/sediment and allow the construction

of the rock revetment wall. The capping should cover all exposed soil/sediment area below the existing catch drain and settlement pit. The second stage of capping is required following excavation and offsite disposal of surplus contaminated soils and removal of underground infrastructure including the catch drain and settlement it.

In general, the staging of capping in remediation Area A should be kept to a minimum as this will minimise the potential for cross contamination and having to penetrate the capping system exposing the underlying contaminated soils. The project manager, remediation contractor and validation consultant in consultation with the site auditor must agree on the sequence of these works prior to the commencement of any capping.

The capping specifications are outlined in the following table and conceptual cross-sections included proposed development plans attached in Appendix B. An additional example of conceptual cross-section for underground services is provided on Figure 3 attached in the appendices. In the event that the capping specification is to be altered following the initial consultation, this must be documented by JKE in Remediation Works Plan (RWP) and reviewed by the site auditor.

Table 5-3: Capping Specification

Remediation Area	Capping Specification
Area A	High-visibility (orange) geofabric[15] visual marker layer placed over the contaminated soil ground surface, followed by geogrid[16] mechanical barrier placed directly over the geofabric, followed by subbase/base course and pavement/hardstand as per the relevant engineering specification. All imported materials placed above the marker layer are to be validated in accordance with the Validation Plan in Section 6. Based on the development plans provided the capping thickness to the underside of the concrete slab will range from approximately 0.15m in the north section of the site to approximately 1.6m in the south-west section of the site in the area of the existing slipway.
Area B	A concrete slab approximately 0.2m thick was encountered at the surface in BH204 drilled for the JKE DSI. The concrete slab encountered at BH204 within remediation Area A appears to be similar to paved surface in remediation Area B. Therefore, it is assumed that the capping of contaminated soil in remediation Area B comprise of a concrete slab approximately 0.2m think.
Area C	A concrete slab approximately 0.2m thick was encountered at the surface in BH206 drilled for the JKE DSI. The concrete slab encountered at BH206 within remediation Area A appears to be similar to paved surface in remediation Area C. Therefore, it is assumed that the capping of contaminated soil in remediation Area C comprise of a concrete slab approximately 0.2m think.
Area D	Asphaltic concrete pavement 0.05m thick was encountered over a concrete slab 0.2m thick was in BH207 drilled for the JKE DSI. The asphaltic concrete pavement encountered at the surface in BH207 within remediation Area A appears to be similar to

[15] Reference to 'geofabric' in the context of the RAP includes a high visibility (orange), non-woven polyester geotextile fabric product. TerraStopHVL Geotextile, Manufactured by Polyfabrics Australasia (or approved equivalent). The geofabric should be suitable from a free drainage, engineering and geotechnical point of view as required.

[16] Reference to 'geogrid' in the context of the RAP includes a rigid mechanical barrier. E'GRID 2020 Rigid Biaxel Geogrid, Manufactured by Polyfabrics Australasia (or approved equivalent). The Geogrid should be suitable from an engineering and geotechnical point of view as required.

Remediation Area	Capping Specification
	paved surface in remediation Area D. Therefore, it is assumed that the capping of contaminated soil in remediation Area D comprise of an asphaltic concrete over a concrete slab which are combined approximately 0.25m think.

The remediation steps for the general site capping remediation Area A are outlined in the following table. The detailed validation plan relevant to this aspect of the remediation is provided in Section 6.

Table 5-4: Remediation – General Site Capping of Remediation Area A

Step	Primary Role/ Responsibility	Procedure
1.	Remediation contractor	<u>Site Management, PPE and WHS and Geotechnical/Stability:</u> The site management and AMP controls are to be established by the remediation contractor in accordance with this RAP and the AMP referenced in Step 1 above.
2.	Remediation contractor	<u>Capping Procedure:</u> The capping of remediation Area A is to be undertaken in two stages as discussed in Section 5.3.5. The cap is to be constructed as per the details provided in the cross-sectional development plans attached in Appendix B and Figure 3 attached in Appendix A. The overall capping of the contaminated soil in Area A should be undertaken as follows: • The high-visibility (orange) geofabric is to be rolled out across the entire site, and placed within excavations for services/pits. A minimum overlap of 250mm is recommended between each length of geofabric. The geofabric is to be appropriately secured to the ground using soil nails (e.g. 'u' nails or pegs) or other appropriate methods. Enough geofabric should be installed at the boundary to allow the geofabric to later be secured to the outside face of the concrete slab at the boundary; • Once the geofabric is in place and secure the geogrid is to be rolled out across the entire site. Geogrid is not proposed within excavations for services/pits. A minimum overlap of 250mm is recommended between each length of geogrid. The geogrid is to be appropriately secured to the ground using soil nails (e.g. 'u' nails or pegs) or other appropriate methods; • Once the geofabric and geogrid capping marker layers have been installed a survey of the capped Area A boundaries co-ordinates and site surface levels should be undertaken; • Placed imported material over the capping marker layer. Imported materials and capping layers are to be validated by the remediation contractor and validation consultant in accordance with Section 6; • Construct the final capping layer comprise of a concrete slab; and • Once capping is complete a survey of the capped Area A boundaries co-ordinates and site surface levels should be undertaken.
3.	Validation consultant	<u>Inspection of excavation areas:</u> The marker layers, imported materials and capping layers are to be validated by the remediation contractor and validation consultant in accordance with Section 6.

5.3.6 Remediation – Over Water Portion

Remediation of the over water potion of the development (Area E) is not proposed. Instead, the disturbance of the potentially contaminated sediments in this area should be kept to a minimum and are to managed under the LTEMP.

We understand that the routine dredging works generally occur every two years within Terranora Creek and around the Marina area. The proposed development, including the improvement of environmental controls at the slipway, routine dredging and implementation of the LTEMP should improve the sediment quality in this area.

The construction works in Area E should be managed to keep the disturbance of sediment to a minimum. Specific environmental precautions and controls should be documented in the CEMP and implemented.

No validation is envisaged in Area E at this stage.

5.4 Remediation Documentation

The remediation contractor must retain all documentation associated with the remediation, including but not limited to:

- Waste disposal permits and dockets;
- Asbestos management documentation, including all relevant notifications, licences, clearance certificates and air monitoring reports (additional details in this regard are to be outlined in the AMP);
- Imported materials information;
- Photographs of remediation works;
- Waste tracking documentation; and
- Survey information.

Copies of these documents must be forwarded to the project manager and the validation consultant for assessment and inclusion in the validation report.

Prior to proceeding with remediation, the remediation consultant, and validation consultant and site auditor must agree on a waste and import materials tracking spreadsheet.

5.4.1 Waste

All waste removed from the site is to be appropriately classified, tracked and managed in accordance with the relevant guidelines and regulations. The remediation contractor is to maintain adequate records and retain all documentation for waste disposal activities including:

- A summary register (in Microsoft Excel format) including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details, including regulatory authority licencing details) and reconciliation of this information with the associated waste classification documentation and the waste disposal docket numbers;

- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste (i.e. weighbridge dockets for each load).

Any soil waste classification documentation prepared for soil waste at the site is to be prepared in accordance with the reporting requirements specified by the NSW EPA as outlined in the Consultants Reporting Guidelines and the NSW EPA Waste Classification Guidelines (2014). The documentation must be reviewed by the validation consultant (if the documentation is prepared by others) prior to the waste leaving the site.

The above information is to be provided to the validation consultant for inclusion in the validation report. The register must be set up at the beginning of the project and provided to the validation consultant regularly (i.e. weekly) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

At this stage, we understand that approximately 200m^3 of surplus soil is to be disposed of offsite. The off-site disposal of waste should address the presence of CoPC including asbestos and PCB/Organotin CCOs. This information is to be reviewed by the validation consultant on completion of the works and an assessment of the quantities of soil disposed off-site (e.g. comparison with the estimated and actual volumes via review of supplied disposal docket weigh bride information) provided in the validation assessment report.

5.4.2 Imported Materials

The remediation contractor is to maintain, for the duration of the project, an imported material register. This must include a register (in Microsoft Excel format) with details of each imported material type, supplier details, summary record of where the imported materials were placed on site, and importation docket numbers and a tally of quantities (separated for each import stream).

Examples of imported materials for this project may include but would not be limited to: site preparation materials (e.g. DGB, 40/70 etc), rock revetment material, service trench backfill, material used for capping layers etc).

The above information is to be provided to the validation consultant for inclusion in the validation report. The register be set up at the beginning of the project and provided to the validation consultant regularly (i.e. weekly) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

6 VALIDATION PLAN

Validation is necessary to demonstrate that remedial measures described in the RAP have been successful and that the site is suitable for the intended land use. The sampling program for the validation is outlined in Section 6.1. This is the minimum requirement based on the remedial strategy provided. Additional validation sampling may be required based on observations made during remediation or in the event of an unexpected find.

6.1 Validation Sampling and Documentation

The table below outlines the validation requirements for the site:

Table 6-1: Validation Requirements

Aspect	Sampling	Analysis	Observations and Documentation
Capping			
Survey of site levels, site boundaries and capped areas.	NA	NA	**Remediation contractor** to obtain the survey prior to and at the completion of the capping to assess and document the capping thicknesses. It is also expected that the remediation contractor or their nominated construction contractor will provide as-built drawings for the project which document the capping layers. A survey plan showing the site boundaries and capped area boundaries for remediation Area's A to E will also be required. Should an independent Construction Quality Assurance (CQA) role be undertaken as part of the construction works. The information relating to capping should be provided by the **project manager** to the validation consultant for review and inclusion in the validation assessment report.
Inspections.	NA	NA	**Validation consultant** to carry out inspections to document the installation of the cap. Key hold points for inspections include: - Geofabric and geogrid installation; - During importation of materials used to construct the cap; and - Finished surface levels. A photographic record is to be maintained by the **remediation contractor** and **validation consultant**.

Aspect	Sampling	Analysis	Observations and Documentation
Validation of imported materials.	As indicated below.	As indicated below.	As indicated below
Imported Materials – validation of imported materials is required for any materials imported onto the site during the remediation and to the point in time that the site validation report is prepared (e.g. gravels for site preparation, rock revetment material, service trench backfill, material used for capping layers etc).			
Imported VENM	NA	NA	**Remediation contractor** to supply existing VENM documentation/report (report to be prepared in accordance with the NSW EPA waste classification reporting requirements). A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Material is to be inspected upon importation by the **validation consultant** to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Photographic documentation and an inspection log are to be maintained.
Imported engineering recycled materials such as recycled aggregates	Minimum of three samples per 75m^3 or in accordance with NEPM 2013 sampling density for stockpiles.	Asbestos (500ml analysis and asbestos quantification).	**Remediation contractor** to provide product specification and documentation to confirm the material has been classified with reference to a relevant Resource Recovery Order/Exemption. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the facility's Environment Protection Licence (EPL). Material is to be inspected by the **validation consultant** upon importation to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Where check sampling occurs by the **validation consultant** due to deficiencies or irregularities in existing documentation or based on the visual inspection, the following is required: - Date of sampling and description of material sampled;

Aspect	Sampling	Analysis	Observations and Documentation
			- An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the VAC.
Imported engineering materials comprising only natural quarried products.	NA	NA	**Remediation contractor** to provide documentation from the supplier confirming the material is a natural quarried product. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the quarry's EPL. Material is to be inspected by the **validation consultant** upon importation to confirm it is free of anthropogenic materials, visible and olfactory indicators of contamination, and is consistent with documentation. -

6.2 Validation Assessment Criteria and Data Assessment

The VAC to be adopted for the validation assessment are outlined in the table below:

Table 6-2: Validation Assessment Criteria (VAC)

Validation Aspect	VAC
Validation of capping	Validation of capping will occur via a review of survey information, as-built drawings and via the inspection process. The validation report is to include cross-sections documenting the completed capping details for the various areas of the site.
Imported materials	Material imported as general fill must only be VENM or ENM. VENM is defined in the Protection of the Environment Operations Act (1997)[17] as material: • That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • That does not contain sulfidic ores or other waste; and • Includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette. ENM and recycled materials are to meet the criteria of the relevant exemption/order under which they are produced. Laboratory recycled material sample results must be free of asbestos.

[17] Protection of Environment Operations Act 1997 (NSW) (POEO Act 1997)

Validation Aspect	VAC
	Analytical results for VENM and other imported materials will need to be consistent with expectations for those materials. For VENM, it is expected that: - Heavy metal concentrations are to be less than the most conservative Added Contaminant Limit (ACL) concentrations for an URPOS exposure setting presented in Schedule B1 of the NEPM 2013; and - Organic compounds are to be less than the laboratory PQLs and asbestos to be absent. Aesthetics: all imported materials are to be free of staining and odours.

6.3 Data Quality

Appropriate QA/QC samples should be obtained during the validation (where applicable) and analysed for the contaminants of concern. As a minimum, QA/QC sampling should include duplicates (5% inter-laboratory and 5% intra-laboratory (with the exception of asbestos)), trip spikes, trip blanks and rinsate samples.

Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) should be clearly outlined and assessed as part of the validation process. A framework for the DQO and DQI process is outlined below and should be reflected in the validation report.

DQOs should be established for the validation with reference to the seven step process outlined in Schedule B2 of NEPM (2013) and the Guidelines for the NSW Site Auditor Scheme, 3rd Edition (2017)[18]. The seven steps include the following:

- State the problem;
- Identify the decisions/goal of the study;
- Identify information inputs;
- Define the study boundary;
- Develop the analytical approach/decision rule;
- Specify the performance/acceptance criteria; and
- Optimise the design for obtaining the data.

DQIs are to be assessed based on field and laboratory considerations for precision, accuracy, representativeness, completeness and comparability.

6.4 Validation Report

As part of the site validation process, a validation report will be prepared by the validation consultant. The report will present the results of the validation assessment and will be prepared in accordance with the NSW EPA Consultants Reporting Guidelines 2020. The draft validation report should be issued to the site auditor for review and comment.

[18] NSW EPA (2017). *Guidelines for the NSW Site Auditor Scheme, 3rd ed.* (referred to as Site Auditor Guidelines 2017)

6.5 LTEMP

At the completion of remediation and validation works, a LTEMP will be required to manage the contamination that is to be capped at the site. The LTEMP form part of the overall validation process. The draft LTEMP should be issued to the site auditor for review and comment.

The LTEMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential for human and ecological receptor exposure to the underlying contaminated soil/sediment. The LTEMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

Public notification and enforcement mechanisms for the LTEMP are to be arranged by the site owner/project manager. The notification and enforcement mechanisms may include the identification of the LTEMP on an NSW EPA Environmental Protection Licence (EPL), should an EPL be required for operation of the site.

Another option for enforcement of the LTEMP may include the identification of the LTEMP on the lease issued to TfNSW under the Crown Land Management Act 2016. However, at this stage the public notification aspect of the LTEMP is unclear with this option.

JKE recommend that legal advice and early engagement be undertaken with the site owner, consent authority and any other relevant stakeholders so that the LTEMP can be publicly notified and enforceable.

Once the public notification and enforcement mechanisms for the LTEMP have been confirmed an addendum letter to this RAP should be prepared and issued to the Auditor.

7 CONTINGENCY PLAN

A review of the proposed remediation works has indicated that the greatest risks that may affect the success of the remediation include unexpected finds and/or validation failure of imported materials. Contingency plans to address these risks are outlined below, in conjunction with a selection of other contingencies that may apply to this project.

7.1 Unexpected Finds

Residual hazards that may exist at the site would generally be expected to be detectable through visual or olfactory means. At this site, these types of hazards may include: underground tanks, odorous or stained hydrocarbon impacted soils.

The procedure to be followed in the event of an unexpected find is presented below:

- In the event of an unexpected find, all work in the immediate vicinity should cease and the client and the validation consultant should be contacted immediately;
- Temporary barricades should be erected to isolate the area from access to the public and workers;
- The client should engage the validation consultant to attend the site and assess the extent of remediation that may be required and/or adequately characterise the contamination in order to allow for remediation of the material;
- In the event additional remediation is required, the procedures outlined within this report should be adopted where appropriate. Alternatively, RWP should be prepared;
- An additional sampling and analytical rationale should be established by the consultant and should be implemented with reference to the relevant guideline documents; and
- Appropriate validation sampling should be undertaken and the results should be included in the validation report.

7.2 Importation Failure for VENM or other Imported Materials

Where material to be imported onto the site does not meet the importation VAC, the material should not be imported. Alternative material must be sourced that meets the importation requirements.

8 SITE MANAGEMENT PLAN FOR REMEDIATION WORKS

The information outlined in this section of the RAP is for the remediation work only. The client should make reference to the development consent for specific site management requirements for the overall development of the site.

A CEMP must be for the construction works. Some of the site management requirements identified by below may also be captured in the CEMP.

8.1 Asbestos Management Plan

Prior to the commencement of any soil disturbance in the remediation areas, an AMP is to be prepared to document the asbestos-related management requirements for the remediation. The AMP is to be implemented by the remediation contractor (and their nominated subcontractors where relevant) throughout the remediation.

8.2 Interim Site Management

Interim site management measures are not considered necessary at this stage. The site is fenced and mostly covered by pavement. Offsite impacts have been assessed and are not considered significant to warrants interim management.

8.3 Project Contacts

Emergency procedures and contact telephone numbers should be displayed in a prominent position at the site entrance gate and within the main site working areas. The contact details of key project personnel are summarised in the following table:

Table 8-1: Project Contacts

Role	Company	Contact Details
Project Manager	TBA	-
Remediation Contractor	SMC Marine Pty Ltd	Linda Miller Authorised Person **linda@smcmarine.com.au** P: 0488 738 913
Validation Consultant	JKE (at the time of the RAP preparation, subject to formal engagement)	Mitch Delaney Senior Associate **mdelaney@jkenvironments.com.au** P: 02 9888 5000
Site Auditor	Cavvanba Consulting Pty Ltd	Ben Wackett NSW EPA Accredited Site Auditor **ben@cavvanba.com** P: 02 6685 7811

Role	Company	Contact Details
NSW EPA	Pollution Line	P: 131 555
Pollution Emergency	NSW Fire and Rescue	P: 000
Emergency Services	Ambulance, Police, NSW Fire and Rescue	P: 000

8.4 Security

At the time of preparation of this RAP the site was fenced. Appropriate fencing should be maintained to secure the site and to isolate the remediation area. Warning signs should be erected, which outline the personal protective equipment (PPE) required for remediation work.

8.5 Timing and Sequencing of Remediation Works

The anticipated sequence of remediation works is outlined in Section 5.3.

8.6 Site Soil and Water Management Plan

The remediation contractor should prepare a detailed soil and water management plan prior to the commencement of site works and this should consider the requirements of the AMP.

Silt fences/curtains must be used to control the surface water runoff to Terranora Creek. The capping in the lower portion of the slipway where exposed soil/sediment exist must occur first to allow the construction of the rock revetment wall, after which demolition and excavation can be undertaken. Excavation works associated with the demolition of the existing slipway retaining walls must be undertaken at low tide and all excavation works must be planned to prevent tidal saturation of soil previously seldomly exposed to tidal influences and flooding.

All stockpiled materials are to be placed within an erosion containment boundary with silt fences and sandbags employed to limit sediment movement. The containment area should be located away from the site areas impacted by tidal movement, drainage lines/low-points, gutters, stormwater pits and inlets and the site boundary. Under no circumstances should liquid waste or runoff be discharged directly to Terranora Creek. Additionally, liquid waste or runoff should not be discharged the stormwater or sewerage system without the approval of the appropriate authorities.

Vehicle access to the site shall be stabilised to prevent the tracking of sediment onto the roads and footpath. Soil, earth, mud or similar materials must be removed from the roadway by sweeping, shovelling, or a means other than washing, on a daily basis or as required. Soil washings from wheels shall be collected and disposed of in a manner that does not pollute waters.

8.7 PCB Contaminated Soil – Worker Exposure Controls

The total PCBs results of 7.2mg/kg encountered in the fill soil sample BH105 (0-0.1m) during the JKE DSI was above the human health SAC of 7mg/kg. Additionally, the GHD (2018) investigation encountered a total PCB result of 8mg/kg for the natural soil sample THSC1 (0.1-0.4m), which is also above the human health SAC of 7mg/kg. Both sampling locations are location on the lower portion of the slipway beneath the catch drain and settlement pit where exposed soil/sediment exist.

Potential PCB contamination soil exposure risks to construction workers are to be managed by the following:

- Minimisation of dust, by implementation of the Dust Control Plan outlined in Section 8.10;
- Implementation of PPE requirement in the AMP. These should be sufficient to protect workers from dermal and dust inhalation exposure pathways associated with the PCB contaminated soils. Disposable gloves and eye protection should also be worn during soil disturbance;
- Workers should wash their hand prior to consuming food; and
- The capping works in the lower portion of the slipway are to occur as part of the first stage of capping of the exposed soil/sediment and allow the construction of the rock revetment wall. This will isolate the workers from exposure to the PCB contaminated soil in this area provided that the cap is maintained.

8.8 Surface Water Monitoring

Groundwater level data loggers installed for the DSI demonstrated that entire site is influenced by tidal movement associated with Terranora Creek. During incoming tides surface water is visible in the lower to mid portion of the slipway. It should also be considered that the site is subject to flooding and was completing inundated by flood waters from the river in late February/early March 2022.

Following site establishment and up until the new concrete slab has been installed, surface water monitoring should be undertaken from river water sampling location RW4.1 (shown on Figure 7 attached in the appendices) in the event of the following:

- Surface water from the upper portion if the site is visually observed to be flowing to the lower portion of the slipway and into the onsite surface water associated with Terranora Creek; and/or
- A rain event of greater than 15mm has occurred within the preceding 24-hour period.

The surface water sampling plan and methodology is outlined below:

- The samples should be obtained from the rock revetment wall by direct filling of sampling containers with the river water collected from approximately 100mm below the surface water level. The sediment should not be disturbed by the sampling;
- Field staff are to wear dedicated nitrile gloves during sampling, which are to be discarded after each sampling event;
- A calibrated water quality meter should be used at the time of sampling to record the following: pH; electrical conductivity (EC); dissolved oxygen (DO); redox potential; Turbidity (NTU) and temperature;
- The samples are be filtered in the field through a single use 0.45um prior to filling of the sampling containers;

- For consistency with the DSI sampling, samples for Organotin analysis are to be collected in polycarbonate plastic bottles and samples for heavy metals analysis are to be collected in an acid (HNO3) wash plastic bottle;
- The samples are to be preserved with reference to the analytical requirements and placed in an insulated container with ice. On completion of the fieldwork, the samples are to be delivered in the insulated sample container to a NATA registered laboratory for analysis under standard Chain of Custody (COC) procedures;
- The surface water samples are to be analysed for Organotin and heavy metals (copper and zinc); and
- Care must be taken to during sampling, vessels with antifoul paints moored nearby to sampling location RW4.1 should be moved well away prior to sampling.

The surface water results are to be provided to the validation consultant as soon as available. Should the TBT results exceed 0.006µg/L and/or the copper and zinc results exceed the maximum concentrations identified by the DSI at sampling location RW4.1 of 12µg/L for copper and 18µg/L for zinc, then all works should stop until the risks to ecological reports is further assessed. The Auditor should also be notified of the exceedance.

Rectification works may include additional sediment and runoff controls, further surface water monitoring or other substantial measures which may need to be documented in a Remediation Works Plan (RWP) and reviewed by the site auditor.

8.9 Noise and Vibration Control Plan

The guidelines for minimisation of noise on construction sites outlined in AS-2460 (2002)[19] should be adopted. Noise producing machinery and equipment should only be operated between the hours approved by the consent authority.

All practicable measures should be taken to reduce the generation of noise and vibration to within acceptable limits. In the event that short-term noisy operations are necessary, and where these are likely to affect residences, notifications should be provided to the relevant authorities and the residents by the project manager, specifying the expected duration of the noisy works.

8.10 Dust Control Plan

Based on the subsurface, hydrogeological and surface water conditions, dust levels should be relatively low during remediation works. Regardless, all practicable measures should be taken to reduce dust emanating from the site. Factors that contribute to dust production are:

- Wind over a cleared surface;
- Wind over stockpiled material; and
- Movement of machinery in unpaved areas.

[19] Australian Standard, (2002). *AS2460: Acoustics - Measurement of the Reverberation Time in Rooms.*

Visible dust should not be present at the site boundary. Measures to minimise the potential for dust generation include:

- Use of water sprays on unsealed or exposed soil surfaces;
- Covering of stockpiled materials and excavation faces (particularly during periods of site inactivity and/or during windy conditions) or alternatively the erection of hessian fences around stockpiled soil or large exposed areas of soil;
- Establishment of dust screens consisting of a 2m high shade cloth or similar material secured to a chain wire fence;
- Maintenance of dust control measures to keep the facilities in good operating condition;
- Stopping work during strong winds;
- Loading or unloading of dry soil as close as possible to stockpiles to prevent spreading of loose material around the development area; and
- Geofabric/geotextile could be placed over exposed soils in the event that excavation is staged.

Dust monitoring should be undertaken at the site if exposed soils are present and during high wind weather. If excessive dust is generated all site activities should cease until either wind conditions are more acceptable or a revised method of excavation/remediation is developed. Reference is also to be made to the AMP in this regard.

Dust is also produced during the transfer of material to and from the site. All material should be covered during transport and should be properly disposed of on delivery. No material is to be left in an exposed, un-monitored condition.

All equipment and machinery should be brushed or washed down before leaving the site to limit dust and sediment movement off-site. In the event of prolonged rain and lack of paved areas all vehicles should be washed down prior to exit from the site, and any soil or dirt on the wheels of the vehicles removed. Water used to clean the vehicles should be collected and tested prior to appropriate disposal under the relevant waste classification guidelines.

8.11 Dewatering

Dewatering is not expected to be required under the scope of remediation and is therefore not applicable under the RAP. However, if dewatering is required a Dewatering Management Plan (DMP) should be prepared. The DMP will require approval from TfNSW.

Groundwater must not be pumped directly to Terranora Creek. Groundwater must not be pumped to sewer or stormwater without obtaining prior approval from the relevant authorities.

8.12 Air Monitoring

Reference is to be made to the AMP for details regarding asbestos air fibre monitoring. Air monitoring must only be carried out by personnel registered and accredited by NATA (National Association of Testing Authorities). Filter analysis must only be carried out within a NATA certified laboratory. The monitoring

results must conform to the requirements of the NOHSC Guidance note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003 (2005)].

A monitoring program will be used to assess whether the control procedures being applied are satisfactory and that criteria for airborne asbestos fibre levels are not being exceeded. The following levels will be used as action criteria during the air monitoring:

- <0.01 Fibres/ml: Work procedures deemed to be successful;
- 0.01 to 0.02 Fibres/ml: Inspection of the site and review of procedures; and
- >0.02 Fibres/ml: Stop work, inspection of the site, review of procedures, clean-up, rectification works where required and notify the relevant regulator.

Asbestos air fibre monitoring should generally be undertaken during asbestos removal/remediation works. As these results can be provided to workers and/or neighbours if necessary.

8.13 Odour Control Plan

All activities undertaken at the site should be completed in a manner that minimises emissions of smoke, fumes and vapour into the atmosphere and any odours arising from the works or stockpiled material should be controlled. Control measures may include:

- Maintenance of construction equipment so that exhaust emissions comply with the Clean Air Regulations issued under the POEO Act 1997;
- Demolition materials and other combustible waste should not be burnt on site;
- The spraying of a suitable proprietary product to suppress any odours that may be generated by excavated materials; and
- Use of protective covers (e.g. builder's plastic).

All practicable measures should be taken to reduce fugitive emissions emanating from the site so that associated odours do not constitute a nuisance and that the ambient air quality is not adversely impacted.

The following odour management plan should be implemented to limit the exposure of site personnel and surrounding residents to unpleasant odours:

- Excavation and stockpiling of material should be scheduled during periods with low winds if possible;
- A suitable proprietary product could be sprayed on material during excavation and following stockpiling to reduce odours (subject to an appropriate assessment of the product by the validation consultant);
- All complaints from workers and neighbours should be logged and a response provided. Work should be rescheduled as necessary to minimise odour problems;
- The site foreman should consider the following odour control measures as outlined in NEPM:
  - reduce the exposed surface of the odorous materials;
  - time excavation activities to reduce off-site nuisance (particularly during strong winds); and
  - cover exposed excavation faces overnight or during periods of low excavation activity.
- If continued complaints are received, alternative odour management strategies should be considered and implemented.

8.14 Work Health and Safety (WHS) Plan

A site specific WHS plan should be prepared by the remediation contractor for all work to be undertaken at the site. The WHS plan should meet all the requirements outlined in SafeWork NSW WHS regulations.

As a minimum requirement, personnel must wear appropriate protective clothing, including long sleeve shirts, long trousers, steel cap boots and hard hats. Additional asbestos-related PPE will be required and this will be specified in the AMP. Washroom and lunchroom facilities should also be provided to allow workers to remove potential contamination from their hands and clothing prior to eating or drinking.

8.15 Waste Management

Prior to commencement of remedial works and excavation for the proposed development, the remediation contractor should develop a waste management or recycling plan to minimise the amount of waste produced from the site.

8.16 Incident Management Contingency

The validation consultant must be contacted if any unexpected contamination-related conditions are encountered at the site. This should enable the scope of remedial/validation works to be adjusted as required. Similarly, if any incident occurs at the site, the validation consultant should be advised to assess potential impacts on contamination conditions and the remediation/validation timetable.

8.17 Hours of Operation

Hours of operation should be between those approved by the consent authority under the development approval process.

8.18 Community Consultation

The head contractor should provide details for managing community consultation and complaints within their CEMP.

9 CONCLUSION

The JKE PSI and DSI identified risks associated with COPC including asbestos risks to human health; Tributyltin (TBT), copper and zinc risks to ecological receptors. On this basis, preparation of a RAP was recommended.

The preferred primary option for remediation at the site is considered to be 'cap and containment' of the contaminated material followed by long term monitoring. The preferred secondary option for remediation of surplus soil is considered to be 'excavation and off-site disposal' to landfill. These options are considered to be most appropriate considering the proposed development and lack of on-site and off-site treatment options available for the COPC.

The remediation capping feasibility assessment demonstrated that the capping approach for remediation was suitable to address the identified site contamination. JKE are of the opinion that the site can be made suitable for the proposed development provided this RAP is implemented. A site validation report is to be prepared on completion of remediation activities and submitted to the site auditor and consent authority to demonstrate that the site is suitable for the proposed development.

Following remediation/validation the site will require passive management under a LTEMP. The LTEMP will also be submitted to the site auditor and consent authority to demonstrate that the site is suitable for the proposed development.

The LTEMP will provide a passive management approach which would not impose any constraints on the day-to-day site use under the proposed development scenario. The LTEMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential for human and ecological receptor exposure to the underlying contaminated soil/sediment. The LTEMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

Public notification and enforcement mechanisms for the LTEMP are to be arranged by the site owner/project manager. JKE recommend that legal advice and early engagement be undertaken with the site owner, consent authority and any other relevant stakeholders so that the LTEMP can be publicly notified and enforceable. Once the public notification and enforcement mechanisms for the LTEMP have been confirmed an addendum letter to this RAP should be prepared and issued to the Auditor.

The RAP has met the objectives outlined in Section 1.2.

9.1 Regulatory Requirements

The regulatory requirements applicable for the remediation are discussed in the following table:

Table 9-1: Regulatory Requirement

Guideline / Legislation / Policy	Applicability
SEPP2021	Under SEPP2021, site remediation can fall under Category 1 or Category 2 remediation works. JKE recommend the client consult the project planner to determine the remediation category prior to commencement of works. Approval is required from the consent authority for Category 1 remediation work. The RAP needs to be assessed as part of the development consent. Category 1 remediation work is identified as advertised development work unless the remediation work is a designated development or a state significant development (Clause 4.8 of SEPP2021). Development consent is not required for Category 2 remediation works, however the consent authority should be given 30 days' notice prior to commencement of works. Under Clause 4.14 of SEPP2021, a notice of completion of remediation work is to be given to council within 30 days of completion of the work. The notice of completion of remediation works must be in accordance with Clause 4.15 of SEPP2021.
POEO Act 1997	The presence of PCBs and TBT at the site has triggered the PCB and Organotin CCOs under the POEO Act. Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. Appropriate waste tracking is required for all waste that is disposed off-site. Activities should be carried out in a manner which does not result in the pollution of waters.
POEO (Waste) Regulation 2014	Part 7 of the POEO Waste Regulation 2014 set outs the requirements for the transportation and management of asbestos waste and Clause 79 of the POEO Waste Regulation requires waste transporters to provide information to the NSW EPA regarding the movement of any load in NSW of more than 10 square meters of asbestos sheeting, or 100 kilograms of asbestos waste. To fulfil these legal obligations, asbestos waste transporters must use WasteLocate. Clause 78 of the POEO Waste Regulation requires that a person who transport asbestos waste must ensure that: • Any part of any vehicle in which the person transports the waste is covered, and leak-proof, during the transportation; and • If the waste consists of bonded asbestos material—it is securely packaged during the transportation; and • If the waste consists of friable asbestos material—it is kept in a sealed container during transportation; and • If the waste consists of asbestos-contaminated soils—it is wetted down. Asbestos waste in any form cannot be re-used or recycled.

Guideline / Legislation / Policy	Applicability
SafeWork NSW Code of Practice: How to manage and control asbestos in the workplace (2019)	Sites with asbestos become a 'workplace' when work is carried out there and require a register and AMP. Appropriate SafeWork NSW notification will be required for licensed (e.g. Class A) asbestos removal works or handling.
NSW EPA Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997	JKE understand that the Department of Planning and Environments – Crown Lands have notified the NSW EPA under the NSW EPA Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997 (2015)[20] of the site contamination on 18 February 2022. This RAP should also be provided as part of the notification process to the NSW EPA.

[20] NSW EPA, (2015). *Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997* (referred to as Duty to Report Contamination)

10 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations
Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title: **SITE LOCATION PLAN**

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBDrpt3-RAP

Figure No: 1

JKEnvironments

PLOT DATE: 21/06/2022 4:22:01 PM DWG FILE: K:\SC EIS \JOBS\34000\SIE34453UB TWEED HEADS\CAD\E34453UBDRPT3-RAP.DWG

LEGEND

- APPROXIMATE SITE BOUNDARY
- AREA A
- AREA B
- AREA C
- AREA D
- AREA E

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 5 10 15 20 25

SCALE 1:500 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **REMEDIATION AREA PLAN**

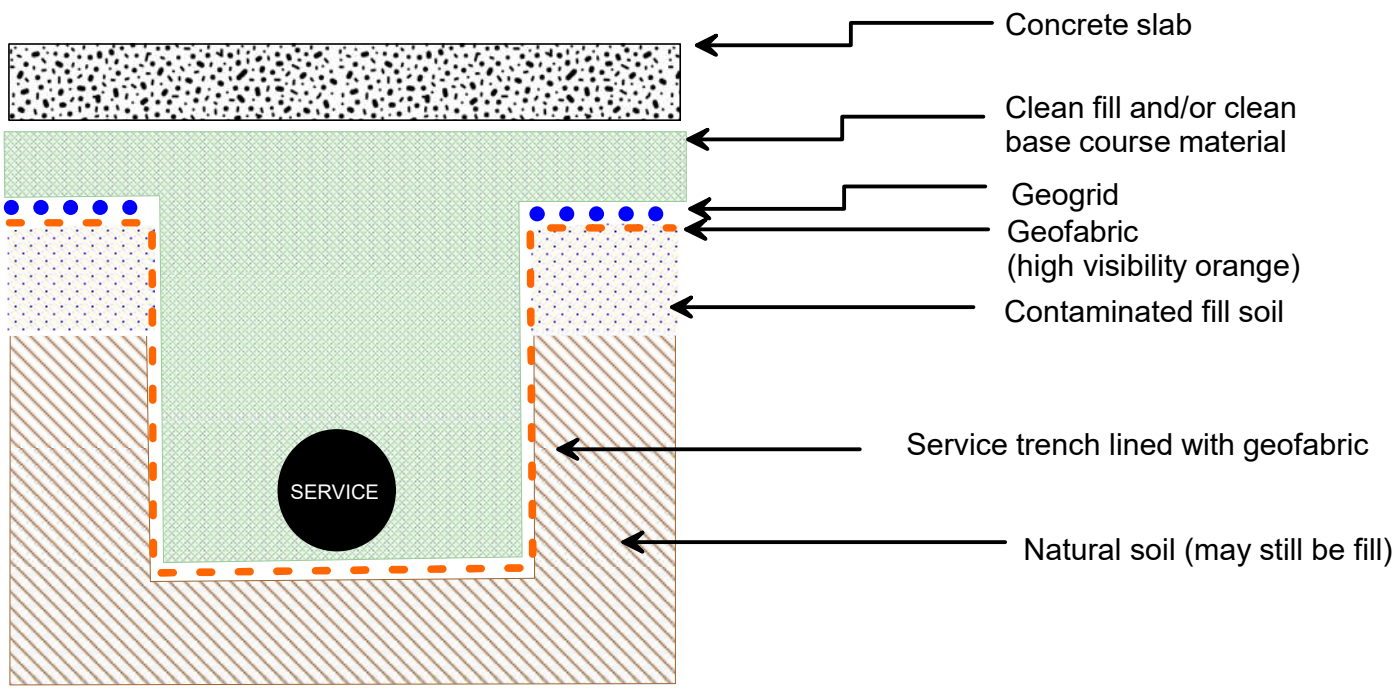
Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBDrpt3-RAP

Figure No: 2

JKEnvironments

PLOT DATE: 21/06/2022 4:23:35 PM DWG FILE: K:\5C EIS JOBS\34000'S\E34453UB TWEED HEADS\CAD\E34453UBDRPT3-RAP.DWG



Notes: Reference should be made to the report text for a full understanding of this plan.

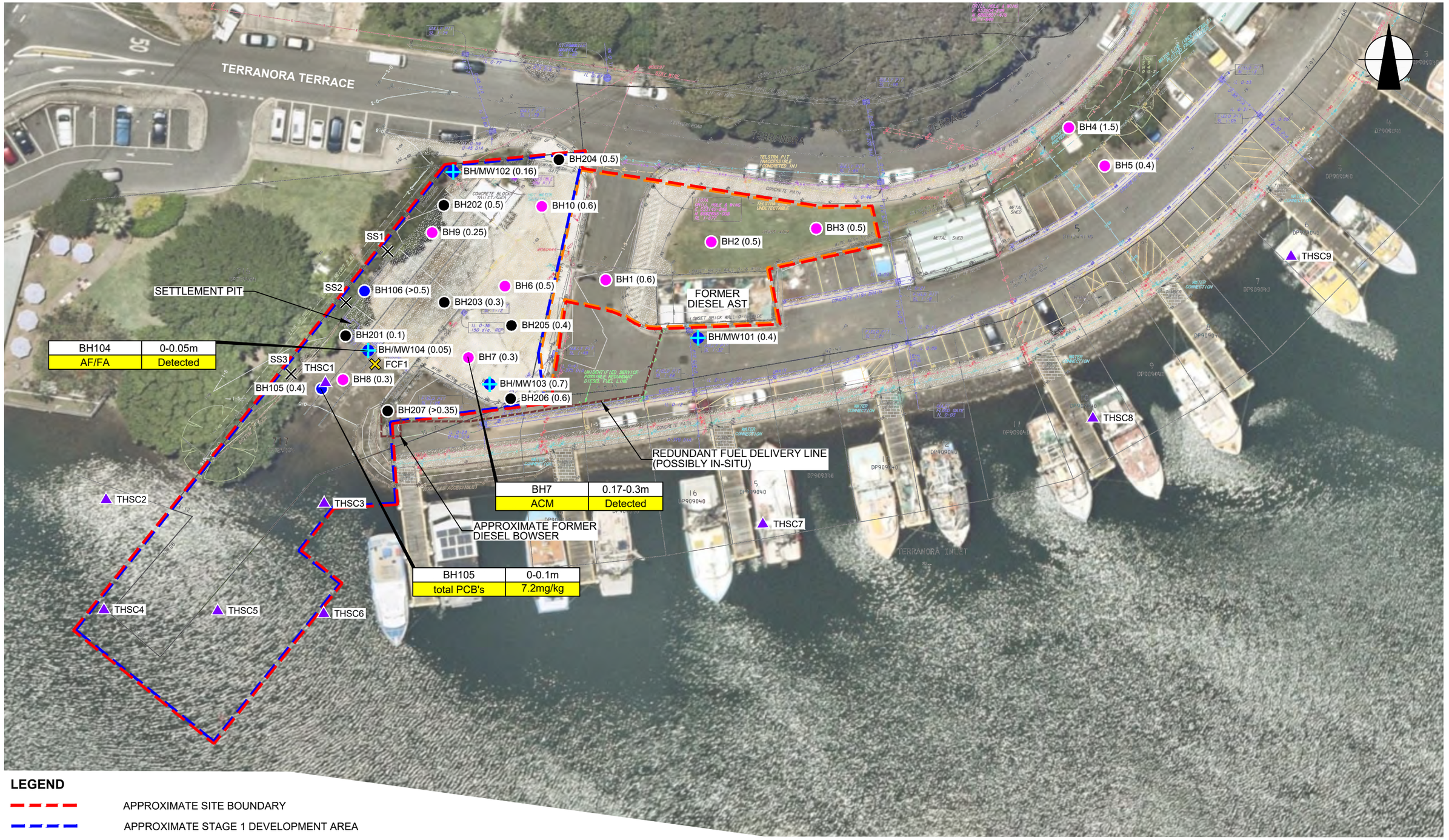
Title: **SCHEMATIC CROSS SECTION OF AREA A CAPPING - TYPICAL SERVICES INSTALLATION**

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453rpt3-RAP

Figure No: 3

JK ENVIRONMENTS



LEGEND

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STAGE 1 DEVELOPMENT AREA
- APPROXIMATE STAGE 2 DEVELOPMENT AREA
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, PSI 2021)
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI, 2022)
- BH/MW(Fill Depth) — BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI 2022)
- FCF(Surface) — FIBRE CEMENT FRAGMENT SAMPLING LOCATION (JKE, DSI, 2022)
- FORMER DIESEL BOWSER
- THSC1 — SEDIMENT SAMPLING LOCATION AND NUMBER (GHD, 2018)
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (JKE, DSI 2022)
- SS1 — SURFACE SAMPLE (JKE, DSI 2022)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

SOIL CONTAMINATION ABOVE SAC FOR HUMAN HEALTH RISK OR ASBESTOS DETECTION

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 5 10 15 20 25
SCALE 1:500 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **HUMAN HEALTH SAC EXCEEDANCE PLAN**

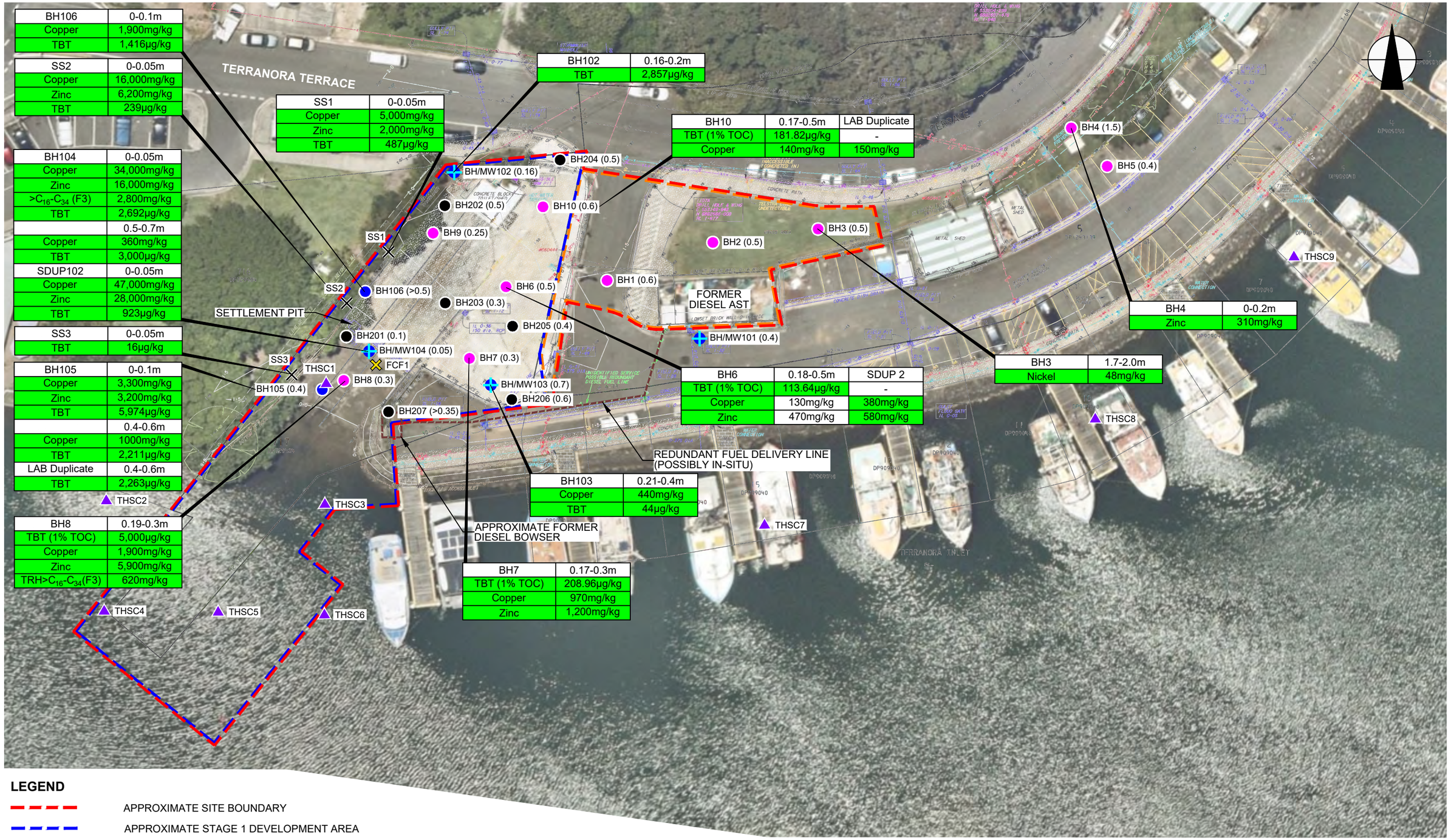
Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBD

Figure No: 4

JKEnvironments

PLOT DATE: 7/06/2022 9:14:12 AM DWG FILE: K:\SC EIS JOBS\34000'S\E34453UB TWEED HEADS\CAD\E34453UBD.DWG



BH106	0-0.1m
Copper	1,900mg/kg
TBT	1,416µg/kg

SS2	0-0.05m
Copper	16,000mg/kg
Zinc	6,200mg/kg
TBT	239µg/kg

SS1	0-0.05m
Copper	5,000mg/kg
Zinc	2,000mg/kg
TBT	487µg/kg

BH102	0.16-0.2m
TBT	2,857µg/kg

BH10	0.17-0.5m	LAB Duplicate
TBT (1% TOC)	181.82µg/kg	-
Copper	140mg/kg	150mg/kg

BH104	0-0.05m
Copper	34,000mg/kg
Zinc	16,000mg/kg
$>C_{16}$-C_{34} (F3)	2,800mg/kg
TBT	2,692µg/kg
	0.5-0.7m
Copper	360mg/kg
TBT	3,000µg/kg
SDUP102	0-0.05m
Copper	47,000mg/kg
Zinc	28,000mg/kg
TBT	923µg/kg

SS3	0-0.05m
TBT	16µg/kg

BH105	0-0.1m
Copper	3,300mg/kg
Zinc	3,200mg/kg
TBT	5,974µg/kg
	0.4-0.6m
Copper	1000mg/kg
TBT	2,211µg/kg
LAB Duplicate	0.4-0.6m
TBT	2,263µg/kg

BH8	0.19-0.3m
TBT (1% TOC)	5,000µg/kg
Copper	1,900mg/kg
Zinc	5,900mg/kg
TRH>C_{16}-C_{34}(F3)	620mg/kg

BH7	0.17-0.3m
TBT (1% TOC)	208.96µg/kg
Copper	970mg/kg
Zinc	1,200mg/kg

BH103	0.21-0.4m
Copper	440mg/kg
TBT	44µg/kg

BH6	0.18-0.5m	SDUP 2
TBT (1% TOC)	113.64µg/kg	-
Copper	130mg/kg	380mg/kg
Zinc	470mg/kg	580mg/kg

BH4	0-0.2m
Zinc	310mg/kg

BH3	1.7-2.0m
Nickel	48mg/kg

LEGEND

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STAGE 1 DEVELOPMENT AREA
- APPROXIMATE STAGE 2 DEVELOPMENT AREA
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, PSI 2021)
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- SS1 — SURFACE SAMPLE (JKE, DSI 2022)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

SOIL CONTAMINATION ABOVE SAC FOR ECOLOGICAL RISK

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 5 10 15 20 25

SCALE 1:500 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **ECOLOGICAL SAC EXCEEDANCE PLAN**

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBD

Figure No: 5

JKEnvironments

PLOT DATE: 7/06/2022 9:14:44 AM DWG FILE: K:\SC EIS JOBS\34000'S\E34453UB TWEED HEADS\CADIE34453UBD.DWG

MW102 (13/01/2022)		(05/05/2022)
pH	6.3	6.4
Arsenic	7µg/L	13µg/L
Copper	7µg/L	2µg/L
Nickel	21µg/L	23µg/L
Zinc	87µg/L	96µg/L
PFOS		0.0048µg/L

MW104 (13/01/2022)		(05/05/2022)
pH	6.5	6.7
TBT	0.037µg/kg	0.01µg/L
PFOS		0.012µg/L
WDUP1		
TBT	0.035µg/kg	0.01µg/L

ASLP - BH8 (0.19-0.3m)	
TBT	2,000µg/L

MW101 (14/01/2022)		(05/05/2022)
pH	6.9	
PFOS		0.0034µg/L

MW103 (14/01/2022)		(05/05/2022)
pH	6.9	
PFOS		0.026µg/L

LEAF - BH105 (0-0.1m)	
TBT Soil	0.37µg/L
TBT T02	0.53µg/L
TBT T03	0.43µg/L
TBT T04	0.17µg/L
TBT T05	0.63µg/L
TBT T06	0.02µg/L
TBT T07	0.02µg/L
TBT T09	0.01µg/L

TERRANORA TERRACE

SETTLEMENT PIT

FORMER DIESEL AST

REDUNDANT FUEL DELIVERY LINE (POSSIBLY IN-SITU)

APPROXIMATE FORMER DIESEL BOWSER

TERRANORA INLET

BH/MW102 (0.16) BH204 (0.5) BH4 (1.5) BH5 (0.4) BH202 (0.5) BH10 (0.6) BH9 (0.25) BH3 (0.5) BH2 (0.5) SS1 SS2 BH106 (>0.5) BH6 (0.5) BH1 (0.6) BH203 (0.3) BH205 (0.4) BH201 (0.1) BH/MW101 (0.4) BH/MW104 (0.05) BH7 (0.3) SS3 THSC1 FCF1 BH105 (0.4) BH8 (0.3) BH/MW103 (0.7) BH206 (0.6) BH207 (>0.35) THSC9 THSC8 THSC2 THSC3 THSC7 THSC4 THSC5 THSC6

LEGEND

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STAGE 1 DEVELOPMENT AREA
- APPROXIMATE STAGE 2 DEVELOPMENT AREA
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, PSI 2021)
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI, 2022)
- BH/MW(Fill Depth) BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI 2022)
- FCF(Surface) FIBRE CEMENT FRAGMENT SAMPLING LOCATION (JKE, DSI, 2022)
- FORMER DIESEL BOWSER
- THSC1 SEDIMENT SAMPLING LOCATION AND NUMBER (GHD, 2018)
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (JKE, DSI 2022)
- SS1 SURFACE SAMPLE (JKE, DSI 2022)

SAMPLE ID	-
CHEMICAL	CONCENTRATION (µg/L)

GROUNDWATER SAMPLE EXCEEDANCE

GROUNDWATER CONTAMINATION ABOVE SAC

SOIL LEACHATE LABORATORY RESULTS ABOVE ECOLOGICAL MARINE SAC

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 5 10 15 20 25

SCALE 1:500 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **MARINE WATER SAC EXCEEDANCE PLAN**

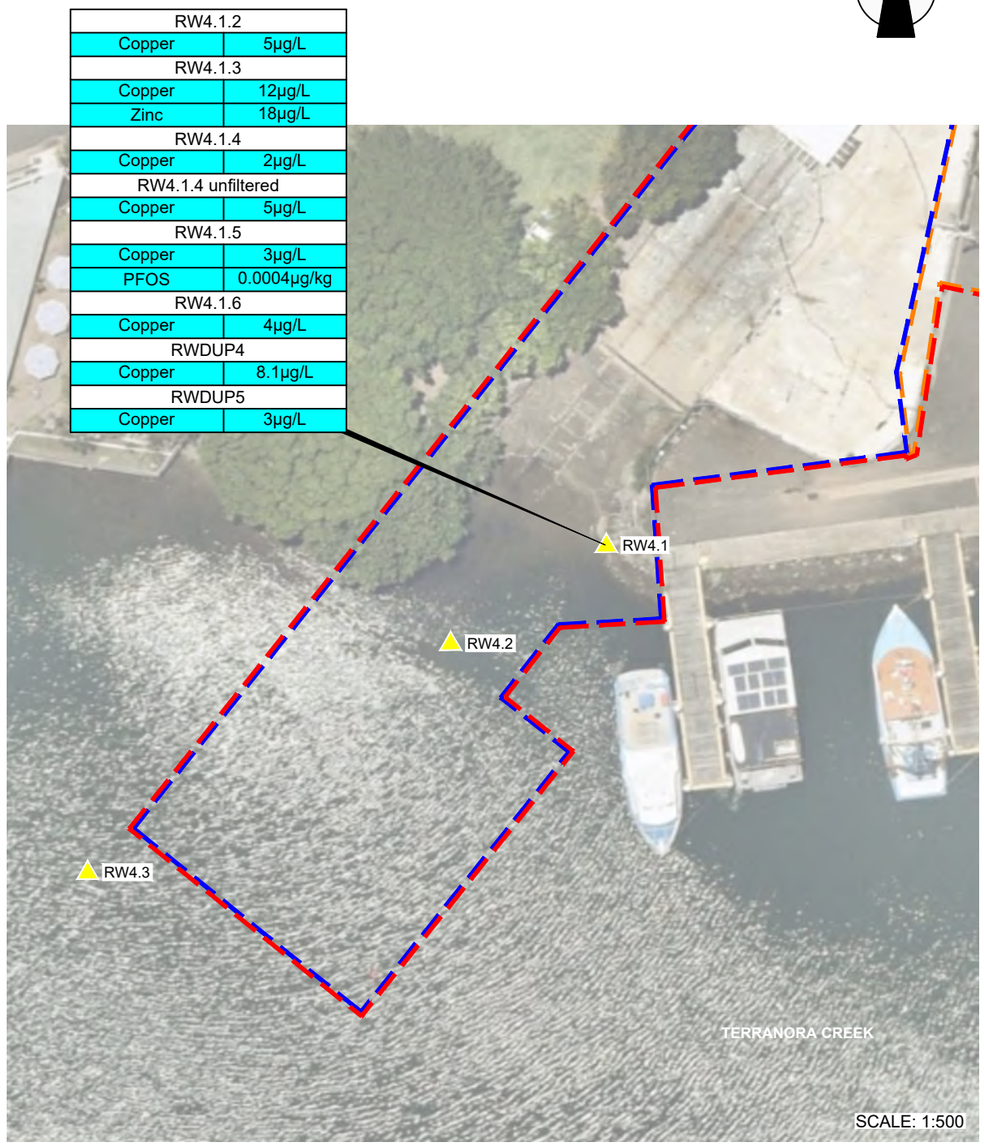
Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBD

Figure No: 6

JKEnvironments

PLOT DATE: 7/06/2022 9:15:07 AM DWG FILE: K:\SC EIS JOBS\34000'S\E34453UB TWEED HEADS\CADIE34453UBD.DWG



LEGEND

- APPROXIMATE SITE BOUNDARY
- APPROXIMATE STAGE 1 DEVELOPMENT AREA
- APPROXIMATE STAGE 2 DEVELOPMENT AREA
- RW APPROXIMATE RIVER WATER SAMPLING LOCATION

SAMPLE ID	-
CHEMICAL	CONCENTRATION (µg/L)

GROUNDWATER SAMPLE EXCEEDANCE

GROUNDWATER CONTAMINATION ABOVE SAC

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 20 40 60 80 100

SCALE 1:2000 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **RIVER WATER SAMPLING PLAN AND MARINE WATER SAC EXCEEDANCE PLAN**

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Project No: E34453UBD

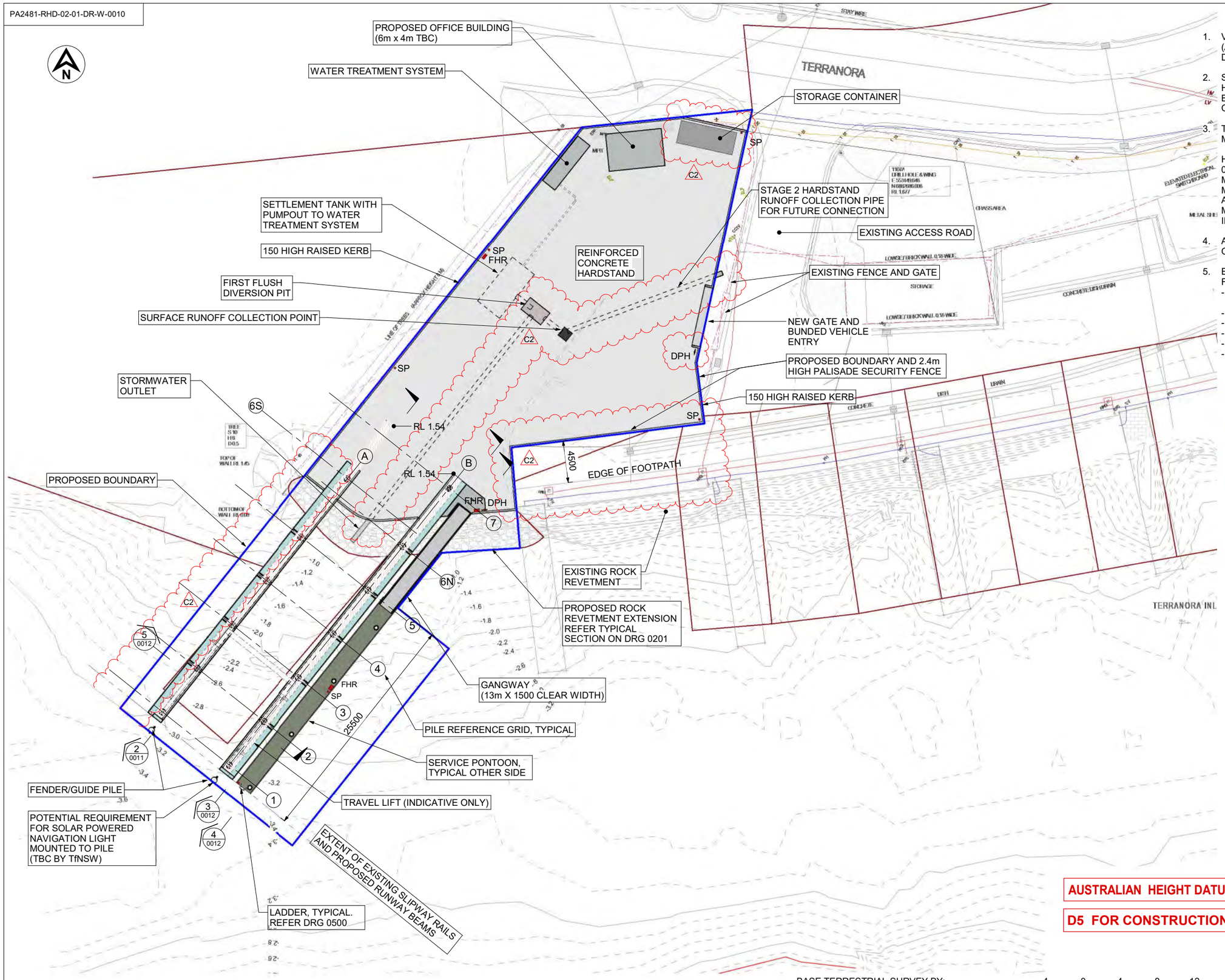
Figure No: 7

JKEnvironments

PLOT DATE: 7/06/2022 9:17:11 AM DWG FILE: K:\5C EIS JOBS\34000'S\E34453UB TWEED HEADS\CAD\E34453UBD.DWG

Appendix B: Selected Proposed Development Plans

PA2481-RHD-02-01-DR-W-0010



NOTES

1. VERTICAL DATUM IS AUSTRALIAN HEIGHT DATUM (AHD), WHICH IS 0.875m ABOVE TWEED RIVER HYDRO DATUM (TRHD).
2. SEABED CONTOURS ARE TO AHD AND DERIVED FROM HYDROGRAPHIC SURVEY COMPLETED IN MARCH 2018 BY NORTH COAST SURVEYS FOLLOWING DREDGING OF THE SOUTHERN BOATHARBOUR BERTHS.
3. TIDAL PLANES FOR TERRANORA CREEK (DRY DOCK, MHL GAUGE NO. 201428) TO AHD ARE AS FOLLOWS:

   HIGH HIGH WATER SOLSTICES SPRINGS (HHWSS) = 0.74m
   MEAN HIGH WATER (MHW) = 0.36m
   MEAN SEA LEVEL (MSL) = 0.08m
   AUSTRALIAN HEIGHT DATUM (AHD) = 0.00m
   MEAN LOW WATER (MLW) = -0.21m
   INDIAN SPRING LOW WATER (ISLW) = -0.50m.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
5. EACH PONTOON SHALL BE PROVIDED WITH THE FOLLOWING FACILITIES:
   - 1 SERVICE PEDESTAL WITH POWER OUTLETS, WATER SUPPLY AND LED LIGHT
   - LIGHTING PEDESTAL AT END OF PONTOON
   - 1 FIRE HOSE REEL
   - 9Kg DRY CHEMICAL FIRE EXTINGUISHER
   - SAFETY LADDER
   - LIFEBUOY MOUNTED TO HOSE REEL STAND

LEGEND

	PROPOSED CROWN PARCEL
FHR	FIRE HOSE REEL
DPH	DOUBLE PILLAR FIRE HYDRANT
SP	SERVICES PEDESTAL
LP	LIGHT PEDESTAL

BASE TERRESTRIAL SURVEY BY:
B & P SURVEYS
DATED 23-24 FEB 2021, 1 MAR 2021, AND 8 JUL 2021

4 0 4 8 12 16 20m
1:200 (A1) 1:400 (A3)

AUSTRALIAN HEIGHT DATUM

D5 FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY	CHK	APP
C2	29.11.2021	ISSUED FOR CONSTRN, CLOUDED	SGB	MP	GWB
C1	19.11.2021	ISSUED FOR CONSTRUCTION	SGB	MP	GWB
P03	13.10.2021	HARDSTAND AMENDED	SGB	MP	GWB
P02	25.06.2021	ISSUED FOR TENDER	SGB	MP	GWB
P01	21.05.2021	80% DESIGN FOR REVIEW	SGB	MP	

REVISIONS

CLIENT

NSW GOVERNMENT | Transport for NSW

PROJECT

TWEED HEADS TRAVEL LIFT BOAT FACILITY

TITLE

GENERAL ARRANGEMENT

Royal HaskoningDHV
Enhancing Society Together
Level 15, 99 Mount Street North Sydney NSW 2060, Australia
Tel +61 2 8854 5000
Email info@rhdhv.com
Website: www.royalhaskoningdhv.com

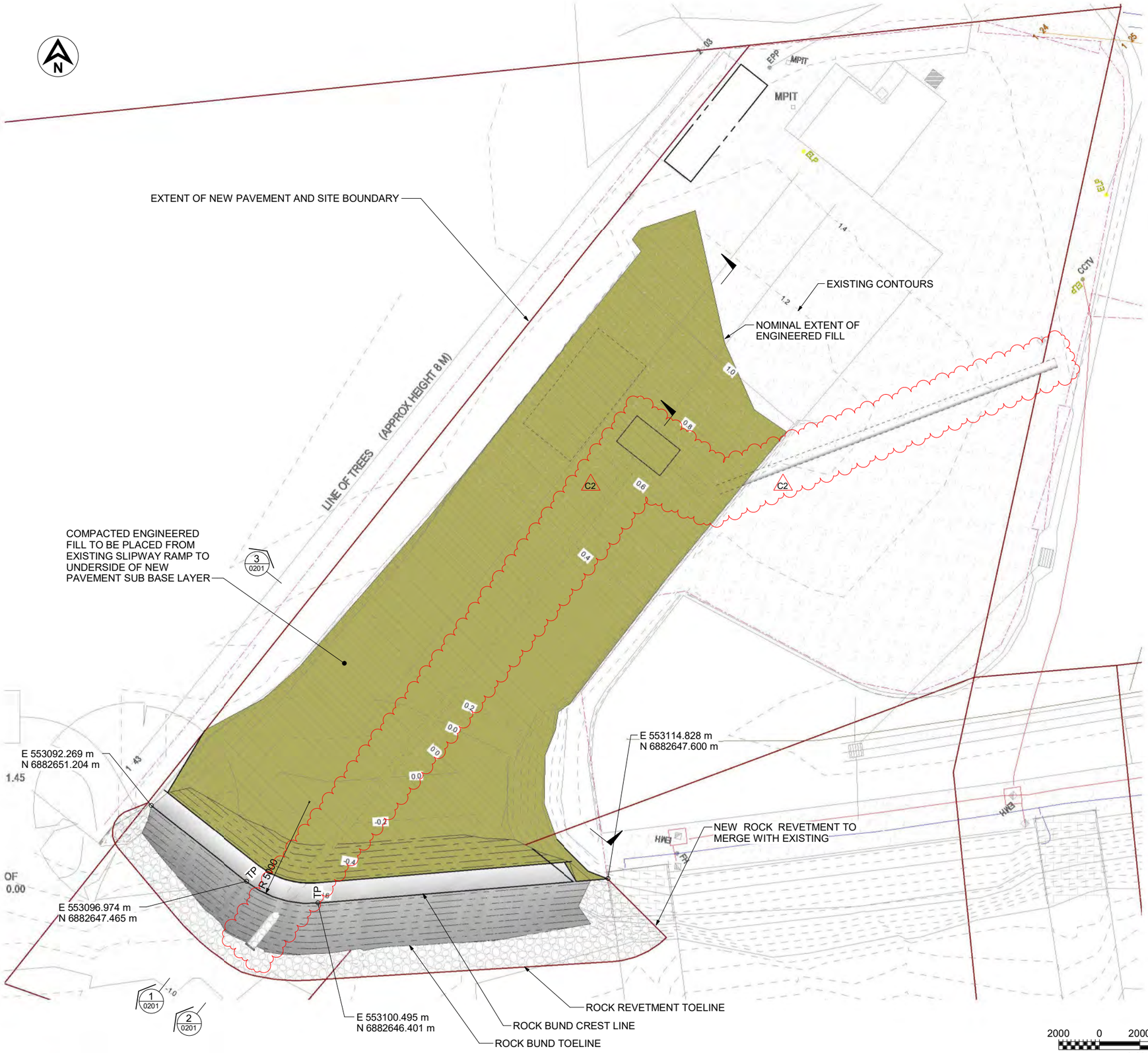
DRAWN	CHECKED	APPROVED
SGB	Checker	GWB

DATE	SCALE AT A1	REF.
29.11.2021	As indicated	

DRAWING No.	SUITABILITY	REVISION
PA2481-RHD-02-01-DR-W-0010	D5	C2

C:\Users\220000\Box\PA2481 Tweed Heads\PA2481 Tweed Heads Team\PA2481 Technical Data\E11 Working Drawings\PA2481-RHD-02-M3-W-0001[AFC].rvt

PA2481-RHD-02-01-DR-W-0200



2000 0 2000 4000 6000 8000 10000mm

1:100 (A1) 1:200 (A3)

AUSTRALIAN HEIGHT DATUM

D5 FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY	CHK	APP
C2	29.11.2021	ISSUED FOR CONSTRN. CLOUDED	SGB	MP	GWB
C1	19.11.2021	ISSUED FOR CONSTRUCTION	SGB	MP	GWB
P02	25.06.2021	ISSUED FOR TENDER	SGB	MP	GWB
P01	21.05.2021	80% DESIGN FOR REVIEW	SGB	MP	

REVISIONS

CLIENT

NSW GOVERNMENT | Transport for NSW

PROJECT

TWEED HEADS TRAVEL LIFT BOAT FACILITY

TITLE

SITE FILLING AND ROCK REVETMENT SETOUT PLAN

Royal HaskoningDHV
Enhancing Society Together

Level 15,
99 Mount Street
North Sydney NSW 2060, Australia
Tel +61 2 8854 5000
Email info@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	SGB	CHECKED	SHJ	APPROVED	GWB
DATE	29.11.2021	SCALE AT A1	1 : 100	REF.	

DRAWING No.	SUITABILITY	REVISION
PA2481-RHD-02-01-DR-W-0200	D5	C2

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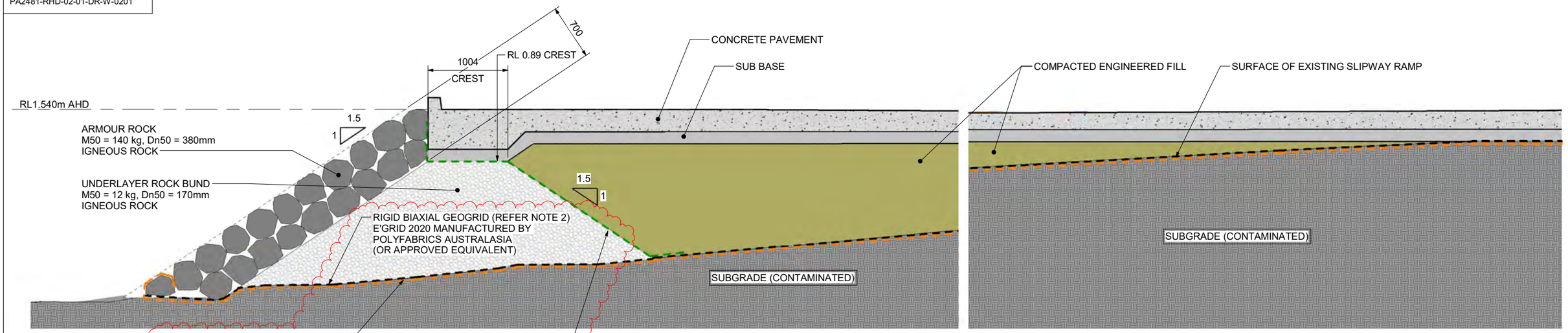
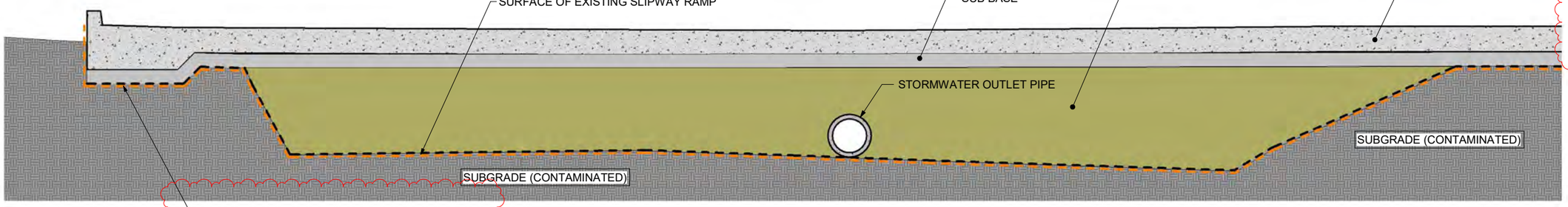
PA2481-RHD-02-01-DR-W-0201



SECTION 1 / 0200
1 : 25 (A1)

FILL LONGITUDINAL SECTION ALONG EXISTING RAMP



SECTION 3 / 0200
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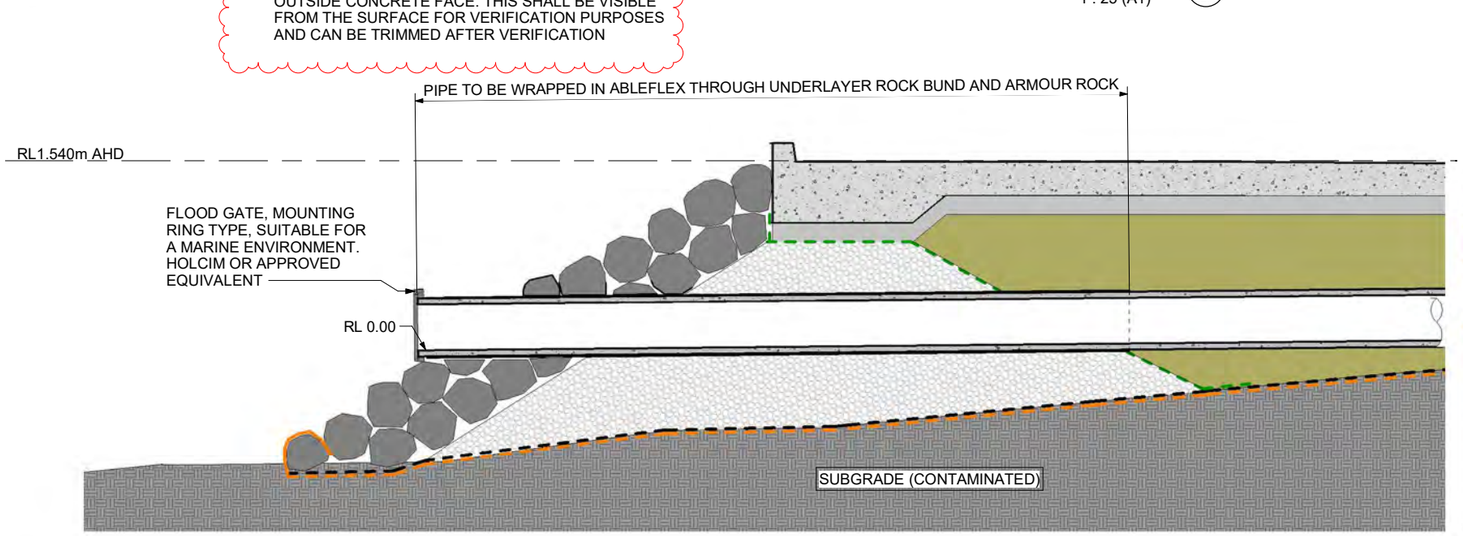
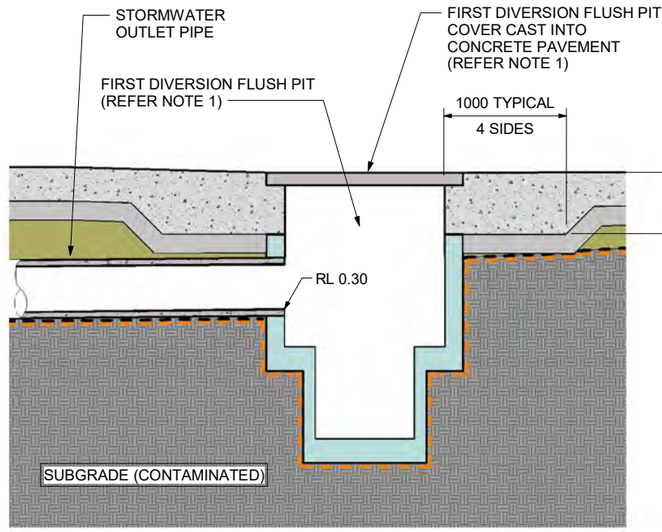




SECTION 2 / 0200
1 : 25 (A1)

SW OUTLET PIPELINE

500 0 500 1000 1500 2000 2500mm
1:25 (A1) 1:50 (A3)

NOTES

1. DETAILED DESIGN OF FIRST FLUSH DIVERSION PIT TO BE COMPLETED AS A DESIGN AND CONSTRUCT ELEMENT BY CONTRACTOR.
2. GEOGRID AND HIGH-VISIBILITY GEOTEXTILE FABRIC MARKER LAYER TO COVER EXTENT OF SLIPWAY RAMP SURFACE AND EXPOSED SUBGRADE ACROSS THE SITE.

AUSTRALIAN HEIGHT DATUM

D5 FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY	CHK	APP
C3	22.06.2022	GEOFABRIC AMENDED	SGB	MP	GWB
C2	29.11.2021	ISSUED FOR CONSTRN, CLOUDED	SGB	MP	GWB
C1	19.11.2021	ISSUED FOR CONSTRUCTION	SGB	MP	GWB
P02	25.06.2021	ISSUED FOR TENDER	SGB	MP	GWB
P01	21.05.2021	80% DESIGN FOR REVIEW	SGB	MP	

REVISIONS

CLIENT

NSW GOVERNMENT Transport for NSW

PROJECT

TWEED HEADS TRAVEL LIFT BOAT FACILITY

TITLE

SITE FILLING AND ROCK REVETMENT TYPICAL SECTIONS

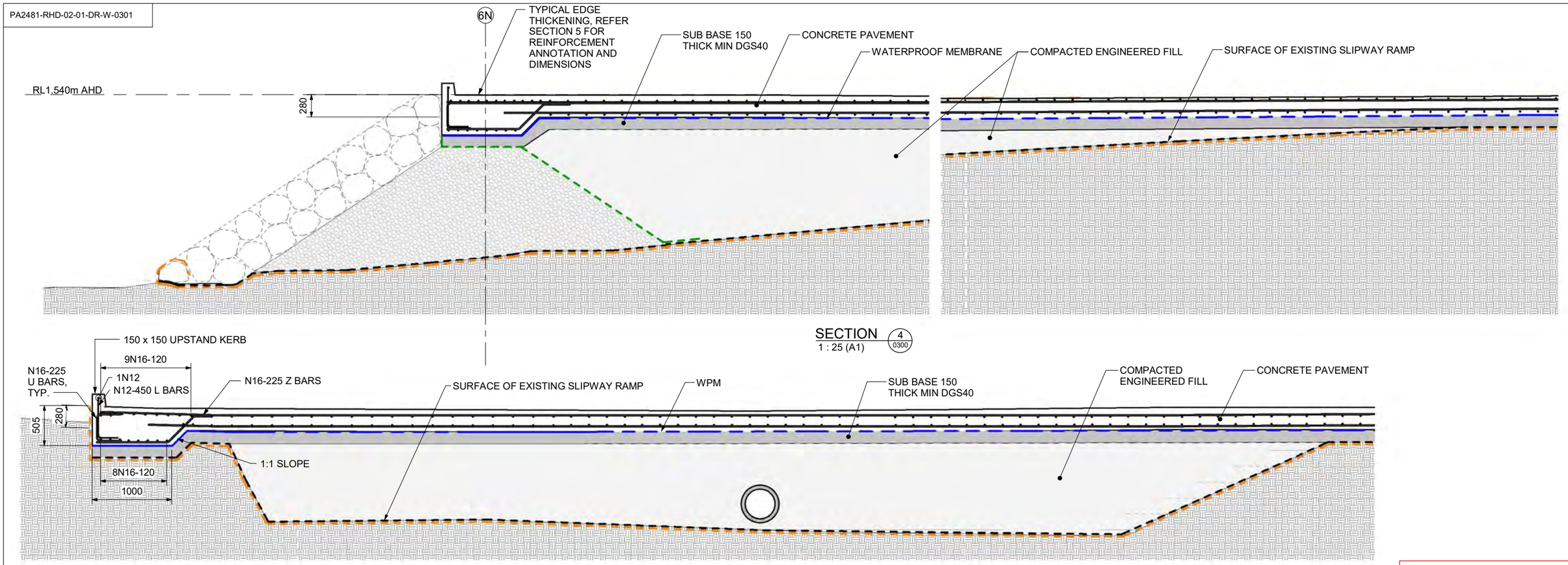
Royal HaskoningDHV
Enhancing Society Together
Level 15,
99 Mount Street
North Sydney NSW 2060, Australia
Tel +61 2 8854 5000
Email info@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	SGB	CHECKED	SHJ	APPROVED	GWB
DATE	29.11.2021	SCALE AT A1	1 : 25	REF.	

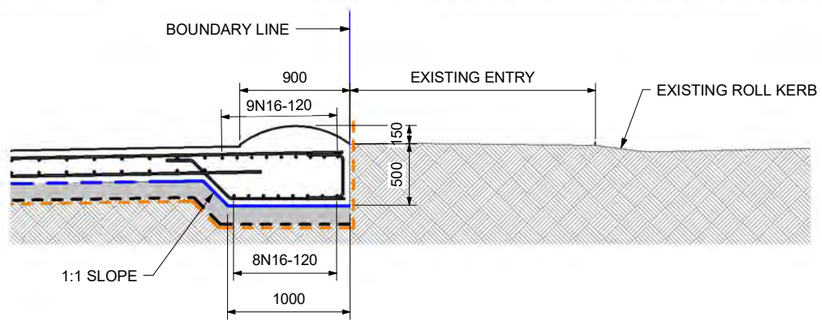
DRAWING No.	SUITABILITY	REVISION
PA2481-RHD-02-01-DR-W-0201	D5	C3

C:\Users\220000\Box\PA2481 Tweed Heads\PA2481 Tweed Heads Team\PA2481 Technical Data\E11 Working Drawings\PA2481-RHD-02-M3-W-0001[AFC].rvt

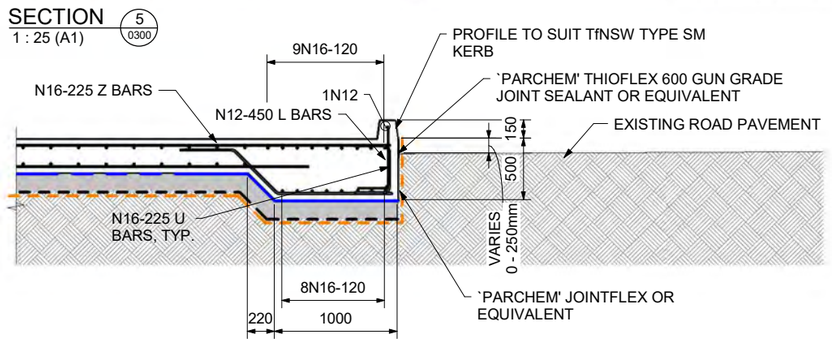
PA2481-RHD-02-01-DR-W-0301



SECTION 4 (0300)
1 : 25 (A1)

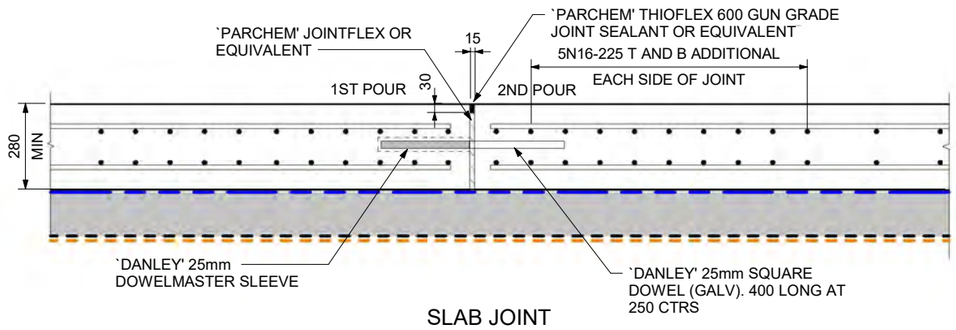


SECTION 6 (0300)
1 : 25 (A1)

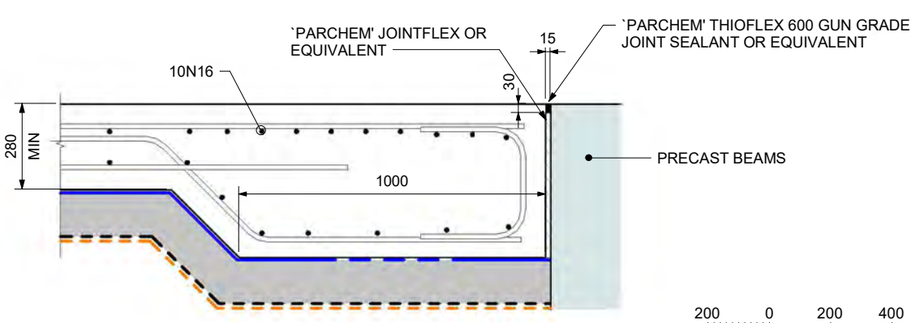


SECTION 7 (0300)
1 : 25 (A1)

BUNDED ENTRY DETAIL



SLAB JOINT



ISOLATION JOINT

PAVEMENT JOINT DETAILS
1 : 10(A1)

200 0 200 400 600 800 1000mm
1:10 (A1) 1:20 (A3)

AUSTRALIAN HEIGHT DATUM

D5 FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY	CHK	APP
C3	22.06.2022	GEOFABRIC AMENDED	SGB	MP	GWB
C2	29.11.2021	ISSUED FOR CONSTRN, CLOUDED	SGB	MP	GWB
C1	19.11.2021	ISSUED FOR CONSTRUCTION	SGB	MP	GWB
P02	25.06.2021	ISSUED FOR TENDER	SGB	MP	GWB
P01	21.05.2021	80% DESIGN FOR REVIEW	SGB	MP	

REVISIONS

CLIENT

NSW GOVERNMENT Transport for NSW

PROJECT

TWEED HEADS TRAVEL LIFT BOAT FACILITY

TITLE

CONCRETE HARDSTAND SECTIONS AND DETAILS

Royal HaskoningDHV
Enhancing Society Together
Level 15,
99 Mount Street
North Sydney NSW 2060, Australia
Tel +61 2 8854 5000
Email info@rhdhv.com
Website: www.royalhaskoningdhv.com

DRAWN	CHECKED	APPROVED
SGB	SHJ	GWB

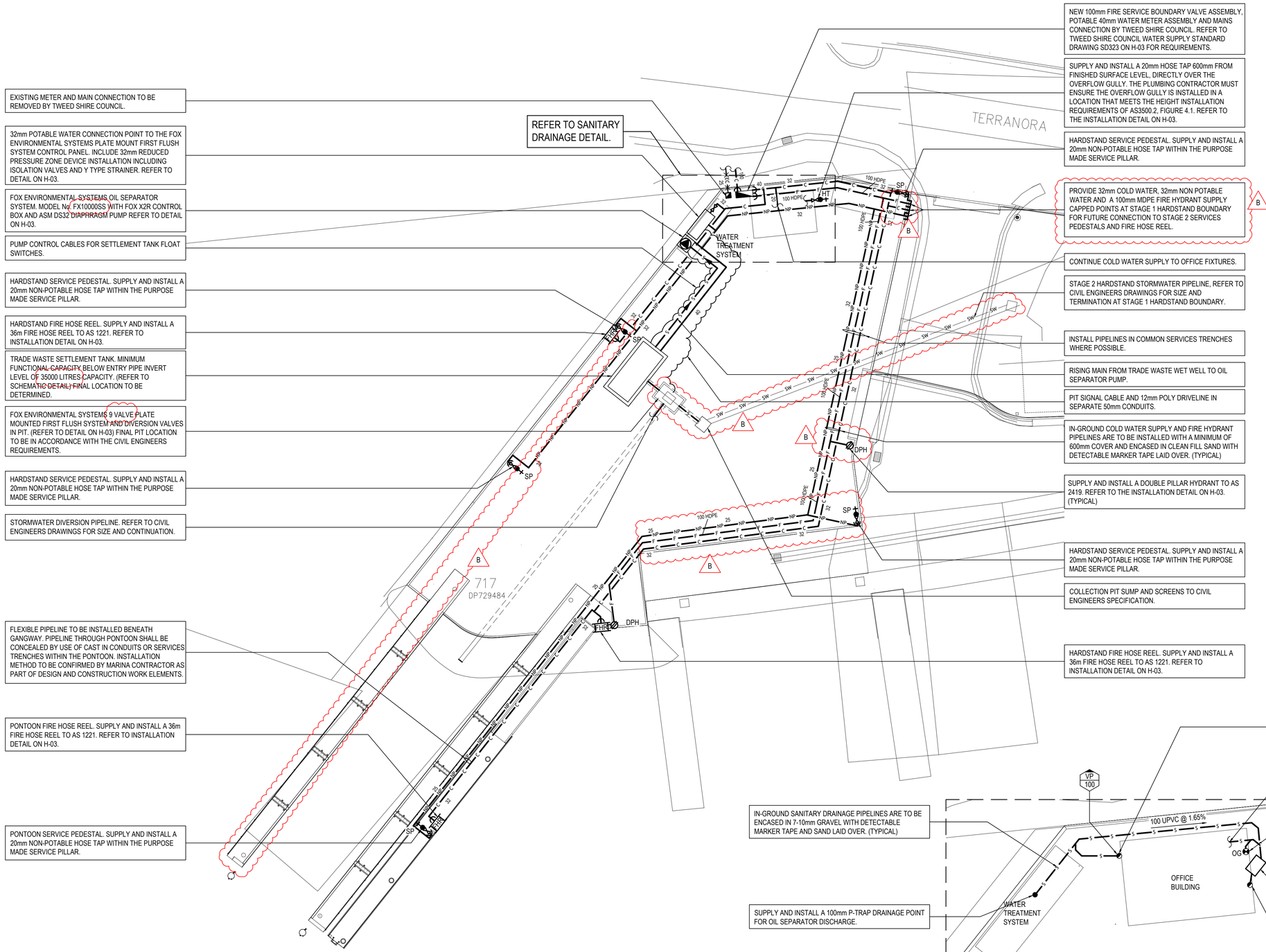
DATE	SCALE AT A1	REF.
29.11.2021	As indicated	

DRAWING No.	SUITABILITY	REVISION
PA2481-RHD-02-01-DR-W-0301	D5	C3

C:\Users\220000\Box\PA2481 Tweed Heads\PA2481 Tweed Heads Team\PA2481 Technical Data\E11 Working Drawings\PA2481-RHD-02-M3-W-0001[AFC].rvt

NOTE: THE ENTIRE PLUMBING INSTALLATION IS TO COMPLY WITH THE FULL REQUIREMENTS OF THE LOCAL REGULATORY AUTHORITY, A.S.3500 AND THE PLUMBING AND THE BUILDING CODES OF AUSTRALIA.

NOTE:
1. LIAISE WITH FOX ENVIRONMENTAL SYSTEMS AND TWEED HEADS COUNCIL TO ENSURE THE DESIGN AND DOCUMENTATION OF THE LIQUID TRADE WASTE SYSTEM IS IN ACCORDANCE WITH ALL LEGISLATIVE AND ENVIRONMENTAL REQUIREMENTS.
2. ALL PITS ARE TO BE SUITABLE FOR INSTALLATION IN THE MARINE ENVIRONMENT WITH POSSIBLE TIDAL INUNDATION.
3. ALL PITS ARE TO BE FITTED WITH RISERS AS NECESSARY AND LIDS APPROPRIATE FOR THE TRAFFIC LOADING.
4. INCLUDE SIGNAGE FOR ALL NON-POTABLE WATER HOSE TAPS STATING 'NON-POTABLE WATER - DO NOT DRINK' WITH APPROPRIATE SYMBOLS.
5. IN-GROUND WATER SUPPLY PIPELINES TO BE BLUELINE POLY OF APPROPRIATE INTERNAL DIAMETER.



SANITARY DRAINAGE DETAIL
SCALE 1:100

1:200 @A1

0M 10M 20M 30M

GENERAL NOTES:
1. THE DRAWING ISSUED IS DIAGRAMMATIC. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY. REFER TO ARCHITECTURAL DRAWINGS WHERE APPROPRIATE FOR EXACT LOCATION OF FIXTURES, DUCTS AND THE LIKE. THE DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DOCUMENTS FORMING THE PROJECT DOCUMENTATION PACKAGE.
2. CONFIRM ALL LEVELS AND DIMENSIONS AS ACCURATE ON SITE PRIOR TO INSTALLATION. REPORT ALL DISCREPANCIES TO THE SUPERINTENDENT IMMEDIATELY.
3. THIS DRAWING HAS BEEN ISSUED IN CONFIDENCE AND REMAINS THE PROPERTY OF MCCALLUM PLUMBING & FIRE CONSULTANTS AUSTRALIA. DISTRIBUTION OR REPRODUCTION OF THE WHOLE OR PART OF THIS DRAWING WITHOUT THE EXPRESS PERMISSION OF MCCALLUM PLUMBING & FIRE CONSULTANTS AUSTRALIA IS A BREACH OF THE COMMONWEALTH COPYRIGHT ACT.

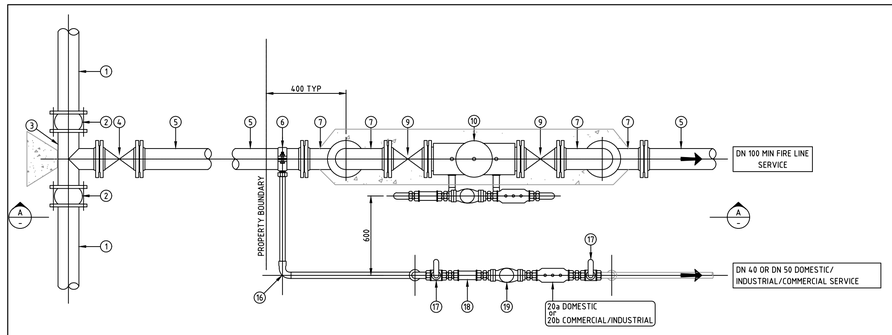
REV	DATE	AMENDMENT
B	03/12/21	REVISED FOR CONSTRUCTION
A	18/11/21	FOR CONSTRUCTION
6	12/11/21	REVISED FOR TENDER
5	24/06/21	REVISED FOR TENDER
4	21/06/21	FOR TENDER
3	13/05/21	REVISED 80% COMPLETION

CEILING LEVEL ABOVE
FLOOR LEVEL NOTED IN TITLE
PIPE
PIPEWORK LOCATION (U.N.O.)

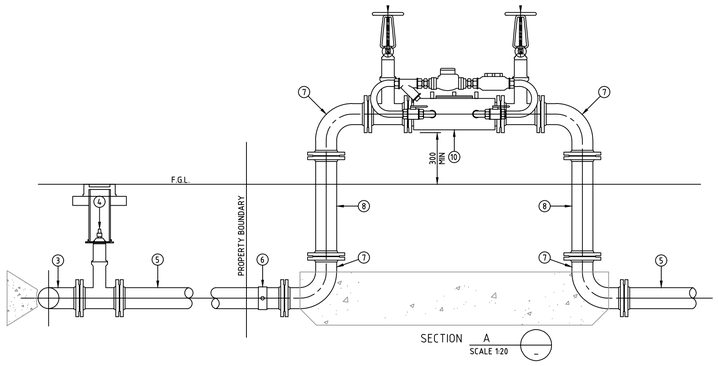
NSW GOVERNMENT Transport for NSW
Royal HaskoningDHV Enhancing Society Together

Ph: (02)49462633
McCALLUM PFCA
PLUMBING & FIRE CONSULTANTS AUSTRALIA
Email: mail@pfca.net.au
5/35 Smith Street Charlestown
ACN 098 124 620 ABN 58 098 124 620
ENGINEERS AUSTRALIA

ARCHITECT: ROYAL HASKONING DHV	Drawn M.PRIETO	FOR CONSTRUCTION			Size A1
CLIENT: NSW GOVERNMENT/TRANSPORT FOR NSW	Design R.McCALLUM	Scale 1:200	Job No. 4250-720A		No. in Set 3
PROJECT: TWEED HEADS TRAVEL LIFT BOAT FACILITY 8 TERRANORA TERRACE, TWEED HEADS SITE PLAN - HYDRAULIC SERVICES	Approved R.McCALLUM	DRG. No. H-02			Revision B



PLAN



SECTION A
SCALE 1:20

NOTES

1. ANY IRRIGATION TAKEN OFF THE DOMESTIC SERVICE SHALL REQUIRE AN ADDITIONAL BACKFLOW PREVENTION DEVICE TO BE INSTALLED AT TAKE OFF POINT
2. ALL PIPE FITTINGS TO COMPLY WITH TWEED SHIRE COUNCIL SUPPLY CONTRACT SPECIFICATION, REFER TO STANDARD DRAWING SD 322
3. CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING PIPE LENGTHS AND FITTINGS TO ENSURE CONSTRUCTABILITY PRIOR TO ORDERING PIPES AND FITTINGS
4. LOCKED CHAIN TO BE INSTALLED ON VALVES WITH TSC 55888 PADLOCK

FITTING SCHEDULE

ITEM	DESCRIPTION	No
1	EXISTING COUNCIL WATER MAIN	
2	MULTIFIT GIBAULT FBN COATED WITH S/S NUTS & BOLTS	2
3	DICL TEE SP/SP/FL	1
4	SLUICE VALVE FL/FL. RESILIENT SEATED, FBN COATED	1
5	DICL PIPE DN 100 MINIMUM	
6	TAPPING BAND, FBN COATED	1
7	DICL 90° BEND FL/FL	4
8	DICL PIPE PIECE FL/FL	2
9	RISING SPINDLE SLUICE VALVE FL/FL. RESILIENT SEATED, FBN COATED.	2
10	FIRELINE DOUBLE DETECTOR CHECK VALVE WITH 40mm METERED BYPASS (35Kpa 1st CHECK ASSEMBLY)	1
16	TYPE 'A' COPPER TUBE	1
17	BALL VALVE	1
18	'Y' STRAINER	1
19	WATER METER	1
20a	40mm OR 50mm DUAL CHECK VALVE FOR DOMESTIC SERVICE (LOW BACKFLOW HAZARD RATING)	1
20b	40mm OR 50mm DOUBLE CHECK VALVE FOR INDUSTRIAL/COMMERCIAL SERVICE. (LOW TO MEDIUM BACKFLOW HAZARD RATING)	1

TWEED SHIRE COUNCIL
DESIGN UNIT

COUNCIL OFFICES
TUMBULGUM ROAD,
MURWILLUMBAH,
NEW SOUTH WALES, 2484

PHONE MURWILLUMBAH 02 66702400
FAX MURWILLUMBAH 02 66727513
WEBSITE www.tweed.nsw.gov.au

0μm 10μm 20μm 30μm 40μm 50μm 100μm 150μm 200μm 250μm

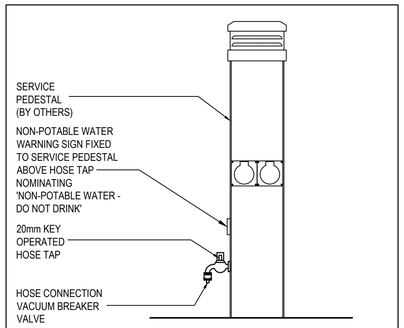
BY DATE MAY 2006
DATE MAY 2006
ENGINEERING & OPERATIONS DESIGN UNIT
AS SHOWN

PROJECT: WATER SUPPLY STANDARDS

PLAN TITLE: DN50 OR SMALLER PROPERTY SERVICE WITH DN100 OR LARGER FIRE SERVICE

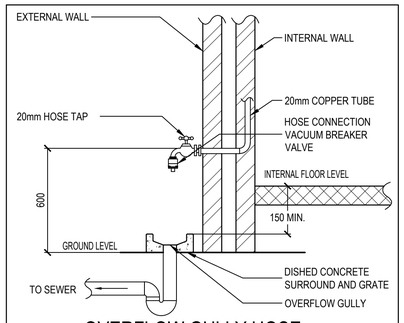
DRAWING NUMBER: SD 323

MAY 2006



SERVICE PEDESTAL

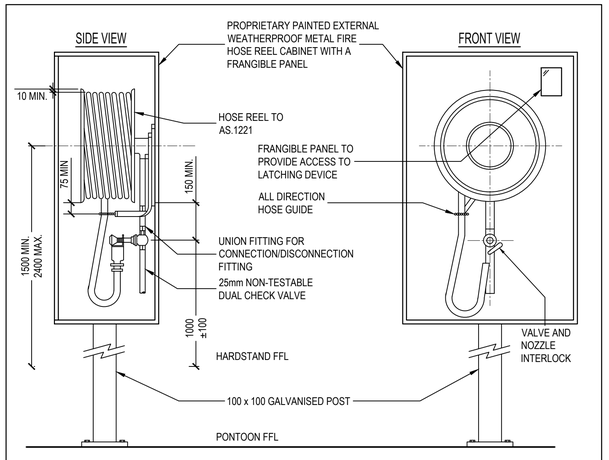
NOT TO SCALE



OVERFLOW GULLY HOSE TAP INSTALLATION

NOT TO SCALE

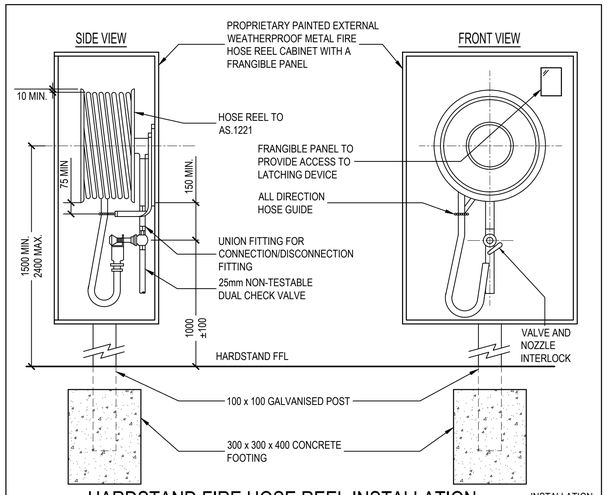
NOTE: THE ENTIRE PLUMBING INSTALLATION IS TO COMPLY WITH THE FULL REQUIREMENTS OF THE LOCAL REGULATORY AUTHORITY, A.S.3500 AND THE PLUMBING AND THE BUILDING CODES OF AUSTRALIA.



NOT TO SCALE

PONTOON FIRE HOSE REEL INSTALLATION

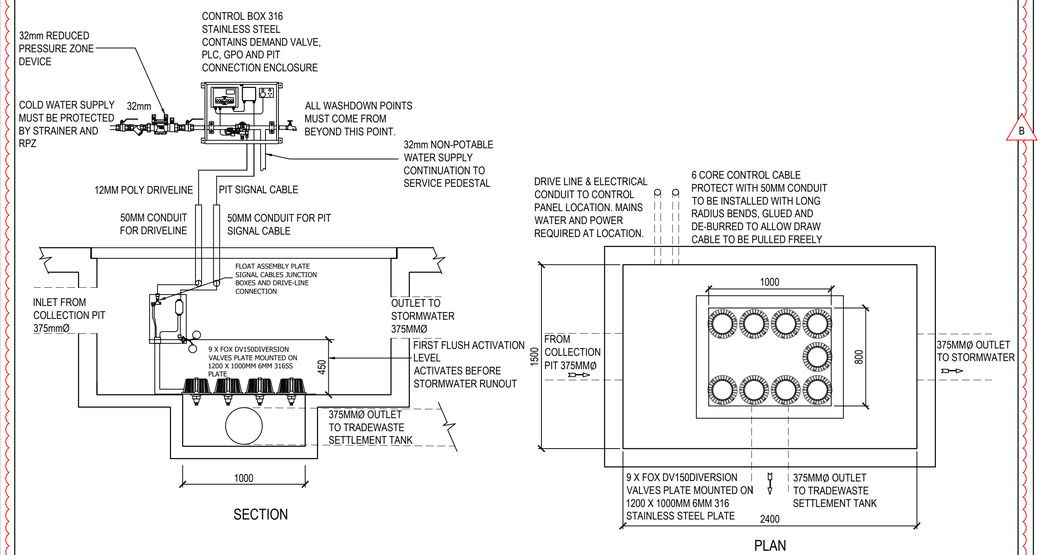
INSTALLATION TO AS 2441



NOT TO SCALE

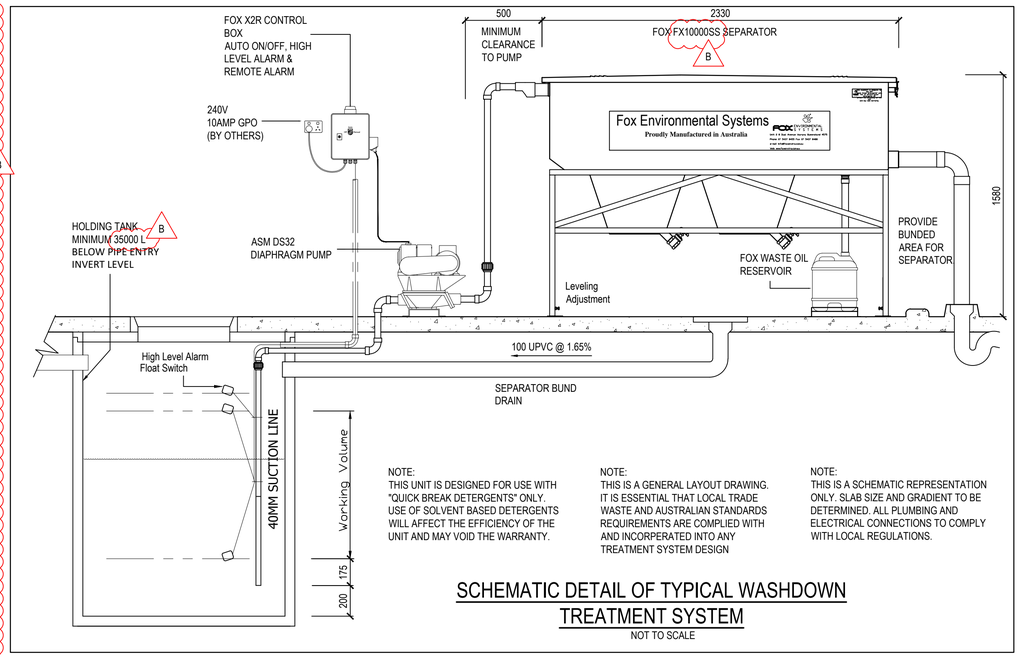
HARDSTAND FIRE HOSE REEL INSTALLATION

INSTALLATION TO AS 2441



SCHEMATIC DETAIL OF 6 VALVE PLATE MOUNTED FIRST FLUSH SYSTEM

NOT TO SCALE



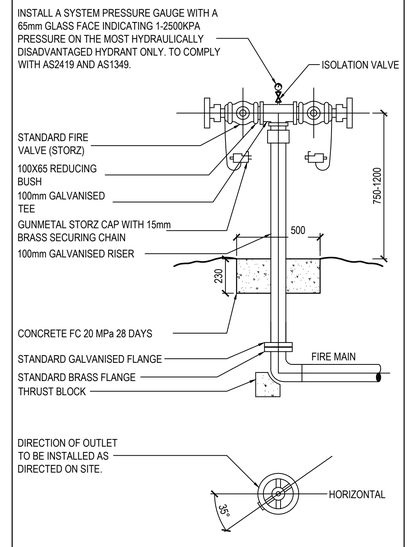
NOTE:
THIS UNIT IS DESIGNED FOR USE WITH "QUICK BREAK DETERGENTS" ONLY. USE OF SOLVENT BASED DETERGENTS WILL AFFECT THE EFFICIENCY OF THE UNIT AND MAY VOID THE WARRANTY.

NOTE:
THIS IS A GENERAL LAYOUT DRAWING. IT IS ESSENTIAL THAT LOCAL TRADE WASTE AND AUSTRALIAN STANDARDS REQUIREMENTS ARE COMPLIED WITH AND INCORPERATED INTO ANY TREATMENT SYSTEM DESIGN

NOTE:
THIS IS A SCHEMATIC REPRESENTATION ONLY. SLAB SIZE AND GRADIENT TO BE DETERMINED. ALL PLUMBING AND ELECTRICAL CONNECTIONS TO COMPLY WITH LOCAL REGULATIONS.

SCHEMATIC DETAIL OF TYPICAL WASHDOWN TREATMENT SYSTEM

NOT TO SCALE



DOUBLE PILLAR HYDRANT DETAIL

NOT TO SCALE

GENERAL NOTES:
1. THE DRAWING ISSUED IS DIAGRAMMATIC. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY. REFER TO ARCHITECTURAL DRAWINGS WHERE APPROPRIATE FOR EXACT LOCATION OF FIXTURES, DUCTS AND THE LIKE. THE DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DOCUMENTS FORMING THE PROJECT DOCUMENTATION PACKAGE.
2. CONFIRM ALL LEVELS AND DIMENSIONS AS ACCURATE ON SITE PRIOR TO INSTALLATION. REPORT ALL DISCREPANCIES TO THE SUPERINTENDENT IMMEDIATELY.
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REV	DATE	AMENDMENT
B	03/12/21	REVISED FOR CONSTRUCTION
A	18/11/21	FOR CONSTRUCTION
4	12/11/21	REVISED FOR TENDER
3	24/06/21	FOR TENDER
2	13/05/21	REVISED 80% COMPLETION
1	07/05/21	80% COMPLETION

NSW GOVERNMENT Transport for NSW

Royal HaskoningDHV
Enhancing Society Together

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ENGINEERS AUSTRALIA

ARCHITECT: ROYAL HASKONING DHV

CLIENT: NSW GOVERNMENT/TRANSPORT FOR NSW

PROJECT: TWEED HEADS TRAVEL LIFT BOAT FACILITY
8 TERRANORA TERRACE, TWEED HEADS
DETAIL SHEET

Drawn: M.PRIETO
Design: R.McCALLUM
Approved: R.McCALLUM

FOR CONSTRUCTION

Scale: N.T.S.
Job No.: 4250-720A
DRG. No.: H-03

Size: A1
No. in Set: 3
Revision: B

Appendix C: JKE PSI and DSI Summary Data Tables and Logs

Soil Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZG	Australian and New Zealand Guidelines
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
GSW:	General Solid Waste
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
kg/L	kilograms per litre
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
%w/w:	weight per weight
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} :	pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} :	pH of filtered 1:20 1M KCl after peroxide digestion
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
RSW:	Restricted Solid Waste
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
S_{Cr}:	Chromium reducible sulfur
S_{POS}:	Peroxide oxidisable Sulfur
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
UCL:	Upper Level Confidence Limit on Mean Value
USEPA	United States Environmental Protection Agency
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).

EIL/ESL Table:

Site specific ABC values for specific metals have been adopted.

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

JKEnvironments

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-D: 'Commercial/Industrial'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			3000	900	3600	240000	1500	730	6000	400000	4000	40	80	2000	2500	45	530	3600	50	2000	7	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH101	0.03-0.4	Fill: Gravelly Sand	<4	<0.4	**5**	**19**	**4**	<0.1	**2**	**5**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	<4	<0.4	**5**	**17**	**4**	<0.1	**2**	**6**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH101	0.5-0.95	Sand	<4	<0.4	**1**	**3**	**3**	<0.1	**<1**	**7**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA
BH102	0.16-0.2	Fill: Silty Sand	**5**	<0.4	**8**	**300**	**100**	**0.8**	**7**	**400**	**0.5**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	Not Detected
BH102	0.5-0.9	Sand	<4	<0.4	**1**	**24**	**3**	**0.1**	**<1**	**37**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA
BH103	0.21-0.4	Fill: Silty Sand	**4**	<0.4	**13**	**440**	**130**	**1.2**	**15**	**680**	**1.1**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.5**	Not Detected
BH103	0.7-0.95	Sand	**10**	<0.4	**11**	**38**	**90**	<0.1	**3**	**83**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA
BH104	0-0.05	Fill: Silty Gravelly Sand	**9**	**2**	**67**	**34000**	**200**	**1**	**79**	**16000**	**10**	**1**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	**2.2**	Detected
BH104	0.5-0.7	Silty Sand	<4	<0.4	**4**	**360**	**55**	**0.9**	**2**	**470**	**1.8**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	**1.6**	NA
BH105	0-0.1	Fill: Silty Sand	**11**	**1**	**35**	**3300**	**330**	**10**	**20**	**3200**	**12**	**1.7**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	**7.2**	Not Detected
BH105	0.4-0.6	Sand	**12**	<0.4	**4**	**1000**	**80**	**14**	**2**	**300**	**1.3**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	**1.2**	NA
BH105 - Lab duplicate	0.4-0.6	Sand	**8**	<0.4	**3**	**450**	**31**	**9.1**	**2**	**200**	**0.3**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	**1.6**	NA
BH105 - Lab triplicate	0.4-0.6	Sand	**4**	<0.4	**3**	**330**	**23**	**4.7**	**1**	**150**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0-0.1	Fill: Silty Sand	**6**	**0.5**	**19**	**1900**	**180**	**2.5**	**9**	**1600**	**15**	**1.7**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	**1.3**	Not Detected
SDUP103	0.03-0.4	Fill: Gravelly Sand	**5**	<0.4	**12**	**23**	**5**	<0.1	**3**	**6**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
SDUP102	0-0.05	Fill: Silty Gravelly Sand	**10**	**2**	**84**	**47000**	**280**	**0.3**	**54**	**28000**	**6.6**	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
FCF1-Surface	Surface	FCF	NA	NA	**NA**	**NA**	**NA**	NA	**NA**	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
Total Number of Samples			16	16	16	16	16	16	16	16	15	15	9	9	9	9	9	9	9	9	15	7
Maximum Value			12	2	84	47000	330	14	79	28000	15	1.7	<PQL	<PQL	<PQL	<PQL	<PQL	0.2	<PQL	<PQL	7.2	Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S1.1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-D: 'Commercial/Industrial'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	100
Site Assessment Criteria (SAC)			3000	900	3600	240000	1500	730	6000	400000	4000	40	7	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**												
BH201	0-0.1	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	Not Detected
BH202	0.25-0.45	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	Not Detected
BH203	0.18-0.3	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	Not Detected
BH204	0.2-0.4	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	Not Detected
BH205	0.15-0.3	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	Not Detected
BH206	0.2-0.4	Fill: silty sand	8	<0.4	14	330	110	1.1	10	310	2.1	<0.5	0.6	Not Detected
BH206	0.6-0.8	Sand	<4	<0.4	1	7	4	<0.1	<1	8	<0.05	<0.5	NA	NA
BH207	0.25-0.35	Fill: silty sandy gravel	<4	<0.4	3	27	4	<0.1	3	37	<0.05	<0.5	<0.1	NA
SDUPBB	0.2-0.4	Fill: silty sand	<4	<0.4	25	200	83	0.7	16	230	2	<0.5	<0.1	NA
SDUPAB	0-0.1	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA
SDUPCB	0.25-0.35	Fill: silty sandy gravel	<4	<0.4	11	34	6	<0.1	9	82	<0.05	<0.5	NA	NA
SS1	0-0.05	Fill: silty sandy gravel	15	<0.4	43	5000	270	1.3	23	2000	NA	NA	0.5	NA
SS1 (lab replica	0-0.05	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5	NA
SS2	0-0.05	Fill: silty sandy gravel	7	0.6	56	16000	170	1.1	38	6200	NA	NA	0.5	NA
SS3	0-0.05	Fill: silty sandy gravel	8	<0.4	13	240	31	0.5	9	220	NA	NA	<0.1	NA
Total Number of Samples			8	8	8	8	8	8	8	8	5	5	13	6
Maximum Value			15	0.6	56	16000	270	1.3	38	6200	2.1	<PQL	0.6	Not Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					HSL-D: COMMERCIAL/INDUSTRIAL							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH101	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH101	0.5-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH102	0.16-0.2	Fill: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH102	0.5-0.9	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH103	0.21-0.4	Fill: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH103	0.7-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH104	0-0.05	Fill: Silty Gravelly Sand	0m to <1m	Sand	<25	**160**	<0.2	<0.5	<1	<3	<1	0
BH104	0.5-0.7	Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.6
BH105	0-0.1	Fill: Silty Sand	0m to <1m	Sand	<25	**52**	<0.2	<0.5	<1	<3	<1	1.6
BH105	0.4-0.6	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.2
BH105 - Lab duplicate	0.4-0.6	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH106	0-0.1	Fill: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
SDUP103	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	NA
SDUP102	0-0.05	Fill: Silty Gravelly Sand	0m to <1m	Sand	<25	<500	<0.2	<0.5	**2**	**8**	<1	NA
Total Number of Samples					15	15	15	15	15	15	15	13
Maximum Value					<PQL	160	<PQL	<PQL	2	8	<PQL	1.6

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH101	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH101	0.5-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH102	0.16-0.2	Fill: Silty Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH102	0.5-0.9	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH103	0.21-0.4	Fill: Silty Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH103	0.7-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH104	0-0.05	Fill: Silty Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH104	0.5-0.7	Silty Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH105	0-0.1	Fill: Silty Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH105	0.4-0.6	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH105 - Lab duplicate	0.4-0.6	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH106	0-0.1	Fill: Silty Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUP103	0.03-0.4	Fill: Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUP102	0-0.05	Fill: Silty Gravelly Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL

TABLE S2.1

SOIL LABORATORY RESULTS COMPARED TO HSLs

All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					**HSL-D: COMMERCIAL/INDUSTRIAL**							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH206	0.2-0.4	Fill: silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
BH206	0.6-0.8	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
BH207	0.25-0.35	Fill: silty sandy gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
SDUPBB	0.2-0.4	Fill: silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
SDUPCB	0.25-0.35	Fill: silty sandy gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
Total Number of Samples					5	5	5	5	5	5	5	0
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the SAC **VALUE**

Concentration above the PQL **Bold**

The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH206	0.2-0.4	Fill: silty sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH206	0.6-0.2	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH207	0.25-0.35	Fill: silty sandy gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUPBB	0.2-0.4	Fill: silty sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUPCB	0.25-0.35	Fill: silty sandy gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**COMMERCIAL/INDUSTRIAL**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH101	0.03-0.4	Coarse	<25	<50	<100	<100
BH101 - Lab duplicate	0.03-0.4	Coarse	<25	<50	<100	<100
BH101	0.5-0.95	Coarse	<25	<50	<100	<100
BH102	0.16-0.2	Coarse	<25	<50	160	<100
BH102	0.5-0.9	Coarse	<25	<50	<100	<100
BH103	0.21-0.4	Coarse	<25	<50	130	<100
BH103	0.7-0.95	Coarse	<25	<50	<100	<100
BH104	0-0.05	Coarse	<25	160	2800	890
BH104	0.5-0.7	Coarse	<25	<50	<100	<100
BH105	0-0.1	Coarse	<25	52	660	170
BH105	0.4-0.6	Coarse	<25	<50	<100	<100
BH105 - Lab duplicate	0.4-0.6	Coarse	<25	<50	<100	<100
BH106	0-0.1	Coarse	<25	<50	280	110
SDUP103	0.03-0.4	Coarse	<25	<50	<100	<100
SDUP102	0-0.05	Coarse	<25	<500	2100	<1000
Total Number of Samples			14	14	14	14
Maximum Value			<PQL	160	2800	890

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH101	0.03-0.4	Coarse	700	1000	3500	10000
BH101 - Lab duplicate	0.03-0.4	Coarse	700	1000	3500	10000
BH101	0.5-0.95	Coarse	700	1000	3500	10000
BH102	0.16-0.2	Coarse	700	1000	3500	10000
BH102	0.5-0.9	Coarse	700	1000	3500	10000
BH103	0.21-0.4	Coarse	700	1000	3500	10000
BH103	0.7-0.95	Coarse	700	1000	3500	10000
BH104	0-0.05	Coarse	700	1000	3500	10000
BH104	0.5-0.7	Coarse	700	1000	3500	10000
BH105	0-0.1	Coarse	700	1000	3500	10000
BH105	0.4-0.6	Coarse	700	1000	3500	10000
BH105 - Lab duplicate	0.4-0.6	Coarse	700	1000	3500	10000
BH106	0-0.1	Coarse	700	1000	3500	10000
SDUP103	0.03-0.4	Coarse	700	1000	3500	10000
SDUP102	0-0.05	Coarse	700	1000	3500	10000

TABLE S3.1
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**COMMERCIAL/INDUSTRIAL**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH206	0.2-0.4	Coarse	<25	<50	<100	<100
BH206	0.6-0.8	Coarse	<25	<50	<100	<100
BH207	0.25-0.35	Coarse	<25	<50	<100	<100
SDUPBB	0.2-0.4	Coarse	<25	<50	**120**	<100
SDUPCB	0.25-0.35	Coarse	<25	<50	<100	<100
Total Number of Samples			5	5	5	5
Maximum Value			<PQL	<PQL	120	<PQL

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH206	0.2-0.4	Coarse	700	1000	3500	10000
BH206	0.6-0.2	Coarse	700	1000	3500	10000
BH207	0.25-0.35	Coarse	700	1000	3500	10000
SDUPBB	0.2-0.4	Coarse	700	1000	3500	10000
SDUPCB	0.25-0.35	Coarse	700	1000	3500	10000

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		26,000	20,000	27,000	38,000	430	99,000	27,000	81,000	11,000	
Site Use		**COMMERCIAL/INDUSTRIAL - DIRECT SOIL CONTACT**									
Sample Reference	**Sample Depth**										
BH101	0.03-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH101 - Lab duplicate	0.03-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH101	0.5-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH102	0.16-0.2	<25	<50	160	<100	<0.2	<0.5	<1	<3	<1	0
BH102	0.5-0.9	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH103	0.21-0.4	<25	<50	130	<100	<0.2	<0.5	<1	<3	<1	0
BH103	0.7-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH104	0-0.05	<25	160	2800	890	<0.2	<0.5	<1	<3	<1	0
BH104	0.5-0.7	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0.6
BH105	0-0.1	<25	52	660	170	<0.2	<0.5	<1	<3	<1	1.6
BH105	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0.2
BH105 - Lab duplicate	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH106	0-0.1	<25	<50	280	110	<0.2	<0.5	<1	<3	<1	0
SDUP103	0.03-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	NA
SDUP102	0-0.05	<25	<500	2100	<1000	<0.2	<0.5	2	8	<1	NA
Total Number of Samples		14	14	14	14	14	14	14	14	14	13
Maximum Value		<PQL	160	2800	890	<PQL	<PQL	<PQL	<PQL	<PQL	1.6

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S4.1
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1
CRC 2011 -Direct contact Criteria		26,000	20,000	27,000	38,000	430	99,000	27,000	81,000	11,000
Site Use		**COMMERCIAL/INDUSTRIAL - DIRECT SOIL CONTACT**								
Sample Reference	**Sample Depth**									
BH206	0.2-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1
BH206	0.6-0.8	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1
BH207	0.25-0.35	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1
SDUPBB	0.2-0.4	<25	<50	**120**	<100	<0.2	<0.5	<1	<1	<1
SDUPCB	0.25-0.35	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1
Total Number of Samples		5	5	5	5	5	5	5	5	5
Maximum Value		<PQL	<PQL	120	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HIL-D:Commercial/Industrial

FIELD DATA															LABORATORY DATA											
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.05**			**0.001**			**0.001**											**0.05**	**0.001**
16/12/2021	BH101	0.03-0.4	No	10	4,500	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH101	0.03-0.4	1153.82	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
16/12/2021	BH102	0.16-0.2	No	10	4,000	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH102	0.16-0.2	892.18	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
16/12/2021	BH103	0.21-0.7	No	10	6,050	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH103	0.21-0.4	1069.1	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
16/12/2021	BH104	0-0.05	No	10	17,500	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH104	0-0.05	905.91	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	Chrysotile	–	0.0028	<0.01	<0.001
16/12/2021	BH105	0-0.1	No	10	14,500	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH105	0-0.1	1015.92	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
16/12/2021	BH105	0.1-0.4	NA	10	11,950	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	285812	BH106	0-0.1	988.78	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
16/12/2021	BH106	0-0.1	No	10	10,950	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16/12/2021	BH106	0.1-0.5	NA	10	10,300	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concentration above the SAC **VALUE**

TABLE S5.1
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HIL-D:Commercial/Industrial

FIELD DATA															LABORATORY DATA										
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.05**			**0.001**			**0.001**											**0.05**	**0.001**
3/05/2022	BH201	0-0.1	No	10	13,130	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294745	BH201	0-0.1	1143	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
4/05/2022	BH202	0.25-0.45	No	<10	631	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294745	BH202	0.25-0.45	1176	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
3/05/2022	BH203	0.18-0.3	No	10	445	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294745	BH203	0.18-0.3	1319	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
4/05/2022	BH204	0.2-0.4	No	10	595	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	294745	BH204	0.2-0.4	1294	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
6/05/2022	BH205	0.15-0.3	No	10	623	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	295001	BH205	0.15-0.3	1190	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
6/05/2022	BH206	0.2-0.4	No	10	670	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	295001	BH206	0.2-0.4	1049	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001

Concentration above the SAC **VALUE**

TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				**COMMERCIAL/INDUSTRIAL**																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH101	0.03-0.4	Fill: Gravelly Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**5**	**19**	**4**	**2**	**5**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**5**	**17**	**4**	**2**	**6**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH101	0.5-0.95	Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**1**	**3**	**3**	<1	**7**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH102	0.16-0.2	Fill: Silty Sand	Coarse	**7.9**	**10.3**	**8.6**	**5**	**8**	**300**	**100**	**7**	**400**	<1	<0.1	<25	<50	**160**	<100	<0.2	<0.5	<1	<3	**0.1**
BH102	0.5-0.9	Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**1**	**24**	**3**	<1	**37**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH103	0.21-0.4	Fill: Silty Sand	Coarse	**7.9**	**10.3**	**8.6**	**4**	**13**	**440**	**130**	**15**	**680**	<1	<0.1	<25	<50	**130**	<100	<0.2	<0.5	<1	<3	**0.1**
BH103	0.7-0.95	Sand	Coarse	**7.9**	**10.3**	**8.6**	**10**	**11**	**38**	**90**	**3**	**83**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH104	0-0.05	Fill: Silty Gravelly Sand	Coarse	**7.9**	**10.3**	**8.6**	**9**	**67**	**34000**	**200**	**79**	**16000**	<1	<0.1	<25	**160**	**2800**	**890**	<0.2	<0.5	<1	<3	**0.56**
BH104	0.5-0.7	Silty Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**4**	**360**	**55**	**2**	**470**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.2**
BH105	0-0.1	Fill: Silty Sand	Coarse	**7.9**	**10.3**	**8.6**	**11**	**35**	**3300**	**330**	**20**	**3200**	<1	<0.1	<25	**52**	**660**	**170**	<0.2	<0.5	<1	<3	**1.1**
BH105	0.4-0.6	Sand	Coarse	**7.9**	**10.3**	**8.6**	**12**	**4**	**1000**	**80**	**2**	**300**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
BH105 - Lab duplicate	0.4-0.6	Sand	Coarse	**7.9**	**10.3**	**8.6**	**8**	**3**	**450**	**31**	**2**	**200**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
BH105 - Lab triplicate	0.4-0.6	Sand	Coarse	**7.9**	**10.3**	**8.6**	**4**	**3**	**330**	**23**	**1**	**150**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0-0.1	Fill: Silty Sand	Coarse	**7.9**	**10.3**	**8.6**	**6**	**19**	**1900**	**180**	**9**	**1600**	<1	**0.1**	<25	<50	**280**	**110**	<0.2	<0.5	<1	<3	**1.1**
SDUP103	0.03-0.4	Fill: Gravelly Sand	Coarse	**7.9**	**10.3**	**8.6**	**5**	**12**	**23**	**5**	**3**	**6**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
SDUP102	0-0.05	Fill: Silty Gravelly Sand	Coarse	**7.9**	**10.3**	**8.6**	**10**	**84**	**47000**	**280**	**54**	**28000**	<1	<0.1	<25	<500	**2100**	<1000	<0.2	<0.5	**2**	**8**	<0.5
Total Number of Samples				16	16	16	16	16	16	16	16	16	15	9	15	15	15	15	15	15	15	15	15
Maximum Value				7.9	10.3	8.6	12	84	47000	330	79	28000	<PQL	0.1	<PQL	160	2800	890	<PQL	<PQL	2	8	1.1

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH101	0.03-0.4	Fill: Gravelly Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH101	0.5-0.95	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH102	0.16-0.2	Fill: Silty Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH102	0.5-0.9	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH103	0.21-0.4	Fill: Silty Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH103	0.7-0.95	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH104	0-0.05	Fill: Silty Gravelly Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH104	0.5-0.7	Silty Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH105	0-0.1	Fill: Silty Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
BH105	0.4-0.6	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH105 - Lab duplicate	0.4-0.6	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	--	215	170	1700	3300	75	135	165	180	1.4
BH105 - Lab triplicate	0.4-0.6	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	--	--	--	--	--	--	--	--	--	--	--
BH106	0-0.1	Fill: Silty Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
SDUP103	0.03-0.4	Fill: Gravelly Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4
SDUP102	0-0.05	Fill: Silty Gravelly Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	640	215	170	1700	3300	75	135	165	180	1.4

TABLE S6.1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				COMMERCIAL/INDUSTRIAL																	
							AGED HEAVY METALS-EILs						EILs	ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																			
BH206	0.2-0.4	Fill: silty sand	Coarse	**7.9**	**10.3**	**8.6**	**8**	**14**	**330**	**110**	**10**	**310**	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.2**
BH206	0.6-0.8	Sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**1**	**7**	**4**	<1	**8**	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH207	0.25-0.35	Fill: silty sandy gravel	Coarse	**7.9**	**10.3**	**8.6**	<4	**3**	**27**	**4**	**3**	**37**	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
SDUPBB	0.2-0.4	Fill: silty sand	Coarse	**7.9**	**10.3**	**8.6**	<4	**25**	**200**	**83**	**16**	**230**	<1	<25	<50	**120**	<100	<0.2	<0.5	<1	<1	**0.2**
SDUPCB	0.25-0.35	Fill: silty sandy gravel	Coarse	**7.9**	**10.3**	**8.6**	<4	**11**	**34**	**6**	**9**	**82**	<1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
SS1	0-0.05	Fill: silty sandy gravel	Coarse	**7.9**	**10.3**	**8.6**	**15**	**43**	**5000**	**270**	**23**	**2000**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS2	0-0.05	Fill: silty sandy gravel	Coarse	**7.9**	**10.3**	**8.6**	**7**	**56**	**16000**	**170**	**38**	**6200**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS3	0-0.05	Fill: silty sandy gravel	Coarse	**7.9**	**10.3**	**8.6**	**8**	**13**	**240**	**31**	**9**	**220**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples				8	8	8	8	8	8	8	8	8	5	5	5	5	5	5	5	5	5	5
Maximum Value				7.9	10.3	8.6	15	56	16000	270	38	6200	<PQL	<PQL	<PQL	120	<PQL	<PQL	<PQL	<PQL	<PQL	0.2

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH206	0.2-0.4	Fill: silty sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	215	170	1700	3300	75	135	165	180	1.4
BH206	0.6-0.2	Sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	215	170	1700	3300	75	135	165	180	1.4
BH207	0.25-0.35	Fill: silty sandy gravel	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	215	170	1700	3300	75	135	165	180	1.4
SDUPBB	0.2-0.4	Fill: silty sand	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	215	170	1700	3300	75	135	165	180	1.4
SDUPCB	0.25-0.35	Fill: silty sandy gravel	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	370	215	170	1700	3300	75	135	165	180	1.4
SS1	0-0.05	Fill: silty sandy gravel	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	--	--	--	--	--	--	--	--	--	--
SS2	0-0.05	Fill: silty sandy gravel	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	--	--	--	--	--	--	--	--	--	--
SS3	0-0.05	Fill: silty sandy gravel	Coarse	7.9	10.3	8.6	160	670	330	2000	460	1200	--	--	--	--	--	--	--	--	--	--

TABLE S7
SOIL LABORATORY TBT AND TOC RESULTS
All data in µg/kg unless stated otherwise

			Monbutylin (as Sn)	Dibutyltin (as Sn)	TBT (as Sn)	TOC (mg/kg)	TOC (%)	TBT (Normalised to 1% TOC)
PQL - Envirolab Services			Various	Various	0.5	100	NA	NA
Sediment Quality Guideline (DGV - Low)			NSL	NSL	NSL	NSL	NSL	9
Sediment Quality Guideline (GV - High)			NSL	NSL	NSL	NSL	NSL	70
Sample Reference	**Sample Depth**	**Sample Description**						
BH101	0.03-0.4	Fill: Gravelly Sand	<1.0	<1.0	<0.5	700	0.07	NA
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	NA	NA	NA	800	0.08	NA
BH101	0.5-0.95	Sand	<1.7	<0.8	<0.5	500	0.05	NA
BH102	0.16-0.2	Fill: Silty Sand	260	800	1800	6300	0.63	**2857**
BH102	0.5-0.9	Sand	6.6	5.1	<0.8	1600	0.16	NA
BH103	0.21-0.4	Fill: Silty Sand	280	200	23	5200	0.52	**44**
BH103	0.7-0.95	Sand	<4	<2.3	<2.2	2800	0.28	NA
BH104	0-0.05	Fill: Silty Gravelly Sand	6500	4800	3500	13000	1.3	**2692**
BH104	0.5-0.7	Silty Sand	1100	1200	840	2800	0.28	**3000**
BH105	0-0.1	Fill Silty Sand	4900	7900	4600	7700	0.77	**5974**
BH105	0.4-0.6	Sand	410	580	420	1900	0.19	**2211**
BH105 - Lab duplicate	0.4-0.6	Sand	420	600	430	1900^	0.19	**2263**
BH106	0-0.1	Fill: Silty Sand	4000	1800	1300	8900	0.89	**1461**
BH106 - Lab duplicate	0-0.1	Fill: Silty Sand	NA	NA	NA	8200	0.82	NA
SDUP103	0.03-0.4	Fill: Gravelly Sand	<2.3	<0.5	<0.5	700^	0.07	NA
SDUP102	0-0.05	Fill: Silty Gravelly Sand	3000	1500	1200	13000^	1.3	**923**
Total Number of samples			14	14	14	13	13	9
Maximum Value			6500	7900	4600	13000	1.3	5974

NOTES:
^ Primary sample TOC value

Concentration above the ecological SAC **VALUE**

TABLE S7.1
SOIL LABORATORY TBT AND TOC RESULTS
All data in µg/kg unless stated otherwise

			Monbutylin (as Sn)	Dibutyltin (as Sn)	TBT (as Sn)	TOC (mg/kg)	TOC (%)	TBT (Normalised to 1% TOC)
PQL - Envirolab Services			Various	Various	0.5	100	NA	NA
Sediment Quality Guideline (DGV - Low)			NSL	NSL	NSL	NSL	NSL	9
Sediment Quality Guideline (GV - High)			NSL	NSL	NSL	NSL	NSL	70
Sample Reference	**Sample Depth**	**Sample Description**						
SS1	0-0.05	Fill: silty sandy gravel	5400	1200	780	16000	1.6	**487**
SS2	0-0.05	Fill: silty sandy gravel	4700	1000	550	23000	2.3	**239**
SS3	0-0.05	Fill: silty sandy gravel	170	56	36	23000	2.3	**16**
Total Number of samples			14	14	14	13	13	9
Maximum Value			5400	1200	780	23000	2.3	487

Concentration above the ecological SAC **VALUE**

TABLE S8
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH101	0.03-0.4	Fill: Gravelly Sand	<4	<0.4	**5**	**19**	**4**	<0.1	**2**	**5**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	<4	<0.4	**5**	**17**	**4**	<0.1	**2**	**6**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH101	0.5-0.95	Sand	<4	<0.4	**1**	**3**	**3**	<0.1	**<1**	**7**	<0.05	<0.05	NA	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH102	0.16-0.2	Fill: Silty Sand	**5**	<0.4	**8**	**300**	**100**	**0.8**	**7**	**400**	**0.5**	**0.1**	<0.1	<0.1	<0.1	<0.1	**0.2**	<25	<50	<100	**140**	**140**	<0.2	<0.5	<1	<3	Not Detected
BH102	0.5-0.9	Sand	<4	<0.4	**1**	**24**	**3**	**0.1**	**<1**	**37**	<0.05	<0.05	NA	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH103	0.21-0.4	Fill: Silty Sand	**4**	<0.4	**13**	**440**	**130**	**1.2**	**15**	**680**	**1.1**	**0.1**	<0.1	<0.1	<0.1	<0.1	**0.5**	<25	<50	<100	**110**	**110**	<0.2	<0.5	<1	<3	Not Detected
BH103	0.7-0.95	Sand	**10**	<0.4	**11**	**38**	**90**	<0.1	**3**	**83**	<0.05	<0.05	NA	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH104	0-0.05	Fill: Silty Gravelly Sand	**9**	**2**	**67**	**34000**	**200**	**1**	**79**	**16000**	**10**	**0.56**	<0.1	<0.1	<0.1	**0.1**	**2.2**	<25	**170**	**1800**	**1400**	**3370**	<0.2	<0.5	<1	<3	Detected
BH104	0.5-0.7	Silty Sand	<4	<0.4	**4**	**360**	**55**	**0.9**	**2**	**470**	**1.8**	**0.2**	NA	NA	NA	NA	**1.6**	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH105	0-0.1	Fill: Silty Sand	**11**	**1**	**35**	**3300**	**330**	**10**	**20**	**3200**	**12**	**1.1**	<0.1	<0.1	<0.1	**0.1**	**7.2**	<25	<50	**430**	**340**	**770**	<0.2	<0.5	<1	<3	Not Detected
BH105	0.4-0.6	Sand	**12**	<0.4	**4**	**1000**	**80**	**14**	**2**	**300**	**1.3**	**0.1**	NA	NA	NA	NA	**1.2**	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH105 - Lab duplicate	0.4-0.6	Sand	**8**	<0.4	**3**	**450**	**31**	**9.1**	**2**	**200**	**0.3**	**0.1**	NA	NA	NA	NA	**1.6**	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH105 - Lab triplicate	0.4-0.6	Sand	**4**	<0.4	**3**	**330**	**23**	**4.7**	**1**	**150**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0-0.1	Fill: Silty Sand	**6**	**0.5**	**19**	**1900**	**180**	**2.5**	**9**	**1600**	**15**	**1.1**	<0.1	<0.1	<0.1	**0.2**	**1.3**	<25	<50	**150**	**190**	**340**	<0.2	<0.5	<1	<3	Not Detected
SDUP103	0.03-0.4	Fill: Gravelly Sand	**5**	<0.4	**12**	**23**	**5**	<0.1	**3**	**6**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
SDUP102	0-0.05	Fill: Silty Gravelly Sand	**10**	**2**	**84**	**47000**	**280**	**0.3**	**54**	**28000**	**6.6**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<500	**1500**	<1000	**1500**	<0.2	<0.5	**2**	**8**	NA
FCF1-Surface	Surface	FCF	NA	NA	**NA**	**NA**	**NA**	NA	**NA**	**NA**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
Total Number of Samples			16	16	16	16	16	16	16	16	15	15	9	9	9	9	15	15	15	15	15	15	15	15	15	15	7
Maximum Value			12	2	84	47000	330	14	79	28000	15	1.1	<PQL	<PQL	<PQL	0.2	7.2	<PQL	170	1800	1400	3370	<PQL	<PQL	2	8	Detected

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**

TABLE S8.1
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																					
BH201	0-0.1	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH202	0.25-0.45	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH203	0.18-0.3	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH204	0.2-0.4	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH205	0.15-0.3	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	Not Detected
BH206	0.2-0.4	Fill: silty sand	**8**	<0.4	**14**	**330**	**110**	**1.1**	**10**	**310**	**2.1**	**0.2**	**0.6**	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH206	0.6-0.8	Sand	<4	<0.4	**1**	**7**	**4**	<0.1	<1	**8**	<0.05	<0.05	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH207	0.25-0.35	Fill: silty sandy gravel	<4	<0.4	**3**	**27**	**4**	<0.1	**3**	**37**	<0.05	<0.05	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
SDUPBB	0.2-0.4	Fill: silty sand	<4	<0.4	**25**	**200**	**83**	**0.7**	**16**	**230**	**2**	**0.2**	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
SDUPAB	0-0.1	Fill: silty sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUPCB	0.25-0.35	Fill: silty sandy gravel	<4	<0.4	**11**	**34**	**6**	<0.1	**9**	**82**	<0.05	<0.05	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
SS1	0-0.05	Fill: silty sandy gravel	**15**	<0.4	**43**	**5000**	**270**	**1.3**	**23**	**2000**	NA	NA	**0.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS1 (lab replica	0-0.05	Fill: silty sandy gravel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**0.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS2	0-0.05	Fill: silty sandy gravel	**7**	**0.6**	**56**	**16000**	**170**	**1.1**	**38**	**6200**	NA	NA	**0.5**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS3	0-0.05	Fill: silty sandy gravel	**8**	<0.4	**13**	**240**	**31**	**0.5**	**9**	**220**	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			8	8	8	8	8	8	8	8	5	5	13	5	5	5	5	5	5	5	5	5	6
Maximum Value			15	0.6	56	16000	270	1.3	38	6200	2.1	0.2	0.6	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**

TABLE S9

SOIL LABORATORY TCLP RESULTS

All data in mg/L unless stated otherwise

			Lead	Mercury	Nickel	B(a)P	PCBs
PQL - Envirolab Services			0.03	0.0005	0.02	0.001	2
TCLP1 - General Solid Waste			5	0.2	2	0.04	NSL
TCLP2 - Restricted Solid Waste			20	0.8	8	0.16	NSL
TCLP3 - Hazardous Waste			>20	>0.8	>8	>0.16	NSL
Sample Reference	**Sample Depth**	**Sample Description**					
BH103	0.21-0.4	Fill: Silty Sand	**0.1**	NA	NA	NA	NA
BH104	0-0.05	Fill: Silty Gravelly Sand	**0.3**	NA	**0.06**	NA	NA
BH105	0-0.1	Fill: Silty Sand	**0.2**	<0.0005	NA	<0.001	<2
BH105 - Lab replicate	0-0.1	Fill: Silty Sand	NA	NA	NA	NA	<2
BH105	0.4-0.6	Sand	NA	<0.0005	NA	NA	NA
BH106	0-0.1	Fill: Silty Sand	**0.43**	NA	NA	<0.001	NA
BH106 - Lab replicate	0-0.1	Fill: Silty Sand	**0.35**	NA	NA	NA	NA
Total Number of samples			5	2	1	2	2
Maximum Value			0.43	<PQL	0.06	<PQL	<PQL

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

TABLE S9.1
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Lead
PQL - Envirolab Services			0.03
TCLP1 - General Solid Waste			5
TCLP2 - Restricted Solid Waste			20
TCLP3 - Hazardous Waste			>20
Sample Reference	**Sample Depth**	**Sample Description**	
BH206	0.2-0.4	Fill: silty sand	**0.04**
SS1	0-0.05	Fill: silty sandy gravel	**0.3**
SS2	0-0.05	Fill: silty sandy gravel	**0.07**
Total Number of samples			3
Maximum Value			0.30

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

TABLE S10
SOIL LABORATORY ASLP RESULTS COMPARED TO ECOLOGICAL GILs SAC
All data in µg/L unless stated otherwise

					Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
PQL - Envirolab Services					2	2	2	2	2	2	2
ANZECC (2000) - Fresh Waters (SAC)^					NSL	NSL	NSL	0.3	NSL	0.01	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Lab Report Number**	**Lab Report Date**							
BH105	0-0.1	Fill: Silty Sand	285812-A	14/01/2022	<2	<2	<2	<2	<2	<2	<2
BH105 - Lab replicate	0-0.1	Fill: Silty Sand	285812-A	14/01/2022	<2	<2	<2	<2	<2	<2	<2
Total Number of samples					1	1	1	1	1	1	1
Maximum Value					<2	<2	<2	<2	<2	<2	<2

Notes:
^ Freshwater SAC for 99% level of species proptection used in absence of Marine Water SAC

Concentration above SAC GIL >PQL — **VALUE** (Red)

TABLE S11
SUMMARY OF SOIL/RIVER WATER TBT LEAF LEACHATE LABORATORY RESULTS COMPARED TO ECOLOGICAL MARINE SAC
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLE									
			BH105 (0-0.1m) Soil	BH105 (0-0.1m) 1314 LEAF Eluate T01	BH105 (0-0.1m) 1314 LEAF Eluate T02	BH105 (0-0.1m) 1314 LEAF Eluate T03	BH105 (0-0.1m) 1314 LEAF Eluate T04	BH105 (0-0.1m) 1314 LEAF Eluate T05	BH105 (0-0.1m) 1314 LEAF Eluate T06	BH105 (0-0.1m) 1314 LEAF Eluate T07	BH105 (0-0.1m) 1314 LEAF Eluate T08	BH105 (0-0.1m) 1314 LEAF Eluate T09
Organotin Compounds												
Monobutyltin (as Sn)	0.005	NSL	**0.014**	<0.04	**0.19**	**3.3**	**0.77**	**0.4**	**0.063**	**0.053**	**0.053**	**0.079**
Dibutyltin (as Sn)	0.002	NSL	**3.1**	**0.04**	**0.15**	**0.95**	**0.22**	**0.18**	**0.085**	**0.077**	**0.067**	**0.087**
Tributyltin (as Sn)	0.002	0.006	**0.37**	<0.002	**0.053**	**0.43**	**0.17**	**0.063**	**0.02**	**0.02**	**0.004**	**0.01**

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

Detailed (Stage 2) Site Investigation
8 Terranora Terrace, Tweed Heads, NSW
E34453UBD

TABLE S12
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra laboratory duplicate	BH101	0.03-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
	SDUP103	0.03-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter laboratory duplicate	BH104	0-0.05	<25	160	2800	890	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	0.1	<0.1	0.8	0.1	2.2	2.3	0.8	0.9	1	0.56	0.3	0.1	0.6
	SDUP102	0-0.05	<25	<500	2100	<1000	<0.2	<0.5	2	3	3	<1	<1	<1	<1	<1	<1	3	2.5	<1	1.1	<2	<0.5	<1	<1	<1
	MEAN		nc	92.5	2450	470	nc	nc	1.25	2	1.75	nc	nc	0.075	nc	0.425	0.075	2.6	2.4	0.425	1	0.55	0.2925	0.175	0.075	0.325
	RPD %		nc	146%	29%	179%	nc	nc	120%	100%	143%	nc	nc	67%	nc	176%	67%	31%	8%	176%	20%	164%	183%	143%	67%	169%
Field Blank	TB-S1 16/12/21	-	<25	NA	NA	NA	<0.2	<0.5	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Rinsate	FR1-SPT 16/12/21	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trip Spike	TS-S1 16/12/21		-	-	-	-	113%	114%	113%	109%	110%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra laboratory duplicate	BH101	0.03-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	SDUP103	0.03-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter laboratory duplicate	BH104	0-0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	SDUP102	0-0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.075	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	67%	nc	nc	nc	nc	nc
Field Blank	TB-S1 16/12/21	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Rinsate	FR1-SPT 16/12/21	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trip Spike	TS-S1 16/12/21		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

			Azinphos-methyl (Guthion	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Mobutylin (MBT)	Dibutyltin (DBT)	Tributyltin (TBT)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*NA*	*NA*	*NA*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*NA*	*NA*	*NA*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra laboratory duplicate	BH101	0.03-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1	<0.5	<4	<0.4	5	19	4	<0.1	2	5
	SDUP103	0.03-0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2.3	<0.5	<0.5	5	<0.4	12	23	5	<0.1	3	6
	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	3.5	nc	8.5	21	4.5	nc	2.5	5.5
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	86%	nc	82%	19%	22%	nc	40%	18%
Inter laboratory duplicate	BH104	0-0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.2	6500	4800	3500	9	2	67	34000	200	1	79	16000
	SDUP102	0-0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	3000	1500	1200	10	2	84	47000	280	0.3	54	28000
	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	1.125	4750	3150	2350	9.5	2	75.5	40500	240	0.65	66.5	22000
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	191%	74%	105%	98%	11%	0%	23%	32%	33%	108%	38%	55%
Field Blank	TB-S1 16/12/21	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field Rinsate	FR1-SPT 16/12/21	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trip Spike	TS-S1 16/12/21		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-

Result outside of QA/QC acceptance criteria (highlighted)

TABLE 12.1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH206	0.2-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.3	0.3	0.1	0.1	0.8	0.2	0.1	<0.1	0.2
laboratory	SDUPBB	0.2-0.4	<25	<50	120	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.1	0.7	0.2	0.2	<0.1	0.2
duplicate	MEAN		nc	nc	85	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.075	nc	0.25	0.25	0.15	0.1	0.75	0.2	0.15	nc	0.2
	RPD %		nc	nc	82%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	67%	nc	40%	40%	67%	0%	13%	0%	67%	nc	0%
Inter	BH201	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUPAB	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH207	0.25-0.35	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
laboratory	SDUPCB	0.25-0.35	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-A	-	NA	NA	NA	NA	<0.2	<0.5	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	06/05/22																									
Trip	TS-A		-	-	-	-	76%	98%	106%	107%	108%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	06/05/22																									
Field	FR-HA2	µg/L	NA	NA	NA	NA	<1	<1	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	06/05/22																									

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH206	0.2-0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUPBB	0.2-0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH201	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUPAB	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH207	0.25-0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUPCB	0.25-0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-A	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	06/05/22																					
Trip	TS-A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	06/05/22																					
Field	FR-HA2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	06/05/22																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra	BH206	0.2-0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.6	8	<0.4	14	330	110	1.1	10	310
laboratory	SDUPBB	0.2-0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	<4	<0.4	25	200	83	0.7	16	230
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.325	5	nc	19.5	265	96.5	0.9	13	270
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	169%	120%	nc	56%	49%	28%	44%	46%	30%
Inter	BH201	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUPAB	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH207	0.25-0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	<4	<0.4	3	27	4	<0.1	3	37
laboratory	SDUPCB	0.25-0.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	11	34	6	<0.1	9	82
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	7	30.5	5	nc	6	59.5
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	114%	23%	40%	nc	100%	76%
Field	TB-A	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	06/05/22																						
Trip	TS-A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	06/05/22																						
Field	FR-HA2	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	06/05/22																						

Result outside of QA/QC acceptance criteria (highlighted)

Groundwater and River Water Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ADWG: AustralianDrinking Water Guidelines
ANZG Australian and New Zealand Guidelines
B(a)P: Benzo(a)pyrene
CRC: Cooperative Research Centre
ESLs: Ecological Screening Levels
GIL: Groundwater Investigation Levels
HILs: Health Investigation Levels
HSLs: Health Screening Levels
HSL-SSA: Health Screening Level-SiteSpecific Assessment
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NHMRC: National Health and Medical Research Council
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
ppm: Parts per million
PCBs: Polychlorinated Biphenyls
PCE: Perchloroethylene (Tetrachloroethylene or Tetrachloroethene)
PQL: Practical Quantitation Limit
RS: Rinsate Sample
RSL: Regional Screening Levels
SAC: Site Assessment Criteria
SSA: Site Specific Assessment
SSHSLs Site Specific Health Screening Levels
TB: Trip Blank
TCA: 1,1,1 Trichloroethane (methyl chloroform)
TCE: Trichloroethylene (Trichloroethene)
TS: Trip Spike
TRH: Total Recoverable Hydrocarbons
UCL: Upper Level Confidence Limit on Mean Value
USEPA United States Environmental Protection Agency
VOCC: Volatile Organic Chlorinated Compounds
WHO: World Health Organisation

TABLE G1
SUMMARY OF GROUNDWATER & RIVERWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL SAC (Round 1: 13-14 January 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLES									
			MW101	MW101 Lab replicate	MW102	MW103	MW104	WDUP1	WDUP2	WDUP2 Lab replicate	R1	R1 Lab replicate
Inorganic Compounds and Parameters												
pH		7 - 8.5	7	NA	6.3	6.9	6.5	NA	NA	NA	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**6600**	NA	**9700**	**11000**	**5100**	NA	NA	NA	NA	NA
Turbidity (NTU)		NSL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Organotin Compounds												
Monobutyltin (as Sn)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	**0.04**	**0.053**	<0.005	NA	<0.005	<0.005
Dibutyltin (as Sn)	0.002	NSL	<0.002	<0.002	<0.002	<0.002	**0.064**	**0.07**	<0.002	NA	<0.005	<0.005
Tributyltin (as Sn)	0.002	0.006	<0.002	<0.002	<0.002	<0.002	**0.037**	**0.035**	<0.002	NA	<0.005	<0.005
Metals and Metalloids												
Arsenic (As III)	1	2.3	<1	<1	**7**	<1	<1	<1	<1	NA	NA	NA
Cadmium	0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Chromium (SAC for Cr III adopted)	1	27	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA
Copper	1	1.3	<1	<1	**7**	<1	<1	<1	<1	NA	NA	NA
Lead	1	4.4	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA
Total Mercury (inorganic)	0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	NA	NA
Nickel	1	7	<1	<1	**21**	<1	<1	<1	<1	NA	NA	NA
Zinc	1	15	<1	<1	**87**	<1	<1	<1	<10	NA	NA	NA
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)												
Benzene	1	500	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Toluene	1	180	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Ethylbenzene	1	5	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
m+p-xylene	2	75	<2	<2	<2	<2	<2	<2	<2	<2	NA	NA
o-xylene	1	350	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Total xylenes	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2	NA	NA
Volatile Organic Compounds (VOCs), including chlorinated VOCs												
Dichlorodifluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
Chloromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
Vinyl Chloride	10	100	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
Bromomethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
Chloroethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10	NA	NA
1,1-Dichloroethene	1	700	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Trans-1,2-dichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1-dichloroethane	1	250	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Cis-1,2-dichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Bromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Chloroform	1	370	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2-dichloroethane	1	1900	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1,1-trichloroethane	1	270	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Cyclohexane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Carbon tetrachloride	1	240	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Benzene	1	500	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Dibromomethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2-dichloropropane	1	900	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Trichloroethene	1	330	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Bromodichloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
trans-1,3-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
cis-1,3-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1,2-trichloroethane	1	1900	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Toluene	1	180	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,3-dichloropropane	1	1100	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Dibromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Tetrachloroethene	1	70	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Chlorobenzene	1	55	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Ethylbenzene	1	5	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Bromoform	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
m+p-xylene	2	75	<2	<2	<2	<2	<2	<2	<2	<2	NA	NA
Styrene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,1,2,2-tetrachloroethane	1	400	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
o-xylene	1	350	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Isopropylbenzene	1	30	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Bromobenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
n-propyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
2-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
4-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,3-dichlorobenzene	1	260	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,4-dichlorobenzene	1	60	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2-dichlorobenzene	1	160	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
n-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2,4-trichlorobenzene	1	20	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Hexachlorobutadiene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
1,2,3-trichlorobenzene	1	3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Polycyclic Aromatic Hydrocarbons (PAHs)												
Naphthalene	0.2	50	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.1	NA	NA	NA
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	**0.5**	<0.1	<0.1	<0.1	NA	NA	NA
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Phenanthrene	0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Anthracene	0.1	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Fluoranthene	0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	NA
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G1.1
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL GILs SAC (Round 2: 5 May 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLES							
			MW101	MW101 (lab replicate)	MW102	MW103	MW104	GWDUPA	GWDUPA (lab replicate)	GWDUPB
Inorganic Compounds and Parameters										
pH		7 - 8.5	7.4	NA	6.4	7	6.7	NA	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**2800**	NA	**7500**	**11000**	**1800**	NA	NA	NA
Metals and Metalloids										
Arsenic (As III)	1	2.3	<1	<1	**13**	<1	<1	<1	NA	<1
Cadmium	0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Chromium (SAC for Cr III adopted)	1	27	<1	<1	<1	<1	<1	<5	NA	<1
Copper	1	1.3	<1	<1	**2**	<1	<1	<1	NA	<1
Lead	1	4.4	<1	<1	<1	<1	<1	<1	NA	<1
Total Mercury (inorganic)	0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<1	NA	<0.05
Nickel	1	7	<1	<1	**23**	<1	<1	**5**	NA	<1
Zinc	1	15	**3**	**3**	**96**	**5**	**4**	<0.05	NA	**5**
Organotin Compounds										
Monobutyltin (as Sn)	0.005	NSL	<0.005	NA	<0.005	<0.005	<0.005	<0.002	NA	<0.005
Dibutyltin (as Sn)	0.002	NSL	<0.002	NA	<0.002	<0.002	0.008	0.0022	NA	<0.002
Tributyltin (as Sn)	0.002	0.006	<0.002	NA	<0.002	<0.002	**0.01**	0.0043	NA	<0.002
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)										
Benzene	1	500	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	180	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	5	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	75	<2	<2	<2	<2	<2	<2	<2	<2
o-xylene	1	350	<1	<1	<1	<1	<1	<1	<1	<1
Total xylenes	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs										
Dichlorodifluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl Chloride	10	100	<10	<10	<10	<10	<10	<10	<10	<10
Bromomethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloroethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	1	700	<1	<1	<1	<1	<1	<1	<1	<1
Trans-1,2-dichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	1	250	<1	<1	<1	<1	<1	<1	<1	<1
Cis-1,2-dichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	1	370	<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	1	1900	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	1	270	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	1	240	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	1	500	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	1	900	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	1	330	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	1	1900	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	180	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	1	1100	<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	1	70	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	1	55	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	5	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	75	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	1	400	<1	<1	<1	<1	<1	<1	<1	<1
o-xylene	1	350	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	1	30	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
n-propyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tert-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	1	260	<1	<1	<1	<1	<1	<1	<1	<1
Sec-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	1	60	<1	<1	<1	<1	<1	<1	<1	<1
4-isopropyl toluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	1	160	<1	<1	<1	<1	<1	<1	<1	<1
n-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	1	20	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	1	3	<1	<1	<1	<1	<1	<1	<1	<1
Polycyclic Aromatic Hydrocarbons (PAHs)										
Naphthalene	0.2	50	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	<0.2
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Phenanthrene	0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Anthracene	0.1	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Fluoranthene	0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	<0.2
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Polychlorinated Biphenyls (PCBs)										
Aroclor 1016	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1221	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1232	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1242	0.01	0.3[#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1248	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1254	0.01	0.01[#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1260	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Total PCBs	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
GIL >PQL Red
[#] Freshwater SAC for 99% species protection used in the absence of marine SAC and to account for bioaccumulating nature of PCBs

TABLE G2
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT SAC (Round 1: 13-14 January 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	SAMPLES							
			MW101	MW101 Lab replicate	MW102	MW103	MW104	WDUP1	WDUP2	WDUP2 Lab replicate
Inorganic Compounds and Parameters										
pH		6.5 - 8.5	7	NA	6.3	6.9	6.5	NA	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**6600**	NA	**9700**	**11000**	**5100**	NA	NA	NA
Turbidity (NTU)		NSL	NA	NA	NA	NA	NA	NA	NA	NA
Organotin Compounds										
Monobutyltin (as Sn)	0.005	NSL	<0.005	<0.005	<0.005	<0.005	**0.04**	**0.053**	<0.005	NA
Dibutyltin (as Sn)	0.002	NSL	<0.002	<0.002	<0.002	<0.002	**0.064**	**0.07**	<0.002	NA
Tributyltin (as Sn)	0.002	1	<0.002	<0.002	<0.002	<0.002	**0.037**	**0.035**	<0.002	NA
Metals and Metalloids										
Arsenic (As III)	1	100	<1	<1	**7**	<1	<1	<1	<1	NA
Cadmium	0.1	20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Chromium (total)	1	500	<1	<1	<1	<1	<1	<1	<1	NA
Copper	1	20000	<1	<1	**7**	<1	<1	<1	<1	NA
Lead	1	100	<1	<1	<1	<1	<1	<1	<1	NA
Total Mercury (inorganic)	0.05	10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
Nickel	1	200	<1	<1	**21**	<1	<1	<1	<1	NA
Zinc	1	30000	<1	<1	**87**	<1	<1	<1	<10	NA
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)										
Benzene	1	10	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	8000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2
o-xylene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Total xylenes	2	6000	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs										
Dichlorodifluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl Chloride	10	3	<10	<10	<10	<10	<10	<10	<10	<10
Bromomethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloroethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
Trans-1,2-dichloroethene	1	600	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Cis-1,2-dichloroethene	1	600	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	1	2500	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	1		<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	1	30	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	1	30	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	1	10	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	1	1000	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	1	1000	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	8000	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	1	500	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
o-xylene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
n-propyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tert-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	1	200	<1	<1	<1	<1	<1	<1	<1	<1
Sec-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	1	400	<1	<1	<1	<1	<1	<1	<1	<1
4-isopropyl toluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	1	15000	<1	<1	<1	<1	<1	<1	<1	<1
n-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	1		<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	1	7	<1	<1	<1	<1	<1	<1	<1	<1
Polycyclic Aromatic Hydrocarbons (PAHs)										
Naphthalene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.1	NA
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	**0.5**	<0.1	<0.1	<0.1	NA
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Phenanthrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Fluoranthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE G2.1
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT GILs (Round 2: 5 May 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	SAMPLES							
			MW101	MW101 (lab replicate)	MW102	MW103	MW104	GWDUPA	GWDUPA (lab replicate)	GWDUPB
Inorganic Compounds and Parameters										
pH		6.5 - 8.5	7.4	NA	6.4	7	6.7	NA	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**2800**	NA	**7500**	**11000**	**1800**	NA	NA	NA
Metals and Metalloids										
Arsenic (As III)	1	100	<1	<1	**13**	<1	<1	<1	NA	<1
Cadmium	0.1	20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Chromium (total)	1	500	<1	<1	<1	<1	<1	<5	NA	<1
Copper	1	20000	<1	<1	**2**	<1	<1	<1	NA	<1
Lead	1	100	<1	<1	<1	<1	<1	<1	NA	<1
Total Mercury (inorganic)	0.05	10	<0.05	<0.05	<0.05	<0.05	<0.05	<1	NA	<0.05
Nickel	1	200	<1	<1	**23**	<1	<1	**5**	NA	<1
Zinc	1	30000	**3**	**3**	**96**	**5**	**4**	<0.05	NA	**5**
Organotin Compounds										
Monobutyltin (as Sn)	0.005	NSL	<0.005	NA	<0.005	<0.005	<0.005	<0.002	NA	<0.005
Dibutyltin (as Sn)	0.002	NSL	<0.002	NA	<0.002	<0.002	0.008	0.0022	NA	<0.002
Tributyltin (as Sn)	0.002	1	<0.002	NA	<0.002	<0.002	**0.01**	0.0043	NA	<0.002
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)										
Benzene	1	10	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	8000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2
o-xylene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Total xylenes	2	6000	<2	<2	<2	<2	<2	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs										
Dichlorodifluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl Chloride	10	3	<10	<10	<10	<10	<10	<10	<10	<10
Bromomethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Chloroethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	10	NSL	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
Trans-1,2-dichloroethene	1	600	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Cis-1,2-dichloroethene	1	600	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	1	2500	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	1		<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	1	30	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	1	30	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	1	10	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	1	1000	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	1	1000	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	8000	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	1	500	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	3000	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	NSL	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
o-xylene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
n-propyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
Tert-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	1	200	<1	<1	<1	<1	<1	<1	<1	<1
Sec-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	1	400	<1	<1	<1	<1	<1	<1	<1	<1
4-isopropyl toluene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	1	15000	<1	<1	<1	<1	<1	<1	<1	<1
n-butyl benzene	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	1	300	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	1		<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	1	7	<1	<1	<1	<1	<1	<1	<1	<1
Polycyclic Aromatic Hydrocarbons (PAHs)										
Naphthalene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	<0.2
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Phenanthrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Fluoranthene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	<0.2
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
Polychlorinated Biphenyls (PCBs)										
Aroclor 1016	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1221	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1232	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1242	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1248	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1254	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Aroclor 1260	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01
Total PCBs	0.01	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE G3
GROUNDWATER LABORATORY RESULTS COMPARED TO HSLs (Round 1: 13-14 January 2022)
All data in µg/L unless stated otherwise

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	
PQL - Envirolab Services				10	50	1	1	1	2	1	PID
NEPM 2013 - Land Use Category				HSL-D: COMMERCIAL/INDUSTRIAL							
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**								
MW101	0.83	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	4.8
MW101 - Lab replicate	0.83	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	4.8
MW102	1.21	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
MW103	1.11	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0.1
MW104	0.19	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
WDUP1	0.19	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
WDUP2	0.83	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	4.8
WDUP2 - Lab replicate	0.83	0m to <2m	Sand	<10	NA	<1	<1	<1	<2	<1	4.8
Total Number of Samples				8	7	8	8	8	8	8	8
Maximum Value				<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	4.8

Concentration above the SAC **VALUE**
Site specific assesment (SSA) required **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the Groundwater Assessment Criteria Table below

HSL GROUNDWATER ASSESSMENT CRITERIA

Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
MW101	0.83	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW101	0.83	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW102	1.21	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW103	1.11	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW104	0.19	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
WDUP1	0.19	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
WDUP2	0.83	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
WDUP2	0.83	0m to <2m	Sand	SSA	NA	SSA	SSA	SSA	SSA	SSA

TABLE G3.1
GROUNDWATER LABORATORY RESULTS COMPARED TO HSLs (Round 2: 5 May 2022)
All data in µg/L unless stated otherwise

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services				10	50	1	1	1	2	1	
NEPM 2013 - Land Use Category				**HSL-D: COMMERCIAL/INDUSTRIAL**							
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**								
MW101	1.08	0m to <2m	sand	<10	<50	<1	<1	<1	<2	<1	0
MW101 (lab re	1.08	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
MW102	1.09	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
MW103	1.13	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
MW104	0.19	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
GWDUPA	0.19	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
GWDUPA (lab r	0.19	0m to <2m	Sand	<10	NA	<1	<1	<1	<2	<1	0
GWDUPB	1.13	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0
Total Number of Samples				8	7	9	9	9	10	9	8
Maximum Value				<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0

Concentration above the SAC **VALUE**
Site specific assesment (SSA) required **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the Groundwater Assessment Criteria Table below

HSL GROUNDWATER ASSESSMENT CRITERIA

Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
MW101	1.08	0m to <2m	sand		SSA		SSA	SSA	SSA	SSA
MW101 (lab re	1.08	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW102	1.09	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW103	1.13	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
MW104	0.19	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
GWDUPA	0.19	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA
GWDUPA (lab r	0.19	0m to <2m	Sand	SSA	NA	SSA	SSA	SSA	SSA	SSA
GWDUPB	1.13	0m to <2m	Sand	SSA	SSA	SSA	SSA	SSA	SSA	SSA

TABLE G4
GROUNDWATER LABORATORY RESULTS COMPARED TO SITE SPECIFIC HSLs - RISK ASSESSMENT (Round 1: 13-14 January 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NHMRC ADWG 2011	WHO 2008	USEPA RSL Tapwater 2017	SAMPLES							
					MW101	MW101 Lab replicate	MW102	MW103	MW104	WDUP1	WDUP2	WDUP2 Lab replicate
Total Recoverable Hydrocarbons (TRH)												
C_6-C_9 Aliphatics (assessed using F1)	10	-	15000	-	<10	<10	<10	<10	<10	<10	<10	<10
>C_9-C_{14} Aliphatics (assessed using F2)	50	-	100	-	<50	<50	<50	<50	<50	<50	<50	NA
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)												
Benzene	1	1	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	800	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Total xylenes	2	600	-	-	<2	<2	<2	<2	<2	<2	<2	<2
Polycyclic Aromatic Hydrocarbons (PAHs)												
Naphthalene	1	-	-	6.1	<1	<1	<1	<1	<1	<1	<1	<1
Volatile Organic Compounds (VOCs), including chlorinated VOCs												
Dichlorodifluoromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Chloromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl Chloride	10	0.3	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Bromomethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Chloroethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Trans-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Cis-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	1	250	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	1		-	-	<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	1	3	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	1	3	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	1	1	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	800	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	1	50	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	-	-	-	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
o-xylene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
n-propyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Tert-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	1	20	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Sec-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	1	40	-	-	<1	<1	<1	<1	<1	<1	<1	<1
4-isopropyl toluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	1	1500	-	-	<1	<1	<1	<1	<1	<1	<1	<1
n-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	1		-	-	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	1	7	-	-	<1	<1	<1	<1	<1	<1	<1	<1

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G4.1
GROUNDWATER LABORATORY RESULTS COMPARED TO SITE SPECIFIC HSLs - RISK ASSESSMENT (Round 2: 5 May 2022)
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NHMRC ADWG 2011	WHO 2008	USEPA RSL Tapwater 2017	SAMPLES							
					MW101	MW101 (lab replicate)	MW102	MW103	MW104	GWDUPA	GWDUPA (lab replicate)	GWDUPB
Total Recoverable Hydrocarbons (TRH)												
C_6-C_9 Aliphatics (assessed using F1)	10	-	15000	-	<10	<10	<10	<10	<10	<10	<10	<10
>C_9-C_{14} Aliphatics (assessed using F2)	50	-	100	-	<50	<50	<50	<50	<50	<50	NA	<50
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)												
Benzene	1	1	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	800	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Total xylenes	2	600	-	-	<2	<2	<2	<2	<2	<2	<2	<2
Polycyclic Aromatic Hydrocarbons (PAHs)												
Naphthalene	1	-	-	6.1	<1	<1	<1	<1	<1	<1	<1	<1
Volatile Organic Compounds (VOCs), including chlorinated VOCs												
Dichlorodifluoromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Chloromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl Chloride	10	0.3	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Bromomethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Chloroethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	10	-	-	-	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Trans-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Cis-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	1	250	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	1		-	-	<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	1	3	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	1	3	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	1	1	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	1	800	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Dibromochloromethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	1	50	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	2	-	-	-	<2	<2	<2	<2	<2	<2	<2	<2
Styrene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
o-xylene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
n-propyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Tert-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	1	20	-	-	<1	<1	<1	<1	<1	<1	<1	<1
Sec-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	1	40	-	-	<1	<1	<1	<1	<1	<1	<1	<1
4-isopropyl toluene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	1	1500	-	-	<1	<1	<1	<1	<1	<1	<1	<1
n-butyl benzene	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	1	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	1	30	-	-	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	1		-	-	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	1	7	-	-	<1	<1	<1	<1	<1	<1	<1	<1

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G5
GROUNDWATER QA/QC SUMMARY (Round 1: 13-14 January 2022)

		TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD	*10*	*50*	*100*	*100*	*1*	*1*	*1*	*2*	*1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC	*10*	*50*	*100*	*100*	*1.0*	*1.0*	*1.0*	*2.0*	*1.0*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	MW104	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
laboratory	WDUP1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW101	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
laboratory	WDUP2	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-W1	0	0	0	0	<1	<1	<1	<2	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blank	13/01/2022																								
Trip	TS-W1	-	-	-	-	107%	106%	119%	110%	110%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	13/01/2022																								

		HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.001*	*0.001*	*0.001*
	PQL Envirolab VIC	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.001*	*0.001*	*0.001*
Intra	MW104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	WDUP1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	WDUP2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-W1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blank	13/01/2022																				
Trip	TS-W1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	13/01/2022																				

		Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Ronnel	Parathion	Methyl Parathion	Total PCBS	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD	*0.02*	*0.01*	*0.009*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.05*	*0.01*	*0.004*	*0.01*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
	PQL Envirolab VIC	*0.02*	*0.01*	*0.009*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.05*	*0.01*	*0.004*	*0.010*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
Intra	MW104	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	<0.1	<1	<1	<1	<0.05	<1	<1
laboratory	WDUP1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	<0.1	<1	<1	<1	<0.05	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	<0.1	<1	<1	<1	<0.05	<1	<1
laboratory	WDUP2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	<0.1	<1	<1	<1	<0.05	<1	<10
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-W1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blank	13/01/2022																						
Trip	TS-W1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Spike	13/01/2022																						

		Dichlorodifluoromethane	Chloromethane	Vinyl Chloride	Bromomethane	Chloroethane	Trichlorofluoromethane	1,1-Dichloroethene	Trans-1,2-dichloroethene	1,1-dichloroethane	Cis-1,2-dichloroethene	Bromochloromethane	Chloroform	2,2-dichloropropane	1,2-dichloroethane	1,1,1-trichloroethane	1,1-dichloropropene	Cyclohexane	Carbon tetrachloride	Benzene	Dibromomethane
	PQL Envirolab SYD	*10*	*10*	*10*	*10*	*10*	*10*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
	PQL Envirolab VIC	*10*	*10*	*10*	*10*	*10*	*10*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Intra	MW104	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
laboratory	WDUP1	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW101	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
laboratory	WDUP2	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

		1,2-dichloropropane	Trichloroethene	Bromodichloromethane	trans-1,3-dichloropropene	cis-1,3-dichloropropene	1,1,2-trichloroethane	Toluene	1,3-dichloropropane	Dibromochloromethane	1,2-dibromoethane	Tetrachloroethene	1,1,1,2-tetrachloroethane	Chlorobenzene	Ethylbenzene	Bromoform	m+p-xylene	Styrene	1,1,2,2-tetrachloroethane	o-xylene	1,2,3-trichloropropane
	PQL Envirolab SYD	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*
	PQL Envirolab VIC	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*
Intra	MW104	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1
laboratory	WDUP1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW101	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1
laboratory	WDUP2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

		Isopropylbenzene	Bromobenzene	n-propyl benzene	2-chlorotoluene	4-chlorotoluene	1,3,5-trimethyl benzene	Tert-butyl benzene	1,2,4-trimethyl benzene	1,3-dichlorobenzene	Sec-butyl benzene	1,4-dichlorobenzene	4-isopropyl toluene	1,2-dichlorobenzene	n-butyl benzene	1,2-dibromo-3-chloropropar	1,2,4-trichlorobenzene	Hexachlorobutadiene	1,2,3-trichlorobenzene	Mobutylin (MBT)	Dibutyltin (DBT)	Tributyltin (TBT)
	PQL Envirolab SYD	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0.005*	*0.002*	*0.002*
	PQL Envirolab VIC	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*0.005*	*0.002*	*0.002*
Intra	MW104	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.04	0.064	0.037
laboratory	WDUP1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.053	0.07	0.035
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.046	0.067	0.036
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	2.8	9	5.5
Inter	MW101	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.005	<0.002	<0.002
laboratory	WDUP2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.005	<0.002	<0.002
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

Result outside of QA/QC acceptance criteria: Value

JKEnvironments

TABLE G5.1
GROUNDWATER QA/QC SUMMARY (Round 2: 5 May 2022)

		Dichlorodifluoromethane	Chloromethane	Vinyl Chloride	Bromomethane	Chloroethane	Trichlorofluoromethane	1,1-Dichloroethene	Trans-1,2-dichloroethene	1,1-dichloroethane	Cis-1,2-dichloroethene	Bromochloromethane	Chloroform	2,2-dichloropropane	1,2-dichloroethane	1,1,1-trichloroethane	1,1-dichloropropene	Cyclohexane	Carbon tetrachloride	Benzene	Dibromomethane	1,2-dichloropropane	Trichloroethene	Bromodichloromethane	trans-1,3-dichloropropene	cis-1,3-dichloropropene	1,1,2-trichloroethane	Toluene	1,3-dichloropropane	Dibromochloromethane	1,2-dibromoethane	Tetrachloroethene	1,1,1,2-tetrachloroethane	Chlorobenzene	Ethylbenzene	Bromoform	m+p-xylene	Styrene	1,1,2,2-tetrachloroethane	o-xylene	1,2,3-trichloropropane	Isopropylbenzene	Bromobenzene	n-propyl benzene	2-chlorotoluene	4-chlorotoluene	1,3,5-trimethyl benzene	Tert-butyl benzene	1,2,4-trimethyl benzene	1,3-dichlorobenzene	Sec-butyl benzene	1,4-dichlorobenzene	4-isopropyl toluene	1,2-dichlorobenzene	n-butyl benzene	1,2-dibromo-3-chloropropane	1,2,4-trichlorobenzene	Hexachlorobutadiene	1,2,3-trichlorobenzene
PQL Envirolab SYD		*10*	*10*	*10*	*10*	*10*	*10*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
PQL Envirolab VIC		*10*	*10*	*10*	*10*	*10*	*10*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Intra	MW103	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
laboratory	GWDUPB	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	MW104	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
laboratory	GWDUPA	<10	<10	<10	<10	<10	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

		TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenapth-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene	Total PCBS	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Mobutylin (MBT)	Dibutyltin (DBT)	Tributyltin (TBT)
PQL Envirolab SYD		*10*	*50*	*100*	*100*	*1*	*1*	*1*	*2*	*1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*	*0.005*	*0.002*	*0.002*
PQL Envirolab VIC or WA		*10*	*50*	*100*	*100*	*1*	*1*	*1*	*2*	*1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*	*0.005*	*0.002*	*0.002*
PQL NMI		*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.01*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*0.002*	*0.002*	*0.002*
Intra	MW103	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.01	<1	<0.1	<1	<1	<1	<0.05	<1	5	<0.005	<0.002	<0.002
laboratory	GWDUPB	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.01	<1	<0.1	<1	<1	<1	<0.05	<1	5	<0.005	<0.002	<0.002
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	5	nc	nc	nc
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	nc	nc	nc
Inter	MW104	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.01	<1	<0.1	<1	<1	<1	<0.05	<1	4	<0.005	0.008	0.01
laboratory	GWDUPA	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.01	<1	<0.1	<5	<1	<1	<1	5	<0.05	<0.002	0.0022	0.0043
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	2.75	2.25	nc	0.0051	0.0071
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	164%	156%	nc	114%	80%
Field	TB-W2	NA	NA	NA	NA	<1	<1	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	5.5.22																																				
Trip	TS-W2	-	-	-	-	70%	77%	94%	90%	93%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	5.5.22																																				

Result outside of QA/QC acceptance criteria — Value

River Water Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ADWG: AustralianDrinking Water Guidelines
ANZG Australian and New Zealand Guidelines

CRC: Cooperative Research Centre
ESLs: Ecological Screening Levels
GIL: Groundwater Investigation Levels
HILs: Health Investigation Levels
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NHMRC: National Health and Medical Research Council
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
ppm: Parts per million
PCBs: Polychlorinated Biphenyls

PQL: Practical Quantitation Limit
RS: Rinsate Sample
RSL: Regional Screening Levels
SAC: Site Assessment Criteria

TABLE RW1
SUMMARY OF RIVERWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL SAC
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLES																								
			RW4.1.1	RW4.1.1 (lab replicate)	RW4.2.1	RW4.3.1	RW4.1.2	RW4.2.2	RW4.2.2 (lab replicate)	RW4.3.2	RW4.1.3	RW4.2.3	RW4.3.3	RW3	RW3 (lab replicate)	RW4.1.4	RW4.1.4 unfiltered	RW4.2.4	RW4.3.4	RW4.1.5	RW4.2.5	RW4.3.5	RW4.1.6	RW4.2.6	RW4.3.6	RW4.3.6 (lab replicate)	RWDUP4	RWDUP5
Metals and Metalloids																												
Arsenic (As III)	1	2.3	**1**	**1**	**1**	**1**	**1**	**1**	NA	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1.6**	**2**
Cadmium	0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (SAC for Cr III adopted)	1	27	<1	<1	<1	<1	**1**	**1**	NA	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	<1	**2**
Copper	1	1.3	<1	<1	<1	<1	**5**	<1	NA	<1	**12**	<1	<1	**2**	**2**	**2**	**5**	<1	**1**	**3**	<1	<1	**4**	<1	<1	<1	**8.1**	**3**
Lead	1	4.4	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Mercury (inorganic)	0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<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	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05
Nickel	1	7	<1	<1	**2**	<1	<1	**1**	NA	<1	**1**	<1	**1**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	15	<1	<1	<1	<1	**6**	<1	NA	<1	**18**	<1	<1	**2**	**1**	<1	**7**	**2**	**4**	**4**	<1	<1	**3**	<1	<1	<1	**8.3**	**5**
Organotin Compounds																												
Monobutyltin (as Sn)	0.005	NSL	<0.005	NA	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.002	<0.005
Dibutyltin (as Sn)	0.002	NSL	<0.002	NA	<0.002	0.007	0.005	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	NA	0.002	0.004	<0.002	<0.002	0.003	<0.002	<0.002	0.003	<0.002	<0.002	NA	0.0036	0.003
Tributyltin (as Sn)	0.002	0.006	<0.002	NA	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	NA	0.002	<0.002
Polychlorinated Biphenyls (PCBs)																												
Aroclor 1016	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1221	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1232	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1242	0.01	0.3[#]	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1248	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1254	0.01	0.01[#]	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1260	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Total PCBs	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
[#] Freshwater SAC for 99% species protection used in the absence of marine SAC and to account for bioaccumulating nature of PCBs

TABLE RW2
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT GILs
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	SAMPLES																								
			RW4.1.1	RW4.1.1 (lab replicate)	RW4.2.1	RW4.3.1	RW4.1.2	RW4.2.2	RW4.2.2 (lab replicate)	RW4.3.2	RW4.1.3	RW4.2.3	RW4.3.3	RW3	RW3 (lab replicate)	RW4.1.4	RW4.1.4 unfiltered	RW4.2.4	RW4.3.4	RW4.1.5	RW4.2.5	RW4.3.5	RW4.1.6	RW4.2.6	RW4.3.6	.3.6 (lab replic	RWDUP4	RWDUP5
Metals and Metalloids																												
Arsenic (As III)	1	100	1	1	1	1	1	1	NA	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1.6	2
Cadmium	0.1	20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	<0.1	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (total)	1	500	<1	<1	<1	<1	**1**	**1**	NA	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	<1	**2**
Copper	1	20000	<1	<1	<1	<1	**5**	<1	NA	<1	**12**	<1	<1	**2**	**2**	**2**	**5**	<1	**1**	**3**	<1	<1	**4**	<1	<1	<1	**8.1**	**3**
Lead	1	100	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Mercury (inorganic)	0.05	10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<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	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05
Nickel	1	200	<1	<1	**2**	<1	<1	**1**	NA	<1	**1**	<1	**1**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	1	30000	<1	<1	<1	<1	**6**	<1	NA	<1	**18**	<1	<1	**2**	**1**	<1	**7**	**2**	**4**	**4**	<1	<1	**3**	<1	<1	<1	**8.3**	**5**
Organotin Compounds																												
Monobutyltin (as Sn)	0.005	NSL	<0.005	NA	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.002	<0.005
Dibutyltin (as Sn)	0.002	NSL	<0.002	NA	<0.002	**0.007**	**0.005**	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	NA	**0.002**	**0.004**	<0.002	<0.002	**0.003**	<0.002	<0.002	**0.003**	<0.002	<0.002	NA	**0.0036**	**0.003**
Tributyltin (as Sn)	0.002	1	<0.002	NA	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	NA	**0.002**	<0.002
Polychlorinated Biphenyls (PCBs)																												
Aroclor 1016	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1221	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1232	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1242	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1248	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1254	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Aroclor 1260	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01
Total PCBs	0.01	NSL	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA	<0.01	<0.01

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**

TABLE RW3
RIVERWATER QA/QC SUMMARY
All results in µg/L unless stated otherwise.

		Mobutylin (MBT)	Dibutyltin (DBT)	Tributyltin (TBT)	Total PCBS	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD	*NA*	*NA*	*NA*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
	PQL Envirolab VIC or WA	*0.005*	*0.002*	*0.002*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
	PQL NMI	*0.002*	*0.002*	*0.002*	*0.01*	*1*	*0.1*	*1*	*1*	*1*	*0.1*	*1*	*1*
Intra	RW4.1.5	<0.005	0.003	<0.002	<0.01	2	<0.1	2	3	<1	<0.05	<1	4
laboratory	RWDUP5	<0.005	0.003	<0.002	<0.01	2	<0.1	2	3	<1	<0.05	<1	5
duplicate	MEAN	nc	nc	nc	nc	2	nc	2	3	nc	nc	nc	4.5
	RPD %	nc	nc	nc	nc	0%	nc	0%	0%	nc	nc	nc	22%
Inter	RW4.1.2	<0.005	0.005	<0.002	<0.01	1	<0.1	1	5	<1	<0.05	<1	6
laboratory	RWDUP4	<0.002	0.0036	0.002	<0.01	1.6	<0.1	<1	8.1	<1	<0.1	<1	8.3
duplicate	MEAN	nc	0.0043	nc	nc	1.3	nc	0.75	6.55	nc	nc	nc	7.15
	RPD %	nc	33%	nc	nc	46%	nc	67%	47%	nc	nc	nc	32%

Result outside of QA/QC acceptance criteria — Value

PFAS Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ASLP: Australian Stardard Leachate Procedure
CT: Contaminant Threshold
FTS: Fluorotelomer sulfonic acid
NA: Not Analysed
NC: Not Calculated
NEMP National Environmental Management Plan
NSL: No Set Limit
PFAS Per- and polyfluoroalkyl substances
PFHxS Perfluorohexanesulfonic acid
PFOA Perfluorooctanoic acid
PFOS Perfluorooctanesulfonic acid
PQL: Practical Quantitation Limit
RS: Rinsate Sample
SAC: Site Assessment Criteria
SCC: Specific Contaminant Concentration
TB: Trip Blank
TCLP: Toxicity Characteristics Leaching Procedure
TS: Trip Spike
UCL: Upper Level Confidence Limit on Mean Value

Table Specific Explanations:

Groundwater Ecology Tables:

- 99% refers to a concentration that has been derived to protect 99% of aquatic species. The 99% species protection has been adopted to account for bioaccumulation impacts.

Waste Classification and TCLP Table:

- Data assessed using the Addendum to the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014) -October 201

TABLE P1
SUMMARY OF PFAS CONCENTRATIONS IN GROUNDWATER, RIVER WATER & SOIL ASLP - ECOLOGY
All results in µg/L unless stated otherwise.

	PQL	NEMP 2020	SAMPLES													
	Envirolab Services	Interim 99% Marine	MW101	MW102	MW103	MW104	GWDUPA (envirolab)	GWDUPA (NMI)	GWDUPB (envirolab)	RW4.1.5	RW4.1.5 (lab replicate)	BH201 (0-0.1)/ ASLP	BH201 (0-0.1)/ ASLP (lab replicate)	BH203 (0.18-0.3)/ ASLP	BH205 (0.15-0.3)/ ALSP	BH205 (0.15-0.3)/ ALSP (lab replicate)
PFAS Compound																
Perfluorobutanesulfonic acid	0.1	NSL	**0.0006**	**0.001**	**0.0056**	**0.003**	**0.003**	**0.0017**	**0.0055**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanesulfonic acid	0.1	NSL	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorohexanesulfonic acid - PFHxS	0.1	NSL	**0.0009**	**0.0005**	**0.011**	**0.0026**	**0.0029**	**0.0032**	**0.011**	**0.001**	**0.0009**	<0.01	<0.01	<0.01	**0.02**	**0.02**
Perfluoroheptanesulfonic acid	0.1	NSL	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanesulfonic acid PFOS	0.1	0.00023	**0.0034**	**0.0048**	**0.026**	**0.012**	**0.012**	**0.0066**	**0.024**	**0.0004**	**0.0004**	<0.01	<0.01	**0.01**	**0.07**	**0.07**
Perfluorodecanesulfonic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorobutanoic acid	0.2	NSL	**0.002**	<0.002	**0.006**	<0.002	<0.02	<0.005	**0.006**	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluoropentanoic acid	0.2	NSL	<0.002	<0.002	**0.009**	<0.002	<0.002	<0.002	**0.008**	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorohexanoic acid	0.1	NSL	<0.0004	**0.0006**	**0.0095**	**0.001**	**0.001**	<0.001	**0.0092**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoroheptanoic acid	0.1	NSL	<0.0004	**0.0006**	**0.014**	**0.001**	**0.002**	<0.001	**0.014**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanoic acid PFOA	0.1	19	**0.0005**	**0.002**	**0.023**	**0.0066**	**0.0066**	**0.0046**	**0.022**	**0.0005**	**0.0004**	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorononanoic acid	0.1	NSL	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorodecanoic acid	0.5	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluoroundecanoic acid	0.5	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorododecanoic acid	0.5	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorotridecanoic acid	0.5	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
Perfluorotetradecanoic acid	5	NSL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.002	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5
4:2 FTS	0.1	NSL	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
6:2 FTS	0.1	NSL	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.001	<0.0004	**0.0050**	**0.0050**	<0.01	<0.01	<0.01	<0.01	<0.01
8:2 FTS	0.1	NSL	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.001	<0.0004	<0.0004	<0.0004	<0.02	<0.02	<0.02	<0.02	<0.02
10:2 FTS	0.1	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorooctane sulfonamide	1	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
N-Methyl perfluorooctane sulfonamide	1	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
N-Ethyl perfluorooctanesulfon amide	1	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
N-Me perfluorooctanesulfonamid oethanol	1	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
N-Et perfluorooctanesulfonamid oethanol	5	NSL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.002	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5
MePer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
EtPer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Total Positive PFHxS & PFOS	0.1	NSL	**0.0042**	**0.0053**	**0.037**	**0.014**	**0.015**	**0.0098**	**0.035**	**0.001**	**0.001**	<0.01	<0.01	**0.01**	**0.09**	**0.09**
Total Positive PFOS & PFOA	0.1	NSL	**0.0039**	**0.0063**	**0.048**	**0.018**	**0.019**	**0.0106**	**0.046**	**0.0008**	**0.0008**	<0.01	<0.01	**0.01**	**0.07**	**0.07**
Total Positive PFAS	0.1	NSL	**0.0077**	**0.0090**	**0.11**	**0.025**	**0.028**	**0.0204**	**0.10**	**0.0067**	**0.0068**	<0.01	<0.01	**0.01**	**0.09**	**0.09**

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE P2
SUMMARY OF PFAS CONCENTRATIONS IN GROUNDWATER - HUMAN HEALTH
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NEMP 2020 Recreational	SAMPLES													
			MW101	MW102	MW103	MW104	GWDUPA (envirolab)	GWDUPA (NMI)	GWDUPB (envirolab)	RW4.1.5	RW4.1.5 (lab replicate)	BH201 (0-0.1)/ ASLP	BH201 (0-0.1)/ ASLP (lab replicate)	BH203 (0.18-0.3)/ ASLP	BH205 (0.15-0.3)/ ALSP	BH205 (0.15-0.3)/ ALSP (lab replicate)
PFAS Compound																
Perfluorobutanesulfonic acid	0.1	NSL	**0.0006**	**0.001**	**0.0056**	**0.003**	**0.003**	**0.0017**	**0.0055**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanesulfonic acid	0.1	NSL	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorohexanesulfonic acid - PFHxS	0.1	NSL	**0.0009**	**0.0005**	**0.011**	**0.0026**	**0.0029**	**0.0032**	**0.011**	**0.001**	**0.0009**	<0.01	<0.01	<0.01	**0.02**	**0.02**
Perfluoroheptanesulfonic acid	0.1	NSL	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanesulfonic acid PFOS	0.1	NSL	**0.0034**	**0.0048**	**0.026**	**0.012**	**0.012**	**0.0066**	**0.024**	**0.0004**	**0.0004**	<0.01	<0.01	**0.01**	**0.07**	**0.07**
Perfluorodecanesulfonic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorobutanoic acid	0.2	NSL	**0.002**	<0.002	**0.006**	<0.002	<0.02	<0.005	**0.006**	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluoropentanoic acid	0.2	NSL	<0.002	<0.002	**0.009**	<0.002	<0.002	<0.002	**0.008**	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorohexanoic acid	0.1	NSL	<0.0004	**0.0006**	**0.0095**	**0.001**	**0.001**	<0.001	**0.0092**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoroheptanoic acid	0.1	NSL	<0.0004	**0.0006**	**0.014**	**0.001**	**0.002**	<0.001	**0.014**	<0.0004	<0.0004	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanoic acid PFOA	0.1	5.6	**0.0005**	**0.002**	**0.023**	**0.0066**	**0.0066**	**0.0046**	**0.022**	**0.0005**	**0.0004**	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorononanoic acid	0.1	NSL	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorodecanoic acid	0.5	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluoroundecanoic acid	0.5	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorododecanoic acid	0.5	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorotridecanoic acid	0.5	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
Perfluorotetradecanoic acid	5	NSL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.002	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5
4:2 FTS	0.1	NSL	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
6:2 FTS	0.1	NSL	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.001	<0.0004	**0.0050**	**0.0050**	<0.01	<0.01	<0.01	<0.01	<0.01
8:2 FTS	0.1	NSL	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.001	<0.0004	<0.0004	<0.0004	<0.02	<0.02	<0.02	<0.02	<0.02
10:2 FTS	0.1	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorooctane sulfonamide	1	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
N-Methyl perfluorooctane sulfonamide	1	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
N-Ethyl perfluorooctanesulfon amide	1	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1
N-Me perfluorooctanesulfonamid oethanol	1	NSL	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05
N-Et perfluorooctanesulfonamid oethanol	5	NSL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.002	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5
MePer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
EtPer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02	<0.02
Total Positive PFHxS & PFOS	0.1	0.7	**0.0042**	**0.0053**	**0.037**	**0.014**	**0.015**	**0.0098**	**0.035**	**0.001**	**0.001**	<0.01	<0.01	**0.01**	**0.09**	**0.09**
Total Positive PFOS & PFOA	0.1	NSL	**0.0039**	**0.0063**	**0.048**	**0.018**	**0.019**	**0.0106**	**0.046**	**0.0008**	**0.0008**	<0.01	<0.01	**0.01**	**0.07**	**0.07**
Total Positive PFAS	0.1	NSL	**0.0077**	**0.0090**	**0.11**	**0.025**	**0.028**	**0.0204**	**0.10**	**0.0067**	**0.0068**	<0.01	<0.01	**0.01**	**0.09**	**0.09**

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE P3
SUMMARY OF PFAS CONCENTRATIONS IN SOIL - ECOLOGY
Units are µg/Kg unless stated otherwise.

	PQL	NEMP 2020	NEMP 2020	BH201	BH201	IH201 (lab replicate	BH202	BH202	BH203	BH203	BH204	BH204	BH205	BH205 (lab replicate)	BH205	BH206	BH206	BH207	SDUPBB	SDUPAB	DUPAB (lab replicat	SS1	SS2	SS3
	Envirolab	Direct exposure	Indirect exposure	0-0.1	0.2-0.3	0.2-0.3	0.25-0.45	0.6-0.7	0.18-0.3	0.4-0.5	0.2-0.4	0.5-0.7	0.15-0.3	0.15-0.3	0.5-0.7	0.2-0.4	0.6-0.2	0.25-0.35	0.2-0.4	0-0.1	0-0.1	0-0.05	0-0.05	0-0.05
	Services	All land use	All land use	Fill: silty sand	Silty sand	Silty sand	Fill: silty sand	Sand	Fill: silty sand	Sand	Fill: silty sandy gravel	Silty sandy clay	Fill: silty sandy gravel	Fill: silty sandy gravel	Sand	Fill: silty sand	Sand	Fill: silty sandy gravel	Fill: silty sand	Fill: silty sand	Fill: silty sand	Fill: silty sandy gravel	Fill: silty sandy gravel	Fill: silty sandy gravel
PFAS Compound																								
Perfluorobutanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoropentanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorohexanesulfonic acid - PFHxS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.7	0.8	0.2	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoroheptanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorooctanesulfonic acid PFOS	0.1	1000	10	1.5	0.7	0.5	0.9	0.6	1.1	0.3	0.2	0.5	4.3	3.9	0.4	0.9	1.0	<0.1	0.9	1.3	1.3	0.5	0.2	<0.1
Perfluorodecanesulfonic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorobutanoic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluoropentanoic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorohexanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoroheptanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorooctanoic acid PFOA	0.1	10,000	NSL	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.7	0.1	0.2	0.2	0.2	0.1	<0.1	<0.1	0.2	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorononanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorodecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluoroundecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorododecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotridecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotetradecanoic acid	5	NSL	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
4:2 FTS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
6:2 FTS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
8:2 FTS	0.1	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
10:2 FTS	0.1	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorooctane sulfonamide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Methyl perfluorooctane sulfonamide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Ethyl perfluorooctanesulfon amide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Me perfluorooctanesulfonamid oethanol	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Et perfluorooctanesulfonamid oethanol	5	NSL	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
MePer uorooctanesulf-amid oacetic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
EtPer uorooctanesulf-amid oacetic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Total Positive PFHxS & PFOS	0.1	NSL	NSL	1.5	0.7	0.5	0.9	0.6	1.1	0.3	0.4	0.5	5.1	4.7	0.6	0.9	1.0	<0.1	0.9	1.3	1.3	0.5	0.2	<0.1
Total Positive PFOS & PFOA	0.1	NSL	NSL	1.5	0.7	0.5	1	0.6	1.1	0.3	0.9	0.6	4.6	4.2	0.6	1	1.0	<0.1	1.1	1.3	1.3	0.5	0.2	<0.1
Total Positive PFAS	0.1	NSL	NSL	1.5	0.7	0.5	1	0.6	1.1	0.3	1.6	0.6	5.5	5.2	0.8	1	1.0	<0.1	1.1	1.3	1.3	0.5	0.2	<0.1

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE P4
SUMMARY OF PFAS CONCENTRATIONS IN SOIL - HUMAN HEALTH
Units are µg/Kg unless stated otherwise.

	PQL Envirolab Services	NEMP 2020 Industrial/ Commercial	BH201 0-0.1 Fill: silty sand	BH201 0.2-0.3 Silty sand	I201 (lab replica 0.2-0.3 Silty sand	BH202 0.25-0.45 Fill: silty sand	BH202 0.6-0.7 Sand	BH203 0.18-0.3 Fill: silty sand	BH203 0.4-0.5 Sand	BH204 0.2-0.4 Fill: silty sandy gravel	BH204 0.5-0.7 Silty sandy clay	BH205 0.15-0.3 Fill: silty sandy gravel	BH205 (lab replicate) 0.15-0.3 Fill: silty sandy gravel	BH205 0.5-0.7 Sand	BH206 0.2-0.4 Fill: silty sand	BH206 0.6-0.2 Sand	BH207 0.25-0.35 Fill: silty sandy gravel	SDUPBB 0.2-0.4 Fill: silty sand	SDUPAB 0-0.1 Fill: silty sand	SDUPAB (lab replicate) 0-0.1 Fill: silty sand	SS1 0-0.05 Fill: silty sandy gravel	SS2 0-0.05 Fill: silty sandy gravel	SS3 0-0.05 Fill: silty sandy gravel
PFAS Compound																							
Perfluorobutanesulfonic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	**<0.5**	**<0.1**	**<0.1**	**<0.1**
Perfluoropentanesulfonic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorohexanesulfonic acid - PFHxS	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.7	0.8	0.2	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	**<0.1**
Perfluoroheptanesulfonic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorooctanesulfonic acid PFOS	0.1	NSL	**1.5**	**0.7**	**0.5**	**0.9**	**0.6**	**1.1**	**0.3**	**0.2**	**0.5**	**4.3**	**3.9**	**0.4**	**0.9**	**1.0**	**<0.1**	**0.9**	**1.3**	**1.3**	**0.5**	**0.2**	**<0.1**
Perfluorodecanesulfonic acid	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorobutanoic acid	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluoropentanoic acid	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorohexanoic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	**<0.1**
Perfluoroheptanoic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	**<0.1**
Perfluorooctanoic acid PFOA	0.1	50,000	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	1	0	0.2	0.2	0.2	0.1	<0.1	<0.1	0.2	**<0.5**	<0.5	<0.1	<0.1	**<0.1**
Perfluorononanoic acid	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorodecanoic acid	0.5	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluoroundecanoic acid	0.5	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorododecanoic acid	0.5	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotridecanoic acid	0.5	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotetradecanoic acid	5	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
4:2 FTS	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
6:2 FTS	0.1	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
8:2 FTS	0.1	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
10:2 FTS	0.1	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorooctane sulfonamide	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Methyl perfluorooctane sulfonamide	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Ethyl perfluorooctanesulfon amide	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Me perfluorooctanesulfonamid oethanol	1	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Et perfluorooctanesulfonamid oethanol	5	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
MePer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
EtPer uorooctanesulf-amid oacetic acid	0.2	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Total Positive PFHxS & PFOS	0.1	20,000	**2**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**5.1**	**4.7**	**0.6**	**0.9**	**1.0**	**<0.1**	**0.9**	**1**	**1.3**	**0.5**	**0.2**	**<0.1**
Total Positive PFOS & PFOA	0.1	NSL	**1.5**	**0.7**	**0.5**	**1**	**0.6**	**1.1**	**0.3**	**0.9**	**0.6**	**4.6**	**4.2**	**0.6**	**1**	**1.0**	**<0.1**	**1.1**	**1.3**	**1.3**	**0.5**	**0.2**	**<0.1**
Total Positive PFAS	0.1	NSL	**1.5**	**0.7**	**0.5**	**1**	**0.6**	**1.1**	**0.3**	**1.6**	**0.6**	**5.5**	**5.2**	**0.8**	**1**	**1.0**	**<0.1**	**1.1**	**1.3**	**1.3**	**0.5**	**0.2**	**<0.1**

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE P5
SUMMARY OF PFAS CONCENTRATIONS IN SOIL - WASTE CLASSIFICATION
Units are µg/Kg unless stated otherwise.

	PQL			BH201	BH201	201 (lab replica	BH202	BH202	BH203	BH203	BH204	BH204	BH205	BH205 (lab replicate)	BH205	BH206	BH206	BH207	SDUPBB	SDUPAB	DUPAB (lab replicate	SS1	SS2	SS3
	Envirolab	SCC1	SCC2	0-0.1	0.2-0.3	0.2-0.3	0.25-0.45	0.6-0.7	0.18-0.3	0.4-0.5	0.2-0.4	0.5-0.7	0.15-0.3	0.15-0.3	0.5-0.7	0.2-0.4	0.6-0.2	0.25-0.35	0.2-0.4	0-0.1	0-0.1	0-0.05	0-0.05	0-0.05
	Services			Fill: silty sand	Silty sand	Silty sand	Fill: silty sand	Sand	Fill: silty sand	Sand	Fill: silty sandy gravel	Silty sandy clay	Fill: silty sandy gravel	Fill: silty sandy gravel	Sand	Fill: silty sand	Sand	Fill: silty sandy gravel	Fill: silty sand	Fill: silty sand	Fill: silty sand	Fill: silty sandy gravel	Fill: silty sandy gravel	Fill: silty sandy gravel
PFAS Compound																								
Perfluorobutanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoropentanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorohexanesulfonic acid - PFHxS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.7	0.8	0.2	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoroheptanesulfonic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorooctanesulfonic acid PFOS	0.1	NSL	NSL	1.5	0.7	0.5	0.9	0.6	1.1	0.3	0.2	0.5	4.3	3.9	0.4	0.9	1.0	<0.1	0.9	1.3	1.3	0.5	0.2	<0.1
Perfluorodecanesulfonic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorobutanoic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluoropentanoic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorohexanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluoroheptanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorooctanoic acid PFOA	0.1	18,000	72,000	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	1	0	0.2	0.2	0.2	0.1	<0.1	<0.1	0.2	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorononanoic acid	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
Perfluorodecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluoroundecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorododecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotridecanoic acid	0.5	NSL	NSL	<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	<2	<2	<0.5	<0.5	<0.5
Perfluorotetradecanoic acid	5	NSL	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
4:2 FTS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
6:2 FTS	0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
8:2 FTS	0.1	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
10:2 FTS	0.1	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Perfluorooctane sulfonamide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Methyl perfluorooctane sulfonamide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Ethyl perfluorooctanesulfon amide	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Me perfluorooctanesulfonamid oethanol	1	NSL	NSL	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1
N-Et perfluorooctanesulfonamid oethanol	5	NSL	NSL	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<20	<20	<5	<5	<5
MePer uorooctanesulf-amid oacetic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
EtPer uorooctanesulf-amid oacetic acid	0.2	NSL	NSL	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1	<1	<0.2	<0.2	<0.2
Total Positive PFHxS & PFOS	0.1	1800	7,200	2	1	1	1	1	1	0	0	1	5.1	4.7	0.6	0.9	1.0	<0.1	0.9	1	1	0.5	0.2	<0.1
Total Positive PFOS & PFOA	0.1	NSL	NSL	1.5	0.7	0.5	1	0.6	1.1	0.3	0.9	0.6	4.6	4.2	0.6	1	1.0	<0.1	1.1	1.3	1.3	0.5	0.2	<0.1
Total Positive PFAS	0.1	NSL	NSL	1.5	0.7	0.5	1	0.6	1.1	0.3	1.6	0.6	5.5	5.2	0.8	1	1.0	<0.1	1.1	1.3	1.3	0.5	0.2	<0.1

Result above SCC1 Criteria **Bold**
Result above SCC2 Criteria **Bold**

TABLE P5
SUMMARY OF PFAS CONCENTRATIONS IN TCLP LEACHATE - WASTE CLASSIFICATION
Units are µg/L unless stated otherwise.

	PQL Envirolab Services	TCLP1	TCLP2	BH201 0-0.1 Fill: silty sand	BH201 0.2-0.3 Silty sand	BH201 (lab replicate) 0.2-0.3 Silty sand	BH202 0.25-0.45 Fill: silty sand	BH202 0.6-0.7 Sand	BH203 0.18-0.3 Fill: silty sand	BH203 0.4-0.5 Sand	BH204 0.2-0.4 Fill: silty sandy gravel	BH204 0.5-0.7 Silty sandy clay	BH205 0.15-0.3 Fill: silty sandy gravel	BH205 (lab replicate) 0.15-0.3 Fill: silty sandy gravel	BH205 0.5-0.7 Sand	BH206 0.2-0.4 Fill: silty sand	BH206 0.6-0.2 Sand	BH207 0.25-0.35 Fill: silty sandy gravel	SDUPBB 0.2-0.4 Fill: silty sand	SDUPAB 0-0.1 Fill: silty sand	SDUPAB (lab replicate) 0-0.1 Fill: silty sand	SS1 0-0.05 Fill: silty sandy gravel	SS2 0-0.05 Fill: silty sandy gravel	SS3 0-0.05 Fill: silty sandy gravel
PFAS Compound																								
Perfluorobutanesulfonic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoropentanesulfonic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorohexanesulfonic acid - PFHxS	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoroheptanesulfonic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanesulfonic acid PFOS	<0.01	NSL	NSL	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	<0.01	<0.01	0.07	0.06	0.01	0.01	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorodecanesulfonic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorobutanoic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.04
Perfluoropentanoic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorohexanoic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluoroheptanoic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorooctanoic acid PFOA	<0.01	500	2,000	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorononanoic acid	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perfluorodecanoic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluoroundecanoic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorododecanoic acid	<0.05	NSL	NSL	<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	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Perfluorotridecanoic acid	<0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Perfluorotetradecanoic acid	<0.5	NSL	NSL	<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	<0.5	<0.5	<0.5	<0.5
4:2 FTS	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6:2 FTS	<0.01	NSL	NSL	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
8:2 FTS	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
10:2 FTS	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Perfluorooctane sulfonamide	<0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
N-Methyl perfluorooctane sulfonamide	<0.05	NSL	NSL	<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	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Ethyl perfluorooctanesulfon amide	<0.1	NSL	NSL	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
N-Me perfluorooctanesulfonamid oethanol	<0.05	NSL	NSL	<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	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Et perfluorooctanesulfonamid oethanol	<0.5	NSL	NSL	<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	<0.5	<0.5	<0.5	<0.5
MePer uorooctanesulf-amid oacetic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
EtPer uorooctanesulf-amid oacetic acid	<0.02	NSL	NSL	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Positive PFHxS & PFOS	<0.01	50	200	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	<0.01	<0.01	0.09	0.08	0.01	0.01	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Positive PFOS & PFOA	<0.01	NSL	NSL	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.03	<0.01	0.07	0.06	0.01	0.01	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Positive PFAS	<0.01	NSL	NSL	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.03	<0.01	0.1	0.08	0.01	0.01	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Result above TCLP1 Criteria **Bold**
Result above TCLP2 Criteria **Bold**

TABLE P6
SUMMARY OF PFAS FIELD QA/QC IN SOIL
Units are µg/Kg unless stated otherwise.

			Perfluorobutanesulfonic acid	Perfluoropentanesulfonic acid	Perfluorohexanesulfonic acid - PFHxS	Perfluoroheptanesulfonic acid	Perfluorooctanesulfonic acid PFOS	Perfluorodecanesulfonic acid	Perfluorobutanoic acid	Perfluoropentanoic acid	Perfluorohexanoic acid	Perfluoroheptanoic acid	Perfluorooctanoic acid PFOA	Perfluorononanoic acid	Perfluorodecanoic acid	Perfluoroundecanoic acid	Perfluorododecanoic acid	Perfluorotridecanoic acid	Perfluorotetradecanoic acid	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	Perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamide	N-Ethyl perfluorooctanesulfon amide	N-Me perfluorooctanesulfonamid oethanol	N-Et perfluorooctanesulfonamid oethanol	MePer uorooctanesulfamid oacetic acid	EtPer uorooctanesulf-amid oacetic acid	Total Positive PFHxS & PFOS	Total Positive PFOS & PFOA	Total Positive PFAS
PQL Envirolab			*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.5*	*0.5*	*0.5*	*5*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*1*	*1*	*1*	*5*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*
PQL Envirolab VIC			*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.5*	*0.5*	*0.5*	*5*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*1*	*1*	*1*	*5*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*
Intra	BH206	0.2-0.4	<0.1	<0.1	<0.1	<0.1	0.9	<0.2	<0.2	<0.2	<0.1	<0.1	0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<5	<0.1	<0.1	<0.2	<0.2	<1	<1	<1	<1	<5	<0.2	<0.2	0.9	1	1
laboratory	SDUPBB	0.2-0.4	<0.1	<0.1	<0.1	<0.1	0.9	<0.2	<0.2	<0.2	<0.1	<0.1	0.2	<0.1	<0.5	<0.5	<0.5	<0.5	<5	<0.1	<0.1	<0.2	<0.2	<1	<1	<1	<1	<5	<0.2	<0.2	0.9	1.1	1.1
duplicate	MEAN		nc	nc	nc	nc	0.9	nc	nc	nc	nc	nc	0.15	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.9	1.05	1.05
	RPD %		nc	nc	nc	nc	0%	nc	nc	nc	nc	nc	67%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	10%	10%
Inter	BH201	0-0.1	<0.1	<0.1	<0.1	<0.1	1.5	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<5	<0.1	<0.1	<0.2	<0.2	<1	<1	<1	<1	<5	<0.2	<0.2	1.5	1.5	1.5
laboratory	SDUPAB	0-0.1	<0.5	<0.5	<0.5	<0.5	1.3	<1	<1	<1	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<2	<20	<0.5	<0.5	<1	<1	<5	<5	<5	<5	<20	<1	<1	1.3	1.3	1.3
duplicate	MEAN		nc	nc	nc	nc	1.4	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	1.4	1.4	1.4
	RPD %		nc	nc	nc	nc	14%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	14%	14%	14%
Field	FRA-HA	µg/L	<0.0004	<0.001	<0.0002	<0.001	<0.0002	<0.002	<0.002	<0.002	<0.0004	<0.0004	<0.0002	<0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	<0.0002	<0.0002	<0.0002
Rinsate	3:05:22 AM																																

Result outside of QA/QC acceptance criteria Value

TABLE P7
SUMMARY OF PFAS FIELD QA/QC IN GROUNDWATER
Units are µg/L unless stated otherwise.

		Perfluorobutanesulfonic acid	Perfluoropentanesulfonic acid	Perfluorohexanesulfonic acid - PFHxS	Perfluoroheptanesulfonic acid	Perfluorooctanesulfonic acid PFOS	Perfluorodecanesulfonic acid	Perfluorobutanoic acid	Perfluoropentanoic acid	Perfluorohexanoic acid	Perfluoroheptanoic acid	Perfluorooctanoic acid PFOA	Perfluorononanoic acid	Perfluorodecanoic acid	Perfluoroundecanoic acid	Perfluorododecanoic acid	Perfluorotrideanoic acid	Perfluorotetradecanoic acid	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	Perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamide	N-Ethyl perfluorooctanesulfon amide	N-Me perfluorooctanesulfonamid oethano	N-Et perfluorooctanesulfonamid oethanol	MePer uorooctanesulf-amid oacetic acid	EtPer uorooctanesulf-amid oacetic acid	Total Positive PFHxS & PFOS	Total Positive PFOS & PFOA	Total Positive PFAS
PQL Envirolab		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.5*	*0.5*	*0.5*	*5*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*1*	*1*	*1*	*5*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*
PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.5*	*0.5*	*0.5*	*5*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*1*	*1*	*1*	*5*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*
Intra	MW103	0.0056	0.002	0.011	<0.001	0.026	<0.002	0.006	0.009	0.0095	0.014	0.023	0.002	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	0.037	0.048	0.11
laboratory	GWDUPB (envirolab)	0.0055	0.002	0.011	<0.001	0.024	<0.002	0.006	0.008	0.0092	0.014	0.022	0.002	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	0.035	0.046	0.1
duplicate	MEAN	0.00555	0.002	0.011	nc	0.025	nc	0.006	0.0085	0.00935	0.014	0.0225	0.002	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.036	0.047	0.105
	RPD %	2%	0%	0%	nc	8%	nc	0%	12%	3%	0%	4%	0%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	6%	4%	10%
Intra	MW104	0.003	<0.001	0.0026	<0.001	0.012	<0.002	<0.002	<0.002	0.001	0.001	0.0066	<0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	0.014	0.018	0.025
laboratory	GWDUPA (envirolab)	0.003	<0.001	0.0029	<0.001	0.012	<0.002	<0.02	<0.002	0.001	0.002	0.0066	<0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	0.015	0.019	0.028
duplicate	MEAN	0.003	nc	0.00275	nc	0.012	nc	nc	nc	0.001	0.0015	0.0066	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.0145	0.0185	0.0265
	RPD %	0%	nc	11%	nc	0%	nc	nc	nc	0%	67%	0%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	7%	5%	11%
Inter	MW104	0.003	<0.001	0.0026	<0.001	0.012	<0.002	<0.002	<0.002	0.001	0.001	0.0066	<0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.005	<0.01	<0.005	<0.05	<0.002	<0.002	0.014	0.018	0.025
laboratory	GWDUPA (NMI)	0.0017	<0.001	0.0032	<0.001	0.0066	<0.001	<0.005	<0.002	<0.001	<0.001	0.0046	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.005	<0.005	0.0098	0.0106	0.0204
duplicate	MEAN	0.00235	nc	0.0029	nc	0.0093	nc	nc	nc	0.0255	0.0255	0.0056	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.0119	0.0143	0.0227
	RPD %	55%	nc	21%	nc	58%	nc	nc	nc	192%	192%	36%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	35%	52%	20%

Result outside of QA/QC acceptance criteria Value

Acid Sulfate Soil Results Summary Table

ABBREVIATIONS AND EXPLANATIONS FOR ACID SULFATE SOIL TABLE

Abbreviations used in the Tables:

ANC_{BT}	Acid Neutralising Capacity - Back Titration
ANCE	Excess Acid Neutralising Capacity
$CaCO_3$	Calcium Carbonate
kg	kilogram
mol H^+/t	moles hydrogen per tonne
pHF	Field pH
pHFOX	Field peroxide pH
pH_{KCl}	Pottasium chloride pH
S	Sulfur
SCr	The symbol given to the result from the Chromium Reducible Sulfur method
S_{NAS}	Net Acid Soluble Sulfur
% w/w	Percentage by mass

Results have been assessed against the criteria specified in Table 1.1 of National Acid sulfate Soil Guidance - National acid sulfate soil identification and laboratory method manual. Water Quality Australia. June 2018

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TABLE ASS1
SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOIL ANALYSIS

Soil Texture: Coarse		Analysis	pH_F and pH_{FOX}				pH_{KCL}	Actual Acidity (Titratable Actual Acidity - TAA)	Potential Sulfidic Acidity		Retained Acidity	Acid Neutralising Capacity (ANC_{BT})	a-Net Acidity without ANCE	s-Net Acidity without ANCE	Liming Rate - without ANCE
			pH_F	pH_{FOX}	Reaction	pH_F - pH_{FOX}		(mol H^+/t)	(% SCr)	(mol H^+/t)	(%S_{NAS})	(% $CaCO_3$)	(mol H^+/t)	(%w/w S)	(kg $CaCO_3$/tonne)
National Acid Sulfate Soils Guidance (2018)			-	-	-	-	-	-	-	-	-	-	18	0.03	-
Sample Reference	**Sample Depth (m)**	**Sample Description**													
BH101	0.03-0.4	Fill: Gravelly Sand	8.6	8.1	Volcanic reaction	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH101 - Lab duplicate	0.03-0.4	Fill: Gravelly Sand	8.6	8.1	Volcanic reaction	0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH101	0.5-0.95	Sand	9	8.9	Volcanic reaction	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH101	1.1-1.2	Clayey Sand	8.5	4.2	High reaction	4.3	8.9	<5	0.21	130	[NT]	0.65	130.0	0.21	9.9
BH101 - Lab duplicate	1.1-1.2	Clayey Sand	8.5	4.2	High reaction	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH101	2.4-2.5	Clayey Sand	7.9	5.7	High reaction	2.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH101	3.8-4.0	Sand	7.8	2.8	Low reaction	5	9.3	<5	0.12	76	[NT]	0.4	76.0	0.12	5.7
BH102	0.16-0.2	Fill: Silty Sand	8.3	6	Extreme reaction	2.3	7.9	<5	0.009	6	[NT]	0.3	5.5	0.01	<0.75
BH102	0.16-0.2	Lab Replicate	NA	NA	NA	NA	7.9	<5	0.009	6	[NT]	0.35	5.5	0.01	<0.75
BH102	0.5-0.6	Sand	8.1	5.1	Extreme reaction	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH102	0.9-0.95	Sand	7.8	4.1	Medium reaction	3.7	7	<5	0.007	4	[NT]	0.4	<5	0.01	<0.75
BH102	1.5-1.95	Clayey Sand	7.6	4.4	High reaction	3.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH102	2.4-2.5	Sand	7.5	1.8	Volcanic reaction	5.7	4.5	10	0.17	100	[NT]	[NT]	110.0	0.18	8.6
BH102	4.3-4.45	Silty Clay	7.2	5	High reaction	2.2	5.4	<5	<0.005	<3	[NT]	[NT]	<5	0.01	<0.75
BH103	0.21-0.4	Fill: Silty Sand	8.2	7.3	Volcanic reaction	0.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH103	0.7-0.95	Sand	7.8	3	High reaction	4.8	7.5	<5	0.09	56	[NT]	0.5	56.0	0.09	4.2
BH103	1.5-1.95	Clayey Sand	8.1	7.4	High reaction	0.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH103	2.4-2.5	Silty Sand	7.9	6.1	High reaction	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH103	3.0-3.45	Silty Sand	7.5	2.5	High reaction	5	4.7	<5	0.22	140	[NT]	[NT]	140.0	0.23	11
BH103	4.0-4.45	Silty Sand	7.7	5.8	Medium reaction	1.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	0-0.05	Fill: Silty Gravelly Sand	8.1	6.7	Extreme reaction	1.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	0.05-0.25	Silty Sand	7.7	4.8	Volcanic reaction	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	1.5-1.95	Sand	8	3.5	High reaction	4.5	8.4	<5	0.12	77	[NT]	0.5	77.0	0.12	5.8
BH104	2.4-2.5	Sand	7.7	4.1	Medium reaction	3.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104 - Lab duplicate	2.4-2.5	Sand	7.7	4.1	Medium reaction	3.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	3.0-3.45	Sand	7.3	2.6	Medium reaction	4.7	6.3	<5	0.02	13	[NT]	[NT]	13.0	0.02	0.98
BH104	4.0-4.45	Sand	7.4	6.4	Medium reaction	1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			26	26	-	26	11	11	11	11	11	11	11	11	11
Minimum Value			7.2	1.8	-	0.1	4.5	10	0.007	4	<PQL	0.30	5.5	0.005	0.98
Maximum Value			9.0	8.9	-	5.7	9.3	10	0.22	140	<PQL	0.65	140.0	0.23	11

Values Exceeding Action Criteria

JKE PSI Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC: Ambient Background Concentration
ACM: Asbestos Containing Material
ADWG: AustralianDrinking Water Guidelines
AF: Asbestos Fines
ANZG Australian and New Zealand Guidelines
B(a)P: Benzo(a)pyrene
CEC: Cation Exchange Capacity
CRC: Cooperative Research Centre
CT: Contaminant Threshold
EILs: Ecological Investigation Levels
ESLs: Ecological Screening Levels
FA: Fibrous Asbestos
GSW: General Solid Waste
HILs: Health Investigation Levels
HSLs: Health Screening Levels
kg/L kilograms per litre
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
%w/w: weight per weight
ppm: Parts per million
PCBs: Polychlorinated Biphenyls
PQL: Practical Quantitation Limit
RSL: Regional Screening Levels
RSW: Restricted Solid Waste
SAC: Site Assessment Criteria
SCC: Specific Contaminant Concentration
TB: Trip Blank
TCLP: Toxicity Characteristics Leaching Procedure
TRH: Total Recoverable Hydrocarbons
USEPA United States Environmental Protection Agency
VOCC: Volatile Organic Chlorinated Compounds
WHO: World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-D: 'Commercial/Industrial'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)									
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Total Phenolics (as Phenol)	TOTAL PCBs	ASBESTOS FIBRES
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1	100
Site Assessment Criteria (SAC)			3000	900	3600	240000	1500	730	6000	400000	4000	40	80	2000	2500	45	530	3600	50	240000	7	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH1	0.02-0.3	Fill: Clayey gravel	**7**	<0.4	**9**	**24**	**3**	<0.1	**4**	**8**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	**4**	<0.4	**9**	**19**	**2**	<0.1	**2**	**7**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	NA
BH1	1.0-1.3	Clayey sand	<4	<0.4	<1	<1	<1	<0.1	<1	**2**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0-0.2	Fill: Silty sand	<4	<0.4	**8**	**23**	**15**	<0.1	**6**	**89**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH2	0.5-0.7	Sand	<4	<0.4	<1	<1	<1	<0.1	<1	**3**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH3	0-0.1	Fill: Sandy silt	<4	<0.4	**12**	**19**	**32**	<0.1	**8**	**170**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH3	1.7-2.0	Clayey sand	**15**	<0.4	**3**	**2**	**2**	<0.1	**48**	**55**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH4	0-0.2	Fill: Sandy clay	<4	<0.4	**12**	**15**	**14**	<0.1	**6**	**310**	**1.6**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH4	1.5-1.8	Sand	<4	<0.4	**2**	**5**	**11**	<0.1	**5**	**21**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH5	0.02-0.4	Fill: Clayey gravel	**5**	<0.4	**7**	**17**	**3**	<0.1	**4**	**15**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	**4**	<0.4	**7**	**17**	**3**	<0.1	**5**	**15**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	NA
BH5	0.5-0.7	Sand	<4	<0.4	<1	**1**	**1**	<0.1	<1	**4**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH6	0.18-0.5	Fill: Gravelly sand	<4	<0.4	**17**	**130**	**50**	**0.3**	**18**	**470**	**8**	**1.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	**1.8**	Not Detected
BH6	0.5-0.95	Sand	<4	<0.4	**2**	**11**	**7**	<0.1	**3**	**60**	**0.08**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH7	0.17-0.3	Fill: Clayey sand	**4**	**0.6**	**18**	**970**	**160**	**1.7**	**13**	**1200**	**4.4**	**0.8**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	**0.7**	Not Detected
BH7	0.5-0.95	Sand	<4	<0.4	**2**	**14**	**8**	<0.1	**1**	**66**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	NA
BH8	0.19-0.3	Fill: Gravelly sand	**9**	**2**	**15**	**1900**	**260**	**6.3**	**14**	**5900**	**15**	**2.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	**3.3**	Not Detected
BH8 - [LAB_DUP]	0.19-0.3	Fill: Gravelly sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3**	NA
BH8	0.5-0.95	Sand	<4	<0.4	**2**	**3**	<1	<0.1	**2**	**10**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	NA
BH9	0.5-0.95	Sand	<4	<0.4	**1**	**14**	**7**	<0.1	<1	**21**	**0.4**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH9	1.5-1.95	Sand	<4	<0.4	**1**	**12**	**2**	<0.1	**1**	**19**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH10	0.17-0.5	Fill: Sandy clayey gravel	<4	<0.4	**9**	**140**	**32**	**0.2**	**17**	**150**	**0.99**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	<4	<0.4	**8**	**150**	**35**	**0.2**	**13**	**170**	**0.57**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NA
BH10	0.6-0.95	Sand	<4	<0.4	<1	**1**	<1	<0.1	<1	**11**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FCF1-BH7	0.17-0.3	FCF	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
SDUP1	-	Soil	<4	<0.4	**12**	**16**	**29**	<0.1	**9**	**170**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	NA
SDUP2	-	Soil	<4	<0.4	**24**	**380**	**63**	**1.2**	**17**	**580**	**7.2**	**1.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	NA
Total Number of Samples			25	25	25	25	25	25	25	25	25	25	17	17	17	17	17	17	17	17	18	11
Maximum Value			15	2	24	1900	260	6.3	48	5900	15	2.4	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	3.3	Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					HSL-D: COMMERCIAL/INDUSTRIAL							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH1	0.02-0.3	Fill: Clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH1	1.0-1.3	Clayey sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH2	0-0.2	Fill: Silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.7
BH2	0.5-0.7	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH3	0-0.1	Fill: Sandy silt	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.3
BH3	1.7-2.0	Clayey sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH4	0-0.2	Fill: Sandy clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH4	1.5-1.8	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH5	0.02-0.4	Fill: Clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH5	0.5-0.7	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH6	0.18-0.5	Fill: Gravelly sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	2.5
BH6	0.5-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH7	0.17-0.3	Fill: Clayey sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH7	0.5-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH8	0.19-0.3	Fill: Gravelly sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH8	0.5-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH9	0.5-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH9	1.5-1.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH10	0.17-0.5	Fill: Sandy clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH10	0.6-0.95	Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
SDUP1	-	Soil	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
SDUP2	-	Soil	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
TB-S1	-	Sand			<25	NA	<0.2	<0.5	<1	<3	<1	NA
Total Number of Samples					26	25	26	26	26	26	26	25
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	2.5

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH1	0.02-0.3	Fill: Clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH1	1.0-1.3	Clayey sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH2	0-0.2	Fill: Silty sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH2	0.5-0.7	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH3	0-0.1	Fill: Sandy silt	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH3	1.7-2.0	Clayey sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH4	0-0.2	Fill: Sandy clay	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH4	1.5-1.8	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH5	0.02-0.4	Fill: Clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH5	0.5-0.7	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH6	0.18-0.5	Fill: Gravelly sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH6	0.5-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH7	0.17-0.3	Fill: Clayey sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH7	0.5-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH8	0.19-0.3	Fill: Gravelly sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH8	0.5-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH9	0.5-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH9	1.5-1.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH10	0.17-0.5	Fill: Sandy clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
BH10	0.6-0.95	Sand	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUP1	-	Soil	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
SDUP2	-	Soil	0m to <1m	Sand	260	NL	3	NL	NL	230	NL
TB-S1	-	Sand				NA		NL	NL		NL

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**COMMERCIAL/INDUSTRIAL**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH1	0.02-0.3	Fine	<25	<50	<100	<100
BH1 - [LAB_DUP]	0.02-0.3	Fine	<25	<50	<100	<100
BH1	1.0-1.3	Fine	<25	<50	<100	<100
BH2	0-0.2	Coarse	<25	<50	<100	<100
BH2	0.5-0.7	Coarse	<25	<50	<100	<100
BH3	0-0.1	Fine	<25	<50	<100	<100
BH3	1.7-2.0	Fine	<25	<50	<100	<100
BH4	0-0.2	Fine	<25	<50	<100	<100
BH4	1.5-1.8	Coarse	<25	<50	<100	<100
BH5	0.02-0.4	Fine	<25	<50	<100	**100**
BH5 - [LAB_DUP]	0.02-0.4	Fine	<25	<50	<100	<100
BH5	0.5-0.7	Coarse	<25	<50	<100	<100
BH6	0.18-0.5	Coarse	<25	<50	**210**	<100
BH6	0.5-0.95	Coarse	<25	<50	<100	<100
BH7	0.17-0.3	Fine	<25	<50	**460**	**370**
BH7	0.5-0.95	Coarse	<25	<50	<100	<100
BH8	0.19-0.3	Coarse	<25	<50	**620**	**210**
BH8	0.5-0.95	Coarse	<25	<50	<100	<100
BH9	0.5-0.95	Coarse	<25	<50	<100	<100
BH9	1.5-1.95	Coarse	<25	<50	<100	<100
BH10	0.17-0.5	Fine	<25	<50	<100	<100
BH10 - [LAB_DUP]	0.17-0.5	Fine	<25	<50	<100	<100
BH10	0.6-0.95	Coarse	<25	<50	<100	<100
SDUP1	-	Fine	<25	<50	<100	<100
SDUP2	-	Coarse	<25	<50	<100	<100
TB-S1	-		<25	NA	NA	NA
Total Number of Samples			26	25	25	25
Maximum Value			<PQL	<PQL	620	370

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH1	0.02-0.3	Fine	800	1000	5000	10000
BH1 - [LAB_DUP]	0.02-0.3	Fine	800	1000	5000	10000
BH1	1.0-1.3	Fine	800	1000	5000	10000
BH2	0-0.2	Coarse	700	1000	3500	10000
BH2	0.5-0.7	Coarse	700	1000	3500	10000
BH3	0-0.1	Fine	800	1000	5000	10000
BH3	1.7-2.0	Fine	800	1000	5000	10000
BH4	0-0.2	Fine	800	1000	5000	10000
BH4	1.5-1.8	Coarse	700	1000	3500	10000
BH5	0.02-0.4	Fine	800	1000	5000	10000
BH5 - [LAB_DUP]	0.02-0.4	Fine	800	1000	5000	10000
BH5	0.5-0.7	Coarse	700	1000	3500	10000
BH6	0.18-0.5	Coarse	700	1000	3500	10000
BH6	0.5-0.95	Coarse	700	1000	3500	10000
BH7	0.17-0.3	Fine	800	1000	5000	10000
BH7	0.5-0.95	Coarse	700	1000	3500	10000
BH8	0.19-0.3	Coarse	700	1000	3500	10000
BH8	0.5-0.95	Coarse	700	1000	3500	10000
BH9	0.5-0.95	Coarse	700	1000	3500	10000
BH9	1.5-1.95	Coarse	700	1000	3500	10000
BH10	0.17-0.5	Fine	800	1000	5000	10000
BH10 - [LAB_DUP]	0.17-0.5	Fine	800	1000	5000	10000
BH10	0.6-0.95	Coarse	700	1000	3500	10000
SDUP1	-	Fine	800	1000	5000	10000
SDUP2	-	Coarse	700	1000	3500	10000
TB-S1	-			NA	NA	NA

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		26,000	20,000	27,000	38,000	430	99,000	27,000	81,000	11,000	
Site Use		COMMERCIAL/INDUSTRIAL - DIRECT SOIL CONTACT									
Sample Reference	**Sample Depth**										
BH1	0.02-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH1 - [LAB_DUP]	0.02-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH1	1.0-1.3	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH2	0-0.2	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**0.7**
BH2	0.5-0.7	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH3	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**0.3**
BH3	1.7-2.0	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH4	0-0.2	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH4	1.5-1.8	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH5	0.02-0.4	<25	<50	<100	**100**	<0.2	<0.5	<1	<3	<1	0
BH5 - [LAB_DUP]	0.02-0.4	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH5	0.5-0.7	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH6	0.18-0.5	<25	<50	**210**	<100	<0.2	<0.5	<1	<3	<1	**2.5**
BH6	0.5-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH7	0.17-0.3	<25	<50	**460**	**370**	<0.2	<0.5	<1	<3	<1	0
BH7	0.5-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH8	0.19-0.3	<25	<50	**620**	**210**	<0.2	<0.5	<1	<3	<1	0
BH8	0.5-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH9	0.5-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH9	1.5-1.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH10	0.17-0.5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH10 - [LAB_DUP]	0.17-0.5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH10	0.6-0.95	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
SDUP2	-	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
TB-S1	-	<25	NA	NA	NA	<0.2	<0.5	<1	<3	<1	NA
Total Number of Samples		26	25	25	25	26	26	26	26	26	25
Maximum Value		<PQL	<PQL	620	370	<PQL	<PQL	<PQL	<PQL	<PQL	2.5

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HIL-D:Commercial/Industrial

LABORATORY DATA											
Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
										0.05	**0.001**
282524	BH1	0.02-0.3	1096.5	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH2	0-0.2	677.56	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH3	0-0.1	738.58	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH4	0-0.2	667.58	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH5	0.02-0.4	1112.21	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH6	0.18-0.5	747.24	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH7	0.17-0.3	1090.72	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected: Synthetic mineral fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH8	0.19-0.3	1108.58	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH9	0.5-0.95	368.92	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
282524	BH10	0.17-0.5	1162.09	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001

TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																		
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																			
BH1	0.02-0.3	Fill: Clayey gravel	Fine	NA	NA	NA	**7**	**9**	**24**	**3**	**4**	**8**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	Fine	NA	NA	NA	**4**	**9**	**19**	**2**	**2**	**7**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH1	1.0-1.3	Clayey sand	Fine	NA	NA	NA	<4	<1	<1	<1	<1	**2**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH2	0-0.2	Fill: Silty sand	Coarse	NA	NA	NA	<4	**8**	**23**	**15**	**6**	**89**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH2	0.5-0.7	Sand	Coarse	NA	NA	NA	<4	<1	<1	<1	<1	**3**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH3	0-0.1	Fill: Sandy silt	Fine	NA	NA	NA	<4	**12**	**19**	**32**	**8**	**170**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH3	1.7-2.0	Clayey sand	Fine	NA	NA	NA	**15**	**3**	**2**	**2**	**48**	**55**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH4	0-0.2	Fill: Sandy clay	Fine	NA	NA	NA	<4	**12**	**15**	**14**	**6**	**310**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.2**
BH4	1.5-1.8	Sand	Coarse	NA	NA	NA	<4	**2**	**5**	**11**	**5**	**21**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH5	0.02-0.4	Fill: Clayey gravel	Fine	NA	NA	NA	**5**	**7**	**17**	**3**	**4**	**15**	<1	<0.1	<25	<50	<100	**100**	<0.2	<0.5	<1	<3	<0.05
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	Fine	NA	NA	NA	**4**	**7**	**17**	**3**	**5**	**15**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH5	0.5-0.7	Sand	Coarse	NA	NA	NA	<4	<1	**1**	**1**	<1	**4**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH6	0.18-0.5	Fill: Gravelly sand	Coarse	**8**	**17**	**6**	<4	**17**	**130**	**50**	**18**	**470**	<1	<0.1	<25	<50	**210**	<100	<0.2	<0.5	<1	<3	**0.73**
BH6	0.5-0.95	Sand	Coarse	NA	NA	NA	<4	**2**	**11**	**7**	**3**	**60**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.08**
BH7	0.17-0.3	Fill: Clayey sand	Fine	**8.3**	**11**	**15**	**4**	**18**	**970**	**160**	**13**	**1200**	<1	<0.1	<25	<50	**460**	**370**	<0.2	<0.5	<1	<3	**0.5**
BH7	0.5-0.95	Sand	Coarse	NA	NA	NA	<4	**2**	**14**	**8**	**1**	**66**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH8	0.19-0.3	Fill: Gravelly sand	Coarse	**7.4**	**2.9**	**5**	**9**	**15**	**1900**	**260**	**14**	**5900**	<1	<0.1	<25	<50	**620**	**210**	<0.2	<0.5	<1	<3	**1.5**
BH8	0.5-0.95	Sand	Coarse	NA	NA	NA	<4	**2**	**3**	<1	**2**	**10**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH9	0.5-0.95	Sand	Coarse	NA	NA	NA	<4	**1**	**14**	**7**	<1	**21**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.06**
BH9	1.5-1.95	Sand	Coarse	NA	NA	NA	<4	**1**	**12**	**2**	**1**	**19**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH10	0.17-0.5	Fill: Sandy clayey gravel	Fine	NA	NA	NA	<4	**9**	**140**	**32**	**17**	**150**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	Fine	NA	NA	NA	<4	**8**	**150**	**35**	**13**	**170**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
BH10	0.6-0.95	Sand	Coarse	NA	NA	NA	<4	<1	**1**	<1	<1	**11**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
SDUP1	-	Soil	Fine	NA	NA	NA	<4	**12**	**16**	**29**	**9**	**170**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
SDUP2	-	Soil	Coarse	NA	NA	NA	<4	**24**	**380**	**63**	**17**	**580**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.72**
TB-S1	-	Sand		NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	NA	<25	NA	NA	NA	<0.2	<0.5	<1	<3	NA
Total Number of Samples				3	3	3	25	25	25	25	25	25	26	17	26	25	25	25	26	26	26	26	25
Maximum Value				8.3	17	15	15	24	1900	260	48	5900	<PQL	<PQL	<PQL	<PQL	620	370	<PQL	<PQL	<PQL	<PQL	1.5

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0.02-0.3	Fill: Clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH1	1.0-1.3	Clayey sand	Fine	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	1300	5600	65	105	125	45	20
BH2	0-0.2	Fill: Silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH2	0.5-0.7	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH3	0-0.1	Fill: Sandy silt	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH3	1.7-2.0	Clayey sand	Fine	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	1300	5600	65	105	125	45	20
BH4	0-0.2	Fill: Sandy clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH4	1.5-1.8	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH5	0.02-0.4	Fill: Clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH5	0.5-0.7	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH6	0.18-0.5	Fill: Gravelly sand	Coarse	8	17	6	100	410	240	1300	280	820	170	180	180	120	300	2800	50	85	70	105	20
BH6	0.5-0.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH7	0.17-0.3	Fill: Clayey sand	Fine	8.3	11	15	100	410	240	1300	280	820	170	180	180	120	1300	5600	65	105	125	45	20
BH7	0.5-0.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH8	0.19-0.3	Fill: Gravelly sand	Coarse	7.4	2.9	5	100	330	120	1300	35	350	170	180	180	120	300	2800	50	85	70	105	20
BH8	0.5-0.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH9	0.5-0.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH9	1.5-1.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH10	0.17-0.5	Fill: Sandy clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH10	0.6-0.95	Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
SDUP1	-	Soil	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
SDUP2	-	Soil	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
TB-S1	-	Sand		NA	NA	NA	--	--	--	--	--	--	170	--	180	--	--	--					--

TABLE S7
SOIL LABORATORY TBT AND TOC RESULTS
All data in µg/kg unless stated otherwise

			TBT (as Sn)	TOC (mg/kg)	TOC (%)	TBT (Normalised to 1% TOC)
PQL - Envirolab Services			0.5	100	NA	NA
Sediment Quality Guideline (DGV - Low)			NSL	NSL	NSL	9
Sediment Quality Guideline (GV - High)			NSL	NSL	NSL	70
Sample Reference	**Sample Depth**	**Sample Description**				
BH6	0.18-0.5	Fill: Gravelly Sand	50	4400	0.44	113.64
BH7	0.17-0.3	Fill: Clayey Sand	140	6700	0.67	208.96
BH8	0.19-0.3	Fill: Gravelly Sand	2400	4800	0.48	5000.00
BH8	0.5-0.95	Sand	5	7600	0.76	6.58
BH9	0.5-0.95	Sand	<0.5	5400	0.54	<0.5
BH10	0.17-0.5	Fill: Sandy Clayey Gravel	60	3300	0.33	181.82
Total Number of samples			6	6	6	6
Maximum Value			2400	7600	0.76	5000

Concentration above the ecological SAC **VALUE**

TABLE S8
SOIL LABORATORY ASLP RESULTS
All data in µg/L unless stated otherwise

					TBT (as Sn)
PQL - Envirolab Services					0.002
ANZECC (2000) - Marine Waters					0.006
Sample Reference	**Sample Depth**	**Sample Description**	**Lab Report Number**	**Lab Report Date**	
BH8	0.19-0.3	Fill: Gravelly Sand	282524-A	3/12/2021	1800
BH8	0.19-0.3	Fill: Gravelly Sand	282524-B	8/12/2021	2000
Total Number of samples					1
Maximum Value					2000

Concentration above marine water SAC **VALUE**

TABLE S9
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH1	0.02-0.3	Fill: Clayey gravel	**7**	<0.4	**9**	**24**	**3**	<0.1	**4**	**8**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH1 - [LAB_DUP]	0.02-0.3	Fill: Clayey gravel	**4**	<0.4	**9**	**19**	**2**	<0.1	**2**	**7**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH1	1.0-1.3	Clayey sand	<4	<0.4	<1	<1	<1	<0.1	<1	**2**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH2	0-0.2	Fill: Silty sand	<4	<0.4	**8**	**23**	**15**	<0.1	**6**	**89**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH2	0.5-0.7	Sand	<4	<0.4	<1	<1	<1	<0.1	<1	**3**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH3	0-0.1	Fill: Sandy silt	<4	<0.4	**12**	**19**	**32**	<0.1	**8**	**170**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH3	1.7-2.0	Clayey sand	**15**	<0.4	**3**	**2**	**2**	<0.1	**48**	**55**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH4	0-0.2	Fill: Sandy clay	<4	<0.4	**12**	**15**	**14**	<0.1	**6**	**310**	**1.6**	**0.2**	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH4	1.5-1.8	Sand	<4	<0.4	**2**	**5**	**11**	<0.1	**5**	**21**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH5	0.02-0.4	Fill: Clayey gravel	**5**	<0.4	**7**	**17**	**3**	<0.1	**4**	**15**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH5 - [LAB_DUP]	0.02-0.4	Fill: Clayey gravel	**4**	<0.4	**7**	**17**	**3**	<0.1	**5**	**15**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH5	0.5-0.7	Sand	<4	<0.4	<1	**1**	**1**	<0.1	<1	**4**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH6	0.18-0.5	Fill: Gravelly sand	<4	<0.4	**17**	**130**	**50**	**0.3**	**18**	**470**	**8**	**0.73**	<0.1	NA	NA	NA	**1.8**	<25	<50	**100**	**140**	**240**	<0.2	<0.5	<1	<3	Not Detected
BH6	0.5-0.95	Sand	<4	<0.4	**2**	**11**	**7**	<0.1	**3**	**60**	**0.08**	**0.08**	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH7	0.17-0.3	Fill: Clayey sand	**4**	**0.6**	**18**	**970**	**160**	**1.7**	**13**	**1200**	**4.4**	**0.5**	<0.1	NA	NA	NA	**0.7**	<25	<50	**160**	**420**	**580**	<0.2	<0.5	<1	<3	Not Detected
BH7	0.5-0.95	Sand	<4	<0.4	**2**	**14**	**8**	<0.1	**1**	**66**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH8	0.19-0.3	Fill: Gravelly sand	**9**	**2**	**15**	**1900**	**260**	**6.3**	**14**	**5900**	**15**	**1.5**	<0.1	NA	NA	NA	**3.3**	<25	<50	**340**	**360**	**700**	<0.2	<0.5	<1	<3	Not Detected
BH8 - [LAB_DUP]	0.19-0.3	Fill: Gravelly sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH8	0.5-0.95	Sand	<4	<0.4	**2**	**3**	<1	<0.1	**2**	**10**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH9	0.5-0.95	Sand	<4	<0.4	**1**	**14**	**7**	<0.1	<1	**21**	**0.4**	**0.06**	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH9	1.5-1.95	Sand	<4	<0.4	**1**	**12**	**2**	<0.1	**1**	**19**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH10	0.17-0.5	Fill: Sandy clayey gravel	<4	<0.4	**9**	**140**	**32**	**0.2**	**17**	**150**	**0.99**	**0.1**	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH10 - [LAB_DUP]	0.17-0.5	Fill: Sandy clayey gravel	<4	<0.4	**8**	**150**	**35**	**0.2**	**13**	**170**	**0.57**	**0.1**	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH10	0.6-0.95	Sand	<4	<0.4	<1	**1**	<1	<0.1	<1	**11**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
FCF1-BH7	0.17-0.3	FCF	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
SDUP1	-	Soil	<4	<0.4	**12**	**16**	**29**	<0.1	**9**	**170**	<0.05	<0.05	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
SDUP2	-	Soil	<4	<0.4	**24**	**380**	**63**	**1.2**	**17**	**580**	**7.2**	**0.72**	<0.1	NA	NA	NA	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
TB-S1	-	Sand	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<25	NA	NA	NA	NA	<0.2	<0.5	<1	<3	NA
Total Number of Samples			25	25	25	25	25	25	25	25	25	25	17	0	0	0	18	26	25	25	25	25	26	26	26	26	11
Maximum Value			15	2	24	1900	260	6.3	48	5900	15	1.5	<PQL	<PQL	<PQL	<PQL	3.3	<PQL	<PQL	340	420	700	<PQL	<PQL	<PQL	<PQL	Detected

Concentration above the CT1 — VALUE
Concentration above SCC1 — VALUE
Concentration above the SCC2 — VALUE
Concentration above PQL — **Bold**

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TABLE S10
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Lead	Mercury	Nickel	B(a)P
PQL - Envirolab Services			0.03	0.0005	0.02	0.001
TCLP1 - General Solid Waste			5	0.2	2	0.04
TCLP2 - Restricted Solid Waste			20	0.8	8	0.16
TCLP3 - Hazardous Waste			>20	>0.8	>8	>0.16
Sample Reference	**Sample Depth**	**Sample Description**				
BH3	1.7-2.0	Clayey sand	NA	NA	**0.04**	NA
BH7	0.17-0.3	Fill: Clayey sand	<0.03	NA	NA	NA
BH8	0.19-0.3	Fill: Gravelly sand	**0.34**	<0.0005	NA	<0.001
Total Number of samples			2	1	1	1
Maximum Value			0.34	<PQL	0.04	<PQL

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

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TABLE Q1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene
	PQL Envirolab SYD		25	50	100	100	0.2	0.5	1	2	1
	PQL Envirolab VIC		25	50	100	100	0.2	0.5	1	2	1
Intra	BH3	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1
laboratory	SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH6	0.18-0.5	<25	<50	210	<100	<0.2	<0.5	<1	<2	<1
laboratory	SDUP2	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1
duplicate	MEAN		nc	nc	130	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	123%	nc	nc	nc	nc	nc	nc
Field	TB-S1	-	<25	NA	NA	NA	<0.2	<0.5	<1	<2	<1
Blank	2/11/21										

			Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.05	0.1	0.1	0.1
	PQL Envirolab VIC		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.05	0.1	0.1	0.1
Intra	BH3	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
laboratory	SDUP1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH6	0.18-0.5	<0.1	<0.1	0.2	0.1	0.7	0.1	1.4	1.1	0.7	0.6	1	0.73	0.5	<0.1	0.5
laboratory	SDUP2	-	<0.1	<0.1	<0.1	0.1	0.4	<0.1	1.2	1	0.6	0.7	1.4	0.72	0.5	0.1	0.5
duplicate	MEAN		nc	nc	0.125	0.1	0.55	0.075	1.3	1.05	0.65	0.65	1.2	0.725	0.5	0.075	0.5
	RPD %		nc	nc	120%	0%	55%	67%	15%	10%	15%	15%	33%	1%	0%	67%	0%
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	2/11/21																

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	PQL Envirolab VIC		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Intra	BH3	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH6	0.18-0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP2	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	2/11/21																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel
	PQL Envirolab SYD		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	PQL Envirolab VIC		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Intra	BH3	0-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUP1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH6	0.18-0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUP2	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	2/11/21													

			Total PCBS	Total phenolics (as Phenol)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		0.1	5	4	0.4	1	1	1	0.1	1	1
	PQL Envirolab VIC		0.1	0.2	4	0.4	1	1	1	0.1	1	1
Intra	BH3	0-0.1	<0.1	<5	<4	<0.4	12	19	32	<0.1	8	170
laboratory	SDUP1	-	<0.1	<5	<4	<0.4	12	16	29	<0.1	9	170
duplicate	MEAN		nc	nc	nc	nc	12	17.5	30.5	nc	8.5	170
	RPD %		nc	nc	nc	nc	0%	17%	10%	nc	12%	0%
Inter	BH6	0.18-0.5	1.8	<5	<4	<0.4	17	130	50	0.3	18	470
laboratory	SDUP2	-	<0.1	<0.2	<4	<0.4	24	380	63	1.2	17	580
duplicate	MEAN		0.925	nc	nc	nc	20.5	255	56.5	0.75	17.5	525
	RPD %		189%	nc	nc	nc	34%	98%	23%	120%	6%	21%
Field	TB-S1	-	NA		NA	NA	NA	NA	NA	NA	NA	NA
Blank	2/11/21											

Result outside of QA/QC acceptance criteria (highlighted)

JKGeotechnics

BOREHOLE LOG

Borehole No. 1

1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.60 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						1	0		-	ASPHALTIC CONCRETE: 20mm.t FILL: Clayey gravel, fine to medium grained, orange brown, angular, gravel, medium plasticity clay.	D			APPEARS WELL TO MODERATELY COMPACTED
					N = 36 15,19,17				SP	SAND: fine to medium grained, grey, with shells.	D			
▶						0	1		SC	Clayey SAND: fine to medium grained, dark grey.	W	(L)		MARINE
					N = 3 3,2,1	-1	2		SP	SAND: fine to medium grained, with shells.		VL		
							3					MD		
					N = 12 3,5,7	-2								
							4			END OF BOREHOLE AT 3.95 m				
						-3	5							
						-4	6							
						-5								

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BOREHOLE LOG

Borehole No. 2
1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.60 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty sand, fine to medium grained, dark brown.	D			
										FILL: Sand, fine to medium grained, brown, with gravel.				
	■					1	1		SP	SAND: fine to medium grained, yellow brown.	W	MD		MARINE
	■				N = 13 5,5,8									
						0	2			SAND: fine to medium grained, dark brown, with clay and shells.	M			
				■	N = 11 4,5,6	-1			CI	Silty CLAY: low to medium plasticity, grey mottled brown.	w<PL	(VSt - Hd)		RESIDUAL
							3			END OF BOREHOLE AT 2.95 m				TOO FRIABLE FOR HP TESTING
						-2	4							
						-3	5							
						-4	6							
						-5								

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BOREHOLE LOG

Borehole No. 3
1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.70 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Sandy silt, low plasticity, dark brown, fine to medium grained sand.	D			
										FILL: Gravelly sand, fine to coarse grained, brown, fine to coarse grained angular gravel.				
						1	1		SP	SAND: fine to medium grained, yellow brown, trace of fine grained gravel.	D	MD		MARINE
					N = 17 8,8,9									
▶						0	2		SC	Clayey SAND: fine to medium grained, dark grey, medium plasticity clay.	M			
									CI	Silty CLAY: medium plasticity, brown mottled grey.	w<PL	VSt - Hd		RESIDUAL
					N = 31 12,13,18	-1							350 350	
						-2	3			END OF BOREHOLE AT 2.95 m				
						-3	4							
						-4	5							
						-5	6							

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BOREHOLE LOG

Borehole No. 4

1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.90 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Sandy clay topsoil, medium plasticity, dark brown.	D			APPEARS MODERATELY COMPACTED
					N = 9 4,4,5	1	1			FILL: Sand, fine to medium grained, yellow brown, with fine to medium grained gavel, and shells.				
▶						0	2		SP	SAND: fine to medium grained, grey, with shells.	M	VL - L		MARINE ORGANIC ODOUR
					N = 4 3,2,2									
						-1	3		CI	Silty CLAY: medium plasticity, grey.	w~PL	(VSt - Hd)		RESIDUAL TOO FRIABLE FOR HP TESTING
					N > 24 13,24/ 150mm REFUSAL									
						-2	4			END OF BOREHOLE AT 3.30 m				
						-3	5							
						-4	6							
						-5								

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BOREHOLE LOG

Borehole No. 5
1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.50 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	ASPHALTIC CONCRETE: 20mm.t	D			
										FILL: Clayey gravel, fine to medium grained, orange brown, medium plasticity clay.				
						1			SP	SAND: fine to medium grained, light grey and yellow brown, with shell fragments.	D	MD		MARINE
▶					N = 22 12,13,9		1							
						0				SAND: fine to medium grained, grey, with shells.	W			
							2					L		
					N = 7 1,1,6	-1								
					N = 33 7,11,22		3		Cl	Silty CLAY: medium plasticity, grey brown.	w<PL	(VSt - Hd)		RESIDUAL TOO FRIABLE FOR HP TESTING
						-2			-	Extremely Weathered phyllite: silty CLAY, medium plasticity, grey and brown.	XW	(Hd)		NERANLEIGH - FERN GROUP
							4			END OF BOREHOLE AT 3.95 m				
						-3								
							5							
						-4								
							6							
						-5								

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BOREHOLE LOG

Borehole No. 6

1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.50 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										CONCRETE: 180mm.t				
									-	FILL: Gravelly sand, fine to medium grained, yellow brown, fine to medium grained gravel.	D			
					N = 13 10,8,5	1	1		SP	SAND: fine to medium grained, yellow brown, with shells.	D	MD		MARINE
					N = 9 1,4,5	0	2					L		
						-1				SAND: fine to medium grained, grey, with silty and shells.	M			ORGANIC ODOUR
					N = 7 1,3,4		3			SAND: fine to medium grained, grey.				
						-2	4			END OF BOREHOLE AT 3.45 m				
						-3	5							
						-4	6							
						-5								

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BOREHOLE LOG

Borehole No. 7

1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.50 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										CONCRETE: 170mm.t				
									-	FILL: Clayey sand, fine to medium grained, brown, medium plasticity clay.	M			SCREEN: 0.17-0.3m FCF1
									SP	SAND: fine to medium grained, light grey, with shells.	M	L - MD		MARINE
					N = 10 5,4,6	1	1							
										SAND: fine to medium grained, dark grey, with shells.		L		
					N = 5 1,3,2	0								
							2			END OF BOREHOLE AT 2.00 m				
						-1	3							
						-2	4							
						-3	5							
						-4	6							
						-5								

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BOREHOLE LOG

Borehole No. 8
1 / 1

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~0.30 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										CONCRETE: 190mm.t				
						0			-	FILL: Gravelly sand, fine to medium grained, dark grey, fine to coarse grained, angular, gravel.	M			
									SP	SAND: fine to medium grained, dark grey, with silt.	M	L		MARINE
▶					N = 7 2,3,4	-1	1							
							2			END OF BOREHOLE AT 2.00 m				
						-2								
							3							
						-3								
							4							
						-4								
							5							
						-5								
							6							
						-6								

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BOREHOLE LOG

Borehole No. 9 **1 / 1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.30 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										CONCRETE: 250mm.t				
						1			SP	SAND: fine to medium grained, yellow mottled brown.	M	VL		MARINE
	■			■	N = 2 1,1,1		1							
▶						0				SAND: fine to medium grained, grey, trace of silt.	W			
	■			■	N=0 0,0,0		2							
						-1				END OF BOREHOLE AT 2.00 m				
							3							
						-2								
							4							
						-3								
							5							
						-4								
							6							
						-5								

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BOREHOLE LOG

Borehole No. 10 **1 / 1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: 34453UR **Method:** SPIRAL AUGER **R.L. Surface:** ~1.60 m

Date: 2/11/21 **Datum:** AHD

Plant Type: TRUCK MOUNTED DRILL RIG **Logged/Checked By:** R.G.S./P.R.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										CONCRETE: 120mm.t				
									-	FILL: Sandy clayey gravel, fine to medium grained, brown.	D			APPEARS MODERATELY COMPACTED
					N = 25 12,14,11	1	1		SP	SAND: fine to medium grained, light grey.	D	MD		MARINE
					N = 2 1,1,1	0					M	VL		
							2			SAND: fine to medium grained, dark grey, with clay.	W	(VL)		
					N = 28 8,10,18	-1	3		CI	Silty CLAY: medium plasticity, grey brown.	w<PL	(VSt - Hd)		RESIDUAL TOO FRIABLE FOR HP TESTING
						-2				END OF BOREHOLE AT 3.45 m				
							4							
						-3								
							5							
						-4								
							6							
						-5								

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH101 1/1

SDUP103: 0.03-0.4m

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: TRUCK DRILL RIG **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, DB)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 30mm.t	M			SCREEN: 4.5kg 0.03-0.4m
						FILL: Gravelly sand, fine to medium grained, yellow brown, fine to medium grained, sub-angular, igneous gravel.				NO FCF
ON 17/12/21		N = 28 9,14,14			SP	SAND: fine to medium grained, yellow brown, trace of shells.	M			MARINE
			1		SC	Clayey SAND: fine to medium grained, brown.	W			
		N = 2 1,1,1								
			2							
		N = 5 2,2,3	3		SP	SAND: fine to medium grained, grey, trace of shells.				
		N = 10 5,6,4	4							
						END OF BOREHOLE 4.5m				GROUNDWATER MONITORING WELL INSTALLED TO 4.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.5m TO 4.5m. CASING 0.03m TO 0.5m. 2mm SAND FILTER PACK 0.5m TO 4.5m. BENTONITE SEAL 0.2m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
			5							
			6							
			7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH102** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: TRUCK DRILL RIG **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES (ES / ASS / ASB / SAL / DB)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			CONCRETE: 160mm.t				
					-	FILL: Silty sand, fine to medium grained, yellow brown, trace of igneous gravel.	M			SCREEN: 4.0kg 0.16-0.2m NO FCF
					SP		M			
		N = 7 3,4,3				SAND: fine to medium grained, yellow brown, trace of shells.				MARINE
ON 17/12/21			1			as above, but wet.	W			
		N = 2 1,1,1			SC	Clayey SAND: fine to medium grained, dark brown.				
			2		SP	SAND: fine to medium grained, grey.				
		N = 12 3,5,7	3							
			4		CH	Silty CLAY: high plasticity, grey, trace of sand.	w>PL			
		N = 22 8,9,13								
						END OF BOREHOLE AT 4.5m				GROUNDWATER MONITORING WELL INSTALLED TO 4.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.5m TO 4.5m. CASING 0.16m TO 0.5m. 2mm SAND FILTER PACK 0.5m TO 4.5m. BENTONITE SEAL 0.16m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
			5							
			6							
			7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH103 1/1

SDUP101: 0.21-0.4m

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: TRUCK DRILL RIG **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, DB)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			CONCRETE: 210mm.t				
					-	FILL: Silty sand, fine to medium grained, brown, trace of igneous gravel, clay fines, coal and steel.	M			SCREEN: 6.05kg 0.21-0.7m NO FCF
ON 17/12/21		N > 13 5,13/ 150mm REFUSAL	1		SP	SAND: fine to medium grained, yellow.	M			MARINE
						as above, but wet.	W			
		N = 3 1,1,2			SC	Clayey SAND: fine to medium grained, brown.				ORGANIC ODOUR
			2		SM	Silty SAND: fine to medium grained, trace of shells.				
		N = 5 3,2,3	3							
		N = 35 15,15,20	4							
			5			END OF BOREHOLE AT 4.5m				GROUNDWATER MONITORING WELL INSTALLED TO 4.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.5m TO 4.5m. CASING 0.5m TO 0.2m. 2mm SAND FILTER PACK 0.5m TO 4.5m. BENTONITE SEAL 0.2m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
			6							
			7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH104 1/1

SDUP102: 0-0.05m

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: TRUCK DRILL RIG **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES (ES, ASS, ASB, SAL, DB)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
ON 13/1/22 AND 5/5/22			0		SM	FILL: Silty gravelly sand, brown, fine to medium grained igneous and sandstone gravel, trace of paint flakes, shells and steel.	M W			SCREEN: 17.5kg 0-0.05m NO FCF
		N = 24 5,8,14	1			Silty SAND: fine to medium grained, dark grey, trace of wood fibres.				MARINE
		N = 12 2,4,8	2		SP	SAND: fine to medium grained, grey.				
		N = 28 11,12,16	3							
		N = 29 11,17,12	4							
			5			END OF BOREHOLE AT 4.5m				GROUNDWATER MONITORING WELL INSTALLED TO 4.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.2m TO 4.5m. BENTONITE AND CONCRETE SEAL 0.2m TO SURFACE. PVC STAND PIPE STICK UP 1.08m NOTE: BH/MW104 IS INUNDATED BY TERRANORA CREEK SURFACE WATER AT HIGH TIDE.
			6							
			7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH105** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: - **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■		■		0			FILL: Silty sand, fine to medium grained, dark grey, trace of wood, steel and shells.	M			SCREEN: 14.5kg 0-0.1m NO FCF
▶	■		■		■				SP	SAND: fine to medium grained, yellow brown, with shells.	W			MARINE
										END OF BOREHOLE AT 0.6m				SCREEN: 11.95kg 0.1-0.4m NO FCF
							1							HAND AUGER REFUSAL DUE TO BOREHOLE COLLAPSE
							2							
							3							
							4							
							5							
							6							
							7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH106** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 16/12/21 **Datum:** -

Plant Type: - **Logged/Checked by:** H.W./M.D.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■		■		0			FILL: Silty sand, fine to medium grained, yellow brown, trace of igneous and sandstone gravel, concrete fragments and plastic.	M			SCREEN: 10.95kg 0-0.1m NO FCF
										END OF BOREHOLE AT 0.5m				SCREEN: 10.30kg 0.1-0.5m NO FCF
							1							HAND AUGER REFUSAL
							2							
							3							
							4							
							5							
							6							
							7							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH201 1/1

SDUPAB (0-0.1)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 3/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty sand, fine to medium grained, with shell fragments, trace of igneous gravel, organic matter and paint fragments	W			SCREEN: 13.13kg 0-0.1m NO FCF
	■								SM		W			ORGANIC ODOUR
										Silty SAND: fine to medium grained, dark grey, trace of shell.				MARINE
										END OF BOREHOLE AT 0.5m				
							1							
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH202** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■				0		-	CONCRETE: 250mm.t				
									-	FILL: Silty sand, fine to medium grained, brown, trace of igneous and ironstone gravel, ash and root fibres.	M			SCREEN: 6.31kg 0.25-0.5m NO FCF
	■								SP	SAND: fine to medium grained, yellow brown.	M			MARINE
							1			END OF BOREHOLE 1.0m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH203** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 3/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 180mm.t				
									-	FILL: Silty sand, fine to medium grained, brown, trace of ash and plastic.	D M			SCREEN: 4.45kg 0.18-0.3m NO FCF
	■								SP	SAND: fine to medium grained, yellow brown.	M			MARINE
							1			as above, but grey.				
										END OF BOREHOLE AT 0.7m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH204** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 200mm.t				
									-	FILL: Silty sandy gravel, igneous, brown, fine to medium grained sand, trace of ironstone gravel and ash.	D			SCREEN: 5.95kg 0.2-0.5m
	■								CL	Silty Sandy CLAY: low plasticity, dark brown, fine to medium grained sand, trace of ash and root fibres.	w>PL			NO FCF MARINE
							1			END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH205** **1/1**

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 150mm.t				
									-	FILL: Silty sandy gravel, igneous, brown, fine to medium grained sand,	D			SCREEN: 6.23kg 0.15-0.4m
	■								SP	trace of ironstone gravel and ash.	M			NO FCF
										SAND: fine to medium grained, yellow brown, trace of shells.				MARINE
							1			END OF BOREHOLE AT 1.0m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH206 1/1

SDUPBB (0.2-0.4)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION							0		-	CONCRETE: 200mm.t				
	■		■						-	FILL: Silty sand, fine to medium grained, with igneous gravel, trace of basalt cobbles, wire, shell fragments and ash.	D			SCREEN: 0.2-0.8m
	■								SP	SAND: fine to medium grained, yellow brown, trace of shells.	M			MARINE
							1			END OF BOREHOLE AT 1.1m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH207** **1/1**

SDUPPCB (0.25-0.35)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■						0		-	ASPHALTIC CONCRETE: 50mm.t				
									-	CONCRETE: 200mm.t				
									-	FILL: Silty sandy gravel, brown, igneous, fine to medium grained sand trace of igneous cobbles.	D			HAND AUEGR REFUSAL DUE TO ELECTRICAL CABLE
										END OF BOREHOLE AT 0.35m				
							1							
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH201** **1/1**

SDUPAB (0-0.1)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 3/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	FILL: Silty sand, fine to medium grained, with shell fragments, trace of igneous gravel, organic matter and paint fragments	W			SCREEN: 13.13kg
	■								SM		W			0-0.1m
														NO FCF
														ORGANIC ODOUR
										Silty SAND: fine to medium grained, dark grey, trace of shell.				MARINE
										END OF BOREHOLE AT 0.5m				
							1							
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH202** 1/1

Environmental logs are not to be used for geotechnical purposes

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0		-	CONCRETE: 250mm.t				
	■		■						-	FILL: Silty sand, fine to medium grained, brown, trace of igneous and ironstone gravel, ash and root fibres.	M			SCREEN: 6.31kg 0.25-0.5m NO FCF
	■								SP	SAND: fine to medium grained, yellow brown.	M			MARINE
							1			END OF BOREHOLE 1.0m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No.
BH203
1/1

Environmental logs are not to be used for geotechnical purposes

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 3/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 180mm.t				
									-	FILL: Silty sand, fine to medium grained, brown, trace of ash and plastic.	D			SCREEN: 4.45kg 0.18-0.3m NO FCF
	■								SP		M			
										SAND: fine to medium grained, yellow brown.	M			MARINE
							1			as above, but grey.				
										END OF BOREHOLE AT 0.7m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH204** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 200mm.t				
									-	FILL: Silty sandy gravel, igneous, brown, fine to medium grained sand, trace of ironstone gravel and ash.	D			SCREEN: 5.95kg 0.2-0.5m NO FCF
	■								CL	Silty Sandy CLAY: low plasticity, dark brown, fine to medium grained sand, trace of ash and root fibres.	w>PL			MARINE
							1			END OF BOREHOLE AT 0.7m				HAND AUGER REFUSAL
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Log No. **BH205** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■				0		-	CONCRETE: 150mm.t				
									-	FILL: Silty sandy gravel, igneous, brown, fine to medium grained sand,	D			SCREEN: 6.23kg 0.15-0.4m
	■								SP	trace of ironstone gravel and ash.	M			NO FCF
										SAND: fine to medium grained, yellow brown, trace of shells.				MARINE
							1			END OF BOREHOLE AT 1.0m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH206 1/1

SDUPBB (0.2-0.4)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	■		■				0		-	CONCRETE: 200mm.t				
									-	FILL: Silty sand, fine to medium grained, with igneous gravel, trace of basalt cobbles, wire, shell fragments and ash.	D			SCREEN: 6.7kg 0.2-0.6m NO FCF
	■								SP	SAND: fine to medium grained, yellow brown, trace of shells.	M			MARINE
							1			END OF BOREHOLE AT 1.1m				
							2							
							3							
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH207** **1/1**

SDUPPCB (0.25-0.35)

Client: HASKONING AUSTRALIA PTY LTD

Project: PROPOSED TRAVEL LIFT BOAT FACILITY

Location: 8 TERRANORA TERRACE, TWEED HEADS, NSW

Job No.: E34453UBD **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 6/5/22 **Datum:** -

Plant Type: - **Logged/Checked by:** M.D./ V.B.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0		-	ASPHALTIC CONCRETE: 50mm.t				
									-	CONCRETE: 200mm.t				
									-	FILL: Silty sandy gravel, brown, igneous, fine to medium grained sand, trace of igneous cobbles.	D			HAND AUEGR REFUSAL DUE TO ELECTRICAL CABLE
										END OF BOREHOLE AT 0.35m				
							1							
							2							
							3							
							4							
							5							
							6							
							7							

ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the

structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
Fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

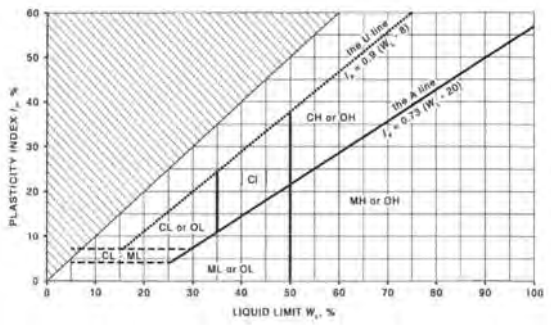
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

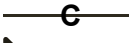
3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	$w > PL$ $w \approx PL$ $w < PL$ $w \approx LL$ $w > LL$	Moisture content estimated to be greater than plastic limit. Moisture content estimated to be approximately equal to plastic limit. Moisture content estimated to be less than plastic limit. Moisture content estimated to be near liquid limit. Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D M W	DRY – runs freely through fingers. MOIST – does not run freely but no free water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S F St VSt Hd Fr ( )	VERY SOFT – unconfined compressive strength ≤ 25kPa. SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa. FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa. STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa. VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa. HARD – unconfined compressive strength > 400kPa. FRIABLE – strength not attainable, soil crumbles. Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)	VL L MD D VD ( )	**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)** VERY LOOSE ≤ 15 / 0 – 4 LOOSE > 15 and ≤ 35 / 4 – 10 MEDIUM DENSE > 35 and ≤ 65 / 10 – 30 DENSE > 65 and ≤ 85 / 30 – 50 VERY DENSE > 85 / > 50 Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Appendix D: Guidelines and Reference Documents

Contaminated Land Management Act 1997 (NSW)

Environmental Planning and Assessment Act 1979 (NSW)

Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

NSW EPA, (2020). Consultants Reporting on Contaminated Land, Contaminated Land Guidelines

National Environment Protection Council (NEPC), (2013). National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

Protection of the Environment Operations Act 1997 (NSW)

State Environmental Planning Policy No.55 – Remediation of Land 1998 (NSW)

Work Health and Safety Regulation 2017 (NSW)

Western Australian Department of Health (DoH), (2021). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia

Appendix B
DPI Permit

NSW GOVERNMENT | Department of Primary Industries

OUR REF: PN22/289

10 August 2022

Transport for NSW
PO Box K659
HAYMARKET NSW 2008
Via email: ali.watters@rhdhv.com, julian.burgess2@transport.nsw.gov.au

Attention: Ali Watters

Dear Ms Watters

Re: Permit # PN22/289 for harm marine vegetation work associated with the removal of 24 mangrove seedlings in order to convert an existing slipway to a marine travel lift, Southern Boat Harbour, off Terranora Inlet, Tweed Heads, Tweed LGA

I refer to your application dated 13 July 2022 for a permit under Part 7 of the *Fisheries Management Act 1994* (FM Act). DPI Fisheries, a division within the Department of Primary Industries, assesses applications for dredging and reclamation works, harm marine vegetation and obstruction of fish passage in accordance with Part 7 of the FM Act and the *Policy and Guidelines for Fish Habitat Conservation and Management (2013 Update).*

An invoice has been prepared and sent to Transport for NSW (TfNSW) for the statutory minimum initial assessment fee of $358. The quality of the application enabled the assessment to be undertaken without additional charges being required.

As TfNSW is a public authority the provisions of s199 of the FM Act apply and a permit is not required for the dredging and reclamation works contingent upon TfNSW consulting with DPI Fisheries prior to undertaking the works and having regard to concerns or recommendations made. TfNSW has previously consulted with DPI Fisheries with regard to the dredging and reclamation component of this proposal in accordance with the requirements of s199 of the FM Act, and DPI Fisheries has responded to TfNSW (Doc ref: C21/8155 issued 20 January 2022).

Please find enclosed a permit under Part 7 of the FM Act for harm marine vegetation work associated with the removal of 24 mangrove seedlings in order to convert an existing slipway to a marine travel lift, Southern Boat Harbour, off Terranora Inlet, Tweed Heads, Tweed LGA.

Please note that the attached permit providing authorisation under the FM Act to undertake harm marine vegetation (s205) does not provide authorisation under any other Act or planning instrument. It is TfNSW's responsibility to ensure they possess all appropriate approvals and land owner consents before works occur. This may include, but is not restricted to, development consent under the *Environmental Planning & Assessment Act 1979*, land owners consent and/or a licences under the *Crown Land Management Act 2016,* and controlled activity approvals under the *Water Management Act 2000*.

Please carefully read and note the conditions included in the permit. **If you agree that all the conditions are reasonable, appropriate and achievable, you must sign and date the attached sheet (Acceptance of Conditions) and return it to the Contact Officer as soon as possible. If you believe that you cannot comply with all the conditions then you must not commence work.** Instead, you should contact the Contact Officer listed on the first page of the permit so that your concerns can be considered.

If you intend to have the work undertaken by a contractor, please ensure that the contractor receives a full copy of the permit and understands the importance of abiding by the conditions. As the permit holder and proponent of the works TfNSW is responsible for ensuring that all conditions are fully adhered to. **Breaching a condition of a permit can incur an on-the-spot fine of up to $500 or up to $11,000 through the local court pursuant to clause 225 of the *Fisheries Management (General) Regulation 2019*.**

The extent of work is to be restricted to that outlined in the application and plans submitted to DPI Fisheries. **If for any reason, other works are required, or the works need to be extended to other areas, you must seek specific approval beforehand.** DPI Fisheries will require justification for these variations and may charge additional assessment fees as outlined in the permit application. Similarly, **please note the expiry date on the permit**. If the works are not completed by the expiry date you will need to obtain an extension. **Requests to renew a permit before the expiry date will not incur a fee. Requests to renew a permit that has expired within the last 3 months will incur a $179 fee. Permits that have expired more than 3 months previously will need to be reapplied for.**

DPI Fisheries places particular importance upon the need to minimise the harm to the natural environment both at the worksite and adjacent waters. We expect implementation of Best Management Practice with respect to erosion and sediment control and marine vegetation management. This includes:

- Mulching and depositing removed mangroves appropriately on land; and
- Removal of mangroves using hand held tools only.

If you have any queries, please contact Annette Comerford, Fisheries Manager, Coastal Systems (North Coast) on 02 6626 1395 or annette.comerford@dpi.nsw.gov.au.

Yours sincerely

Jonathan Yantsch
Senior Fisheries Manager, Coastal Systems (North Coast)
Authorised delegate of the Minister for Primary Industries

Cc: Robert Loring, **Tweed District Fisheries Officer**
Brad Harrison, **Fisheries Conservation Compliance Officer**

NSW GOVERNMENT | Department of Primary Industries

Permit under Part 7 of the

FISHERIES MANAGEMENT ACT 1994

Permit	Permit Number	**PN22/289**
	Expiry Date	Unless cancelled or suspended sooner, this permit or updated variations shall remain in force until **31 August 2023**
Permit Holder:	Transport for NSW PO Box K659 HAYMARKET NSW 2008 **Responsible Officer: Julian Burgess** Mob: 0437 334 455 Email: julian.burgess2@transport.nsw.gov.au	
Permit Area:	Within the Southern Boat Harbour, off Terranora Inlet, Tweed Heads, Tweed LGA **(Refer to Attachment 1)**	
Permit Activity:	Harm marine vegetation, specifically, the removal of 24 mangrove seedlings (River and / or Grey) as proposed in your application of 13 July 2022 **(Refer to Attachment 2)**	
Departmental Contact Officer:	Annette Comerford Fisheries Manager, Coastal Systems (North Coast) 1243 Bruxner Hwy WOLLONGBAR NSW 2477 Ph: 6626 1395 Email: annette.comerford@dpi.nsw.gov.au	

This permit is subject to the following conditions:

ADMINISTRATIVE CONDITIONS

1. The attached **Acceptance of Conditions** form must be completed and returned to ahp.central@dpi.nsw.gov.au before any works authorised by this permit commence.
   Reason – To remove any doubt that the Permit Holder understands and accepts the Conditions before work commences.

2. The attached **Commence Works Notification** form must be completed and sent to ahp.central@dpi.nsw.gov.au **and** the District Fisheries Officer at Tweed (Phone: 07 5523 6900, email: robert.loring@dpi.nsw.gov.au) at least three (3) days BEFORE the commencement of works authorised by this permit.
   Reason - To ensure that local DPI Fisheries staff are aware that works authorised by this permit are about to commence.

3. The permit holder must ensure that all works authorised by this permit are restricted to the permit area and are undertaken in a manner consistent with those described in the application made to DPI Fisheries dated 13 July 2022. In particular, all the actions and recommendations outlined in the TfNSW document titled *Tweed Heads Travel Lift Boat Facility, Review of Environmental Factors* dated August 2021 are to be followed. Other works which have not been described, excepting those activities required by this permit, are not to be undertaken.
Reason – This permit has been granted following an assessment of the potential impacts of the described works upon the aquatic and neighbouring environments. Other works, which were not described in the application have not been assessed and may have significant adverse impacts.

4. This permit (or a true copy), a copy of the determined Part V Assessment, Construction Environmental Management Plan (CEMP) and other relevant approvals must be carried by the permit holder or sub-contractor operating on-site at all times during work activity in the permit area.
Reason – A DPI Fisheries Compliance Officer may wish to check compliance of works with imposed conditions.

AVOIDING MOVING OR HARMING SNAGS AND MARINE VEGETATION

5. Mangroves are to be removed by using hand held tools only. Mangrove and other trees within the agreed works footprint can be removed to ground level.
Reason – To ensure that impacts on aquatic habitats are minimised.

6. Removed mangroves are to be taken away from areas of water land and mulched and deposited appropriately on land.
Reason – To ensure that impacts on aquatic habitats and the riparian zone are minimised.

7. No snags[1] outside of the works area described in the permit application are to be removed, realigned or relocated without first obtaining the authority of the Senior Fisheries Manager, Coastal Systems.
Reason – "Removal of large woody debris from NSW rivers and streams" is listed as a Key Threatening Process under the provisions of the Fisheries Management Act 1994. This approval has been granted on the basis that snags are not to be removed.

[1] "***Snags***" is a term used to describe **large woody debris** from trees and shrubs, including whole fallen trees, broken branches and exposed roots that have fallen or washed into a waterway and are now wholly or partially submerged by water. Snags also includes submerged large rocks (of greater than 500 mm in two dimensions).

FISH KILL CONTINGENCY

8. A visual inspection of the waterway for dead or distressed fish (indicated by fish gasping at the water surface, fish crowding in pools or at the creek's banks) is to be undertaken twice daily during the works. **Observations of dead or distressed fish are to be immediately reported to the Contact Officer by the Permit Holder.** In such a case all works are to cease until the issue is rectified and approval is given to proceed. If requested, the Permit Holder is to commit resources to the satisfaction of the Contact Officer for an effective fish rescue, if in the view of that officer, a fish kill event is imminent and likely to occur within or adjacent to the works area due to conditions associated with weather, water quality and other parameters.
Reason – DPI Fisheries needs to be aware of fish kills so that it can assess the cause and mitigate further incidents in consultation with relevant authorities. They are also potentially contentious incidents from the public perspective. Work practices may need to be modified to reduce the impacts upon the aquatic environment.

IMPORTANT NOTE:

INCONSISTENCY BETWEEN DOCUMENTS

In the event of any inconsistency between the conditions of this approval and:
- the drawings / documents referred to above, the conditions of this approval prevail to the extent of the inconsistency;
- any Government publication referred in this permit, the most recent document, shall prevail to the extent of the inconsistency; and
- the proponent's mitigation measures outlined in the application, the conditions of this approval prevail to the extent of the inconsistency.

STOP WORK ORDERS

A Fisheries Officer or other appropriate delegate who has reasonable cause to suspect that the conditions of this permit have not been complied with, **may order the work to stop immediately**. The order may be given to the permit holder or any person who informs the officer that they are acting in any capacity on behalf of the permit holder. Any damage caused to the habitat outside the specified permit area, or the carrying out of works not in accordance with the conditions specified in this permit and/or the application and that were accepted by the permit holder, could result in a breach of the *Fisheries Management Act 1994* or *Regulations*, and penalties of up to $220,000 may apply. Orders may also be made requiring work to rectify any damage caused by unauthorised works. Failure to abide by permit conditions may incur a $500 on-the-spot fine per breach pursuant to clause 225 of the *Fisheries Management (General) Regulations 2019*.

Authorised:

Jonathan Yantsch
Senior Fisheries Manager, Coastal Systems (North Coast)
Authorised delegate of the Minister for Primary Industries
10 August 2022

Attachment 1

Figure 1: Plan showing location of works as described within the *Permit Area* section above.

Acceptance of Conditions Form specified in Permit No. PN22/289 issued under Part 7 of the *Fisheries Management Act 1994*

PLEASE COPY THIS PAGE AND RETURN TO DPI FISHERIES

In reference to Permit No. PN22/289 for harm marine vegetation work associated with the removal of 24 mangrove seedlings in order to convert an existing slipway to a marine travel lift, Southern Boat Harbour, off Terranora Inlet, Tweed Heads, Tweed LGA:

I the undersigned, acknowledge that I have read and understood and agree to comply with the conditions specified. I understand that penalties can be imposed for non-compliance with conditions.

Permit Holder's name: _____

Permit Holder's signature: _____

Date: _____

Please COPY AND SIGN this page and email to:

ahp.central@dpi.nsw.gov.au

Commence Works Notification Form specified in Permit No. PN22/289 issued under Part 7 of the *Fisheries Management Act 1994*

PLEASE COPY THIS PAGE AND RETURN TO DPI FISHERIES

In reference to Permit No. PN22/289 for harm marine vegetation work associated with the removal of 24 mangrove seedlings in order to convert an existing slipway to a marine travel lift, Southern Boat Harbour, off Terranora Inlet, Tweed Heads, Tweed LGA:

Commence Works Notification Form

(Note: to be completed and returned 3 days before commencement of works)

Permit Holder's Name: _____

Site Location: _____

Works _____

Commencement Date: _____

Comments:

Project Manager:_____Date:_____

Please COPY AND SIGN this page and email to:

ahp.central@dpi.nsw.gov.au
robert.loring@dpi.nsw.gov.au
bradley.harrison@dpi.nsw.gov.au

Appendix C

Consideration of section 171(2) factors

Consideration of matters of National Environmental Significance and Commonwealth land

Section 171(2) Checklist

In addition to the requirements of the *Guidelines for Division 5.1 Assessments* (DPE, 2022) and the *Marinas and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the addendum REF, the following factors, listed in section 171(2) of the Environmental Planning and Assessment Regulation 2021, have also been considered to assess the likely impacts of the proposed modification on the natural and built environment.

Factor	Impact
a) Any environmental impact on a community? No communities will be impacted due to the modification.	Nil
b) Any transformation of a locality? Upgraded facilities will allow improved services and reduced environmental impact.	Positive long term impact
c) Any environmental impact on the ecosystems of the locality? Mangrove seedlings within the construction footprint require removal.	Loss of mangrove seedlings resulting in negligible loss of ecosystem in the overall estuary.
d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? No impacts due to the modification	Nil
e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? No impacts due to the modification	Nil
f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?* No impacts due to the modification	Nil
g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? No impacts due to the modification	Nil
h) Any long-term effects on the environment? Long term positive impacts due to improved environmental controls.	Long term positive impacts
i) Any degradation of the quality of the environment? RAP to be implemented to manage the risks posed by the site contamination to human and environmental receptors. Site can be made suitable for the proposed travel lift facility provided the recommended environmental safeguards are implemented	Nil
j) Any risk to the safety of the environment?	Nil

Factor	Impact
No impacts due to the modification	
k) Any reduction in the range of beneficial uses of the environment? No impacts due to the modification	Nil
l) Any pollution of the environment? RAP to be implemented to manage the risks posed by the site contamination to human and environmental receptors. Site can be made suitable for the proposed travel lift facility provided the recommended environmental safeguards are implemented	Nil
m) Any environmental problems associated with the disposal of waste? Waste management has been addressed for the construction and operational phase of the works.	Nil
n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? No increase in demand of resources.	Nil
o) Any cumulative environmental effect with other existing or likely future activities? No cumulative environmental effects.	Nil
p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? No impacts identified.	Nil
q) Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1. This project forms part of the NSW Government's commitment to providing maritime infrastructure along the NSW coast and aligns with outcomes in the *NSW Maritime Infrastructure Plan 2019-2024*. Further, the Draft Tweed River Estuary Coastal Management Program (2019) identifies "*Restricted levels of boating infrastructure and facilities or reduced navigability*" as a threat to the estuary. A priority action within the plan is to, "*Maintain and improve boating infrastructure, access and ancillary facilities for boaters*". The proposed works align with this the priority action.	

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following matters of national environmental significance and impacts on the Commonwealth land are required to be considered to assist in determining whether the proposed modification should be referred to the Australian Government Department of Agriculture, Water and the Environment.

Factor	Impact
a) Any impact on a World Heritage property? No impacts due to the modification	Nil
b) Any impact on a National Heritage place? No impacts due to the modification	Nil
c) Any impact on a wetland of international importance? No impacts due to the modification	Nil
d) Any impact on a listed threatened species or communities? No impacts due to the modification	Nil
e) Any impacts on listed migratory species? No impacts due to the modification	Nil
f) Any impact on a Commonwealth marine area? No impacts due to the modification	Nil
g) Does the proposed modification involve a nuclear action (including uranium mining)? No impacts due to the modification	Nil
h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land? No impacts due to the modification	Nil

Appendix D

Statutory consultation checklists

SEPP (Transport and Infrastructure)

Certain development types

Development type	Description	Yes/No	If 'yes' consult with
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	
Bus Depots	Does the project propose a bus depot?	No	
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	

Development within the Coastal Zone

Issue	Description	Yes/No/NA	If 'yes' consult with
Development with impacts on certain land within the coastal zone	Is the proposed modification within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No	

Note: See interactive map here: https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with
Stormwater	Is the work likely to have a *substantial* impact on the stormwater management services which are provided by council?	No	
Traffic	Is the work likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	No	
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a *substantial* volume of water?	No	
Temporary structures	Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	
Road & footpath excavation	Would the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which	No	

Issue	Potential impact	Yes/No	If 'yes' consult with
	council is the roads authority and responsible for maintenance?		

Local heritage items

Issue	Potential impact	Yes/No	If 'yes' consult with
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than *minor* or *inconsequential?*	No	[Local council] [Include a copy of the heritage assessment and a scope of works with the consultation letter]

Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with
Flood liable land	Is the work located on flood liable land? If so, would the work change flood patterns to more than a *minor* extent?	No	[Local council]
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	No	State Emergency Services Email: erm@ses.nsw.gov.au

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable* land published by the New South Wales Government.

Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP clause
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act?	No	Environment, Energy and Science, DPE	SEPP cl.2.15
National parks and reserves	Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	Environment, Energy and Science, DPE	SEPP cl. 2.15
Aquatic reserves	Is the work adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	Department of Planning and Environment	SEPP cl.2.15
Sydney Harbour foreshore	Is the work in the Sydney Harbour Foreshore Area as defined by the *Place Management NSW Act 1998?*	No	Property NSW	SEPP cl.2.15
Bush fire prone land	Is the work for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	Rural Fire Service	SEPP cl.2.15
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the	No	Director of the Siding Spring Observatory	SEPP cl.2.15

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP clause
	Siding Spring Observatory)			
Defence communications buffer land	Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011.	No	Secretary of the Commonwealth Department of Defence	SEPP cl. 2.15
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	Mine Subsidence Board	SEPP cl. 2.15

Appendix E

Arborist Report

WM ENVIRONMENTAL
ABN: 67 620 381 928
Wesley Martin
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Assessment of 24 trees and shrubs bordering Terranora Terrace, Marina Park Tweed heads for the Slipway upgrade

Condition Report
completed for
ENV Solutions

Prepared by
WM Environmental
Wesley Martin
Certificate IV Horticulture (Arboriculture)
Dip. Ap. Sci. Forestry

Tree Inspection: 20/07/2022
Report Date: 31/07/2022

Contents

1 Introduction

WM Environmental has been engaged to assess the potential impacts on a row of planted and self-sown trees in Marina Park off Terranora Terrace within the Tweed Heads Shire. The Park is adjacent to an old ship slipway which is in the process of an upgrade.

The Assessment is to include:

- the botanical name, diameter at a height of 1.4 metres, visual inspection of the trees;
- recommendations regarding tree retention/damage mitigation measures/viability of subject trees.

2 Key Objectives

- Identify the tree species.
- Provide a rapid assessment of the health and structure of the trees.
- Provide recommendations for management, protection and/or necessary works within the context of urban tree safety.

3 Methodology

3.1 Site Inspection

On Wednesday the 20 July 2022, Wesley Martin, (Certificate IV Horticulture (Arboriculture); Dip. Ap. Sci. Forestry) carried out a ground inspection of 22 trees and shrubs along the fence line separating Marina Park from the Tweed Heads slipway and 2 very large *Ficus benjamina* in the centre of the adjacent park.

Observations of health and structure were recorded during the inspection. The rapid tree assessment was undertaken using the Visual Tree Assessment method described by Mattheck & Breloer (1999).

The collection of rapid tree data is a quick inspection from a ground perspective of:

1. Species and common name;
2. overall tree health and any damage (limited to visual inspection);
3. approximate age;
4. recommended tree management.

The following data was collected:

- Botanical Name; Common Name
- Status of Health & Structure
- Diameter at Breast height in cm (DBH)
- Canopy spread where applicable
- Approximate height

Methodology includes:

Level 2 Assessment – a standard Level 2 assessment typically conducted from ground level using a method adapted from *Visual Tree Assessment (Mattheck & Breloer 1994)*, a level 2 assessment is a detailed visual inspection of the tree and its surrounds and is conducted from ground level and does not pick up below ground, internal or unobservable canopy defects. Binoculars and sounding hammers are typical tree assessment tools for use at this level.

Individual tree locations were not GPS mapped.

No sounding, aerial inspection, root excavation or tomographic investigations were undertaken on first inspection.

3.2 Site Map

Tree Locations

Subject trees are located as per map and numbered by WM Environmental (WME).

Figure 3-1 Marina Slip Way and Marina Park (Google Maps)

3.3 Explanatory Notes for Data Collection

Health

Term	Definition
Excellent	The tree is demonstrating excellent or exceptional growth. The tree should exhibit a full canopy of foliage and be free of pest and disease problems.
Good	The tree is demonstrating good or exceptional growth. The tree should exhibit a full canopy of foliage and have only minor pest or diseases problems.
Fair	The tree is in reasonable condition and growing well. The tree should exhibit an adequate canopy of foliage. There may be some deadwood present in the crown. Some grazing by insects or possums may be evident.
Poor	The tree is not growing to its full capacity; extension growth of the laterals is minimal. The canopy may be thinning or sparse. Large amounts of deadwood may be evident throughout the crown. Significant pest and disease problems may be evident or symptoms of stress indicating tree decline.
Very Poor	The tree appears to be in a state of decline. The tree is not growing to its full capacity. The canopy may be very thin and sparse. A significant volume of deadwood may be present in the canopy or pest and disease problems may be causing a severe decline in tree health.
Dead	The tree is dead.

Structure

Term	Definition
Good	The tree has a well-defined and balanced crown. Branch unions appear to be strong, with no defects evident in the trunk or the branches. Major limbs are well defined. The tree is considered a good example of the species.
Fair	The tree has some minor problems in the structure of the crown. The crown may be slightly out of balance, and some branch unions may be exhibiting minor structural faults. If the tree has a single trunk, it may be on a slight lean or exhibiting minor defects.
Poor	The tree may have a poorly structured crown. The crown may be unbalanced or exhibit large gaps. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at the point of attachment. The tree may have suffered root damage.
Very Poor	The tree has a poorly structured crown. The crown is unbalanced or exhibit large gaps with possibly large sections of deadwood. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at the point of attachment. Branches may exhibit large cracks that are likely to fail in the future. The tree may have suffered major root damage.
Failed	The tree has a very poorly structured crown. A section of the tree has failed or is in imminent danger of failure.

3.4 Definition Structural Root Zone

Definition as per *AS, 2009: AS 4970-2009 Protection of Trees on Development sites*:

A **Structural Root Zone** (SRZ) is the area around the base of a tree required for the tree's stability in the ground. The woody root growth and soil cohesion in this area are necessary to hold the tree upright. The SRZ is nominally circular with the trunk at its centre and is expressed by its radius in metres. The SRZ is for structural stability only. The larger Tree Protection Zone allows for the root zone required for a tree's vigour and long term viability.

4 Tree Details

Table 1: Tree Collection Data

Tree No	Species	Common name	Location	DBH in cm	Canopy spread m	Age yrs	Height m	Health	Structure
1	Syzygium Leumanii	Small leaf Lilly Pilly	1st from rd	22	NA	7	6	G	F
2	Tristaniopsis murguensis	Watergum	2nd from rd	18	NA	6	6	G	F
3	Tristaniopsis murguensis	Watergum	3rd from rd	12	NA	5	6	G	G
4	Tristaniopsis murguensis	Watergum	4th from rd	10	NA	3	4	F	P
5	Syzygium Jambos	Rose Apple	5th from rd	33	NA	8	8	F	G
6	Syzygium hemilamprum	Broad Leaved Lilly Pilly	6th from rd	32	NA	8	8	G	F
7	Syzygium Leumanii	Small leaf Lilly Pilly	7th from rd	16	NA	5	8	F	F
8	Xthanthostemon Crysanthus	Golden penda	8th from rd	12	NA	5	5	F	P
9	Syzygium Leumanii	small leaved lilly pilly	9th from rd	16	NA	6	5	F	P
10	Syzygium Leumanii	small leaved lilly pilly	10th from rd	9	NA	4	4	P	P
11	Syzygium Jambos	Rose Apple	11th from rd	20	NA	8	7	F	P
12	Waterhousea floribunda	Weeping lilly pilly	12th from rd	33	NA	12	9	G	G
13	Waterhousea floribunda	Weeping lilly pilly	13th from rd	21	NA	12	9	F	P
14	Waterhousea floribunda	Weeping lilly pilly	14th from rd	24	NA	12	9	G	P
15	Syzygium Leumanii	Small leaf Lilly Pilly	15th from rd	9	NA	7	6	F	P
16	Waterhousea floribunda	Weeping lilly pilly	16th from rd	7	NA	4	2	P	P
17	Tristaniopsis murguensis	Watergum	17th from rd	6	NA	5	7	F	P
18	Waterhousea floribunda	Weeping lilly pilly	18th from rd	16	NA	8	7	G	F
19	Tristaniopsis murguensis	Watergum	19th from rd	6	NA	4	3	G	F
20	Waterhousea floribunda	Weeping lilly pilly	20th from rd	10	NA	5	1	P	P
21	Syzygium Leumanii	Small leaf Lilly Pilly	21st from rd	11	NA	5	6	P	P
22	Hibiscus tileaceus	Native hibiscus	from 21 to water 8m	various	NA	20+	6	G	F
23	Ficus benjamina	Weeping Fig	Water side	71	16	40+	12	VG	VG
24	Ficus benjamina	Weeping Fig	Centre of Park	90	20	40+	12	VG	VG

5 Observations / Discussions

5.1 Site Conditions and Tree Habit

Marina Park is council owned and maintained, the park shares boundaries with a café to the west and a slipway to the east. The small park consists of two very large *Ficus benjamina* in the centre and a row of 22 planted trees very close to a chainmesh fence on the east which separates the park from the slipway.
All the trees planted along the fence line are poor examples of their species due to a combination of reasons from rootstock, planting depths and site conditions. The two *Ficus benjamina* are in very good condition and are heavily utilised by the public visiting the café and for leisure.

5.2 Tree Structure and Health

The two Figs have very good structure and show very good health with plenty of new growth and minimal dead branches within the canopy of each tree.

The row of trees along the fence line all show signs of stress, have poor health, poor structure, stunted growth and minimal canopy.

5.3 Factors affecting Tree Stability and Viability

I suspect the trees along the fence have struggled due to poor root stock, planting depth, available light/water, available soil volume and competition from the two large established Figs. There is minimal available soil to the east due to the concrete walls and foundations of the slipway.

Both Figs are in very good health with excellent structure due to being unmolested and established without competition long before the recent plantings along the fence.

6 Recommendations / Options

Amended plans (provided 3/8/2022) show that all excavation work will take place, and not extend beyond, the Marina Park fence line (existing fence line), slipway side.

Tree Retention (Trees 1 – 22)

If the excavations remain slipway side of the existing fence line, then impact to the row of trees numbered 1 – 22 will be minimal.

The following tree protection measures will take place:

- Roots discovered in the excavation trench are to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs.
- All significant roots (>40mm diameter) are to be recorded, photographed and should be pruned by a qualified arborist.

Tree Impact (Trees 23 – 24)

If the excavations remain slipway side of the existing fence line then impact on the Trees 23 – 24 will be minimal.

The following tree protection measure will take place:

- Roots discovered in the excavation trench are to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs.
- All significant roots (>40mm diameter) are to be recorded, photographed and should be pruned by a qualified arborist.

If excavations or construction works extend beyond the existing fence line, tree protection measures must be put in place.

Significant Tree Impacts (Trees 1 – 22)

Any excavation extending beyond the existing fence line will incur into the structural root zone (SRZ) of trees 1 – 22 and compromise their health and structure.

If the SRZ is incurred, the risk of failure for trees 1 – 22 is escalated to extremely high, with significant consequences to human health and safety.

If excavation extends beyond the existing fence line, the row of trees (1 – 22) should be removed to allow access to and construction of the foundation footings and construction of concrete walls for the new slipway.

Tree Impacts (Trees 23 – 24)

Any excavation extending beyond the existing fence line will affect trees 23 – 24.

If excavation extends beyond the existing fence line, the two *Ficus benjamina* will require a Tree Protection Zone (TPZ) to protect their roots from damage and to prevent soil compaction around the root system within the drip zone. This can be achieved by installing a temporary fence inside the existing fence to exclude machinery and vehicles associated with the construction from entering or working from within Marina Park.

Tree number and Name	**DBH**	**TPZ Calculation**
23 *Ficus benjamina*	0.71m	8.52m
24 *Ficus benjamina*	0.9m	10.8m

The use of a spotter should be utilised to check for roots during the works within the TPZ to minimise the potential for root damage to the trees.

No excavation should occur within the SRZ of trees 24 – 24.

Any roots discovered in the excavation trench are to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs.

All significant roots (>40mm diameter) are to be recorded, photographed and should be pruned by a qualified arborist.

7 Conclusions

WM Environmental has been engaged by ENV Solutions to inspect the health and structure of the trees in Marina Park adjacent to the old slipway. A tree health report and recommendations have been requested for the trees within Marina Park.

After inspection and data collection on 20 July 2022, and review of amended plans provided on 3 August 2022, the following conclusions are made:

1. Where excavations do not extend beyond the Marina Park boundary fence (existing fence line) from the slipway construction zone then there will be minimal impact on trees numbered 1-24.
2. Roots discovered in the excavation trench are to be treated with care and minor roots (<40mm diameter) pruned with a sharp, clean handsaw or secateurs.
3. All significant roots (>40mm diameter) are to be recorded, photographed and should be pruned by a qualified arborist.
4. Any excavation extending beyond the existing fence line will incur into the structural root zone (SRZ) of trees 1 – 22 and compromise their health and structure, escalating a risk of failure to extremely high extremely high, with significant consequences to human health and safety.
5. If excavation extends beyond the existing fence line, Remove the row of trees and shrubs along the fence to allow excavation and construction of the slipway project.
6. If excavation extends beyond the existing fence line then a Tree Protection Zone (TPZ) must be established for trees 23 – 24 by installing temporary fencing, and to exclude construction machinery and vehicles from entering the TPZ.
7. If excavation extends beyond the existing fence line, the TPZ will be:
    - Tree 23 8.52m TPZ
    - Tree 24 10.8m TPZ

8 References

Australian Standard., 2007; AS 4373-2007 *Pruning of amenity trees*.
Australian Standard, 2009: AS 4970-2009 *Protection of Trees on Development Sites*.
Dunster, J., E. Thomas, S., Matheny. N., Lilly. S., 2013 *Tree Risk Assessment Manual. International Society of Arboriculture* (ISA) USA.
International Society of Arboriculture (ISA) *Basic Tree Risk Assessment Form*. USA.
Mattheck, C., Breloer, H., 1994 *The body language of Trees – a handbook for failure analysis*, UK: The Stationery Office.
Shigo, A. L., 1991, *Modern Arboriculture*, USA: Shigo and Trees, Ass.

9 Disclaimer and limit of observations

Disclaimer

The potential for a tree to be damaged during a storm exists regardless of its health and vigour. The strength & unusual direction of winds during storms is the dominant contributor to damage in trees. Neither of these can be controlled or prevented in all circumstances. The removal of the surrounding companion trees can often expose the remaining trees to prevailing winds and the elements. Replacement trees are recommended in all cases of removals in order to prevent the degradation of the area and to protect remaining trees. Replacement of trees in the middle of an avenue is often unsuccessful due to competition for light. Construction of planter pits or trenches may only be viable when constructed in long runs.

Conditions that bring about failure may occur over night i.e. storm event or they may form over a long period of time i.e. decay development. This report is based on a snap shot in time and only ongoing monitoring can hopefully foresee deterioration of a tree and allow remedial action to be taken to prevent injury or damage. The timing for re-inspection on individual trees is subjective and will vary however; an annual inspection is advisable for trees in senescent years.

Limit of Observations

There are many factors that may contribute to limb or total tree failure. Factors include, decay (in the trunk, crown or branch junctions), external damage to branches leading to decay, poor branch taper, included bark, root rot / decay. Not all these symptoms are visible i.e. internal decay; of these some external symptoms may indicate the presence of dead internal wood but not the existence or extent of decay.

Healthy timber may also contain breaks in continuity of growth caused by insect damage or poor pruning practices over many years previous. Trees do not heal; they simply box in the damaged area (CODIT Compartmentalisation of Decay in Trees) and continue to expand in girth, completely disguising the fact that the branch or trunk has a hollow or decayed section. Having said this, not all areas of decay, past or present suggests a point of failure.

Care has been taken to obtain all information from reliable sources. All data has been verified in so far as possible, however, the consultant can neither guarantee nor be responsible for the accuracy of the information provided by others.

The consultant shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services.

Appendix A – Diagram of a Tree Protection Zone (TPZ)

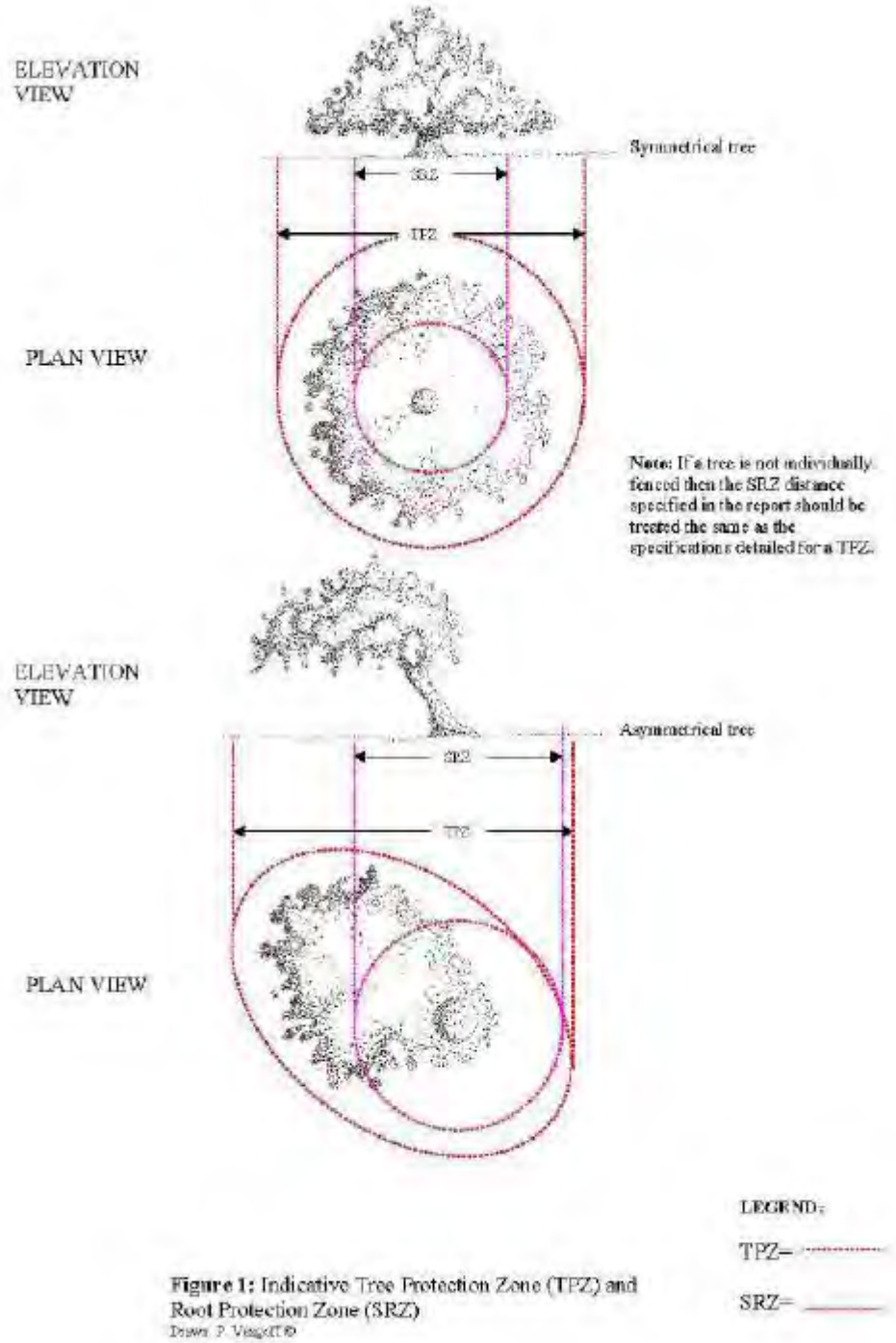

Figure 1: Indicative Tree Protection Zone (TPZ) and Root Protection Zone (SRZ)
Drawn P. Vaughan ©

Appendix B – Activities Restricted in the Tree Protection Zone (TPZ)

Australian Standard, 2009: AS 4970-2009 Protection of Trees on Development Sites

Section 4.2

Activities generally excluded from the TPZ include but are not limited to –

(a) machine excavation including trenching;
(b) excavation for silt fencing;
(c) cultivation;
(d) storage;
(e) preparation of chemicals, including preparation of cement products;
(f) parking of vehicles and plant;
(g) refuelling;
(h) dumping of waste;
(i) wash down and cleaning of equipment;
(j) placement of fill'
(k) lighting of fires;
(l) soil level changes;
(m) temporary or permanent installation of utilities and signs, and
(n) physical damage to the tree.