

# Gas Import Jetty and Pipeline Project

## Environment Effects Statement

July 2020



### EES Technical Report E

Contamination and acid sulfate soils impact assessment



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## Executive summary

This report assesses potential impacts to human health and the environment associated with contamination, specifically disturbance of contaminated soils, groundwater and marine sediment, potential contamination from Project activities such as fuel or chemical leaks/spills and waste management, and the disturbance of acid sulfate soils (ASS), as a result of the Gas Import Jetty and Pipeline Project (The Project).

The Project would establish a gas import jetty and pipeline in Victoria comprising:

- a floating storage and regasification unit (FSRU) at Crib Point Jetty – the Gas Import Jetty Works
- a gas pipeline between Crib Point and Pakenham to connect to the Victorian Transmission System (VTS) east of Pakenham – the Pipeline Works.

The Project would provide an additional supply of natural gas into the south-eastern Australian gas market for industrial, commercial and residential customers.

Potential supply gaps in Victoria's gas market are predicted from 2024. The Project would improve energy security for industrial, commercial and domestic customers and would increase competition in the market.

### Methodology

The study area, for the purpose of soil and groundwater contamination investigation, and ASS investigation, includes the pipeline right of way (ROW) including alignment alternatives and a buffer area of 50 metres either side of the ROW, the Pakenham Delivery Facility, the End of Line Scraper Station (EOLSS), and the landside component of the Gas Import Jetty Works, which includes gas piping and the Crib Point Receiving Facility.

The study area, for the purpose of the marine sediment investigation, includes Berth 1 and 2 and a buffer area of approximately 200 metres east of the berths.

The assessment of existing conditions for contamination and ASS was based on desktop review of historical information, contaminated land registers, ASS distribution maps and previous assessment reports relevant to the Project; and results of a field investigation program carried out between 29 November 2018 and 26 April 2019 and 31 March 2020.

A total of 99 soil bores across the study area were advanced to assess the presence of contamination and ASS. Soil sampling consisted of grid and targeted sampling as outlined below:

- Collection of samples from 58 soil bores, located on a grid basis along the pipeline route, at a density of approximately one soil bore per kilometre of pipeline, including samples collected during installation of 26 groundwater monitoring bores, to assess the potential for widespread / regional contamination of soil, based on the largely rural setting. Assessment of ASS was also completed at a density of one soil bore per kilometre, except targeted ASS sampling locations, described below. This approach is considered sufficient to assess the potential for soil contamination and the presence or absence of ASS within the study area.
- Collection of samples from eleven soil bores, targeting areas that had been identified during desktop review to have higher potential for contamination (e.g. near industrial/commercial areas, existing pipeline easements and former landfill).
- Collection of samples from three soil bores on 31 March 2020, targeting the proposed pipe stringing area in the former Western Port BP refinery (former BP refinery) site following its inclusion in the project.
- Collection of samples from 27 soil bores targeting areas where the desktop review identified that ASS is more likely to be present (as per the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) soil database), at a density of one soil bore per 100 metres of a pipeline, in accordance with guidance in the EPA Victoria Publication *Industry Waste Resource Guideline (IWRG) 655.1 – Acid Sulfate Soil and Rock*.

A total of four groundwater monitoring wells in areas that have been identified, through desktop review, to have higher potential for contamination were installed. Groundwater gauging and sampling was completed from 26 groundwater monitoring wells (including 22 groundwater monitoring wells installed as part of the groundwater investigations (EES Technical Report D: *Groundwater impact assessment*)).

A total of 20 sediment samples were collected from the seabed surrounding the Crib Point Jetty, by Consulting Environmental Engineers Pty Ltd (CEE).

Potential impacts to human health and the environment associated with disturbance of contaminated soils, groundwater, and marine sediment; and the disturbance of ASS have been assessed by comparing the field investigation results against the appropriate screening criteria, for beneficial uses of the study area and identifying risks as a result of the Project construction and operation that may impact beneficial uses or downstream watercourses or receiving waters, in particular the Western Port Ramsar listed wetland.

Methods to mitigate the risks have been developed based on existing regulatory requirements and construction guidelines and practices, to manage environments surrounding construction sites of similar type and scale.

### **Existing conditions – Western Port catchment**

The Project is located within the Western Port catchment area. A large portion of Western Port is listed as a Ramsar Site of international significance, supporting a diversity of plants, animals and ecosystems, including several unique and threatened species, four marine national parks, large tracts of mangroves and seagrasses (Sharp et al., 2013).

The catchment has an area of around 3,700 square kilometres and contains over 2,200 kilometres of rivers and creeks. Seventeen waterways enter Western Port including major rivers and creeks such as Bunyip, Tarago, Cardinia, Yallock, Lang Lang and Bass River networks, all of which discharge directly into the Western Port Ramsar Site. The marine ecosystem within Western Port is of regional, national and international importance and supports mangrove, saltmarsh, seagrass, reef and soft seabed habitats. Several of the rivers and creeks within the Bunyip River catchment flow into Western Port creating estuaries that provide habitat for estuary dependant species.

Much of the catchment has been modified to support rural and green wedge land use. Historically, the Koo Wee Rup swamp covered large areas in the Western Port hinterland but was drained for development and has resulted in a number of watercourses in the lower catchment becoming channelised drains. Although the area contains a mix of land uses including commercial and industrial, the predominant land use is agriculture consisting of dairying, grazing and horticulture.

The Project Area includes coastal floodplains in the lower reaches of the catchment where the relief is mostly low lying and generally flat to gently undulating. The ground surface elevation ranges from approximately one to two metres above sea level in the southern portion to 10 – 25 metres above sea level over the northern portion, where the gently sloping topography grades up to the north.

The proposed Pipeline Works crosses seven main watercourses, as follows:

- Warringine Creek
- Rutherford Creek
- Watson Creek
- Cardinia Creek
- Lower Gum Scrub Creek
- Toomuc Creek
- Deep Creek.

In addition to the above watercourses, the pipeline alignment would also cross another 57 other watercourses and surface drains. These watercourses are ephemeral with the exception of Watson Creek and Cardinia Creek.



The *Western Port Ramsar Site Management Plan* (Department of Environment, Land, Water and Planning (DELWP), 2017) identifies increased sediments and toxicants as one of the high priority threats to Western Port.

The *Understanding the Western Port Environment 2018* report (Melbourne Water, 2018) indicated toxicants in Western Port sediments were found to be at low levels and unlikely to impact resident flora and fauna except in localised areas, generally confined to estuarine sediments and areas that receive flows from catchment tributaries, where several toxicants were at levels of concern (Melbourne Water, 2009). Risks from heavy metals, hydrocarbons and organotins were low, with the exception of isolated areas receiving catchment inflows or high boating activity. Elevated organotin concentrations were reported in areas of boating activity, however, a comparison of 2012 survey concentrations with historical results indicates that organotin concentrations may be declining in Western Port since controls on their use (Melbourne Water, 2018).

The sediments are transported around the embayment as a result of the complex pattern of water circulation. The sediments deposited within Western Port are subject to resuspension and dispersal by the tides, waves and wind, resulting in persistently high turbidity (Wallbrink et al., 2003).

### Existing conditions – contaminated soils and groundwater

Desktop review of available historical information indicated that there have been no significant changes in land use, within the study area, since the 1940s. The majority of the area continues to be used for agricultural purposes, primarily stock grazing and equine activities (see EES Technical Report O: *Agriculture impact assessment* and EES Technical Report L: *Land use impact assessment* for further information). The existing land uses are considered to have a relatively low potential for soil and groundwater contamination with the exception of the following locations:

- the former BP refinery and import jetty facilities
- [REDACTED] (former Tyabb landfill)
- commercial/industrial areas or facilities in Hastings and Tyabb
- Stony Point, Bairnsdale and Leongatha railway lines
- market gardens areas (intensive agriculture) (see EES Technical Report O: *Agriculture impact assessment* for further information).

Intrusive contaminated soil investigation concluded that soil contamination is limited in extent. Contaminated soils were identified at the following locations, noting that localised impacts may be present and could be encountered during Project construction works:

- the proposed location for the Crib Point Receiving Facility (impacted by zinc and benzo(a)pyrene)
- The Esplanade adjacent to the former BP refinery (KP0.2 And KP0.3 impacted by benzo(a)pyrene)
- railway corridor in Hastings between High Street and Cool Store Road (KP6.0 impacted by benzo(a)pyrene).

Soil samples collected from the former BP refinery reported concentrations below the adopted investigation level for commercial/industrial land use, however exceeded the EPA Victoria Publication IWRG621 Fill Material upper limit.

Intrusive contaminated groundwater investigation concluded that groundwater contamination is also limited in extent. Excluding compounds considered likely to be naturally sourced / background (total dissolved solids (TDS), selected metals, sulfate, phosphorous, calcium, etc.), contamination was only encountered at the following locations, noting that while likely areas of concern were assessed as part of this investigation, localised groundwater contamination may be encountered during Project construction works:

- adjacent to the former Tyabb landfill (KP14.0 – KP14.3 impacted by Per- and polyfluoroalkyl substances (PFAS))
- adjacent to the metal recycling yard in Hastings (KP7.3 – KP7.5 impacted by nickel).



However, it is noted that, although TDS is naturally elevated within the aquifer and does not represent contamination, it may preclude the use of the groundwater for beneficial uses including agriculture and irrigation (stock watering), agriculture and irrigation (irrigation), industrial and commercial and water based recreation. Therefore, discharge to land and potentially receiving waters should be restricted.

It is noted, that due to dense vegetation restricting access to the Project Area between KP7.3 – 7.9 in Hastings, intrusive investigation was unable to be completed to assess potential impacts from the adjacent industrial premises, such as the [REDACTED] Metal Recyclers yard and the farm gate manufacturing facility [REDACTED]. Therefore, the Pipeline Works should undertake further intrusive soil and groundwater investigations prior to pipeline construction, to confirm presence or absence of contaminated soil within the area, resulted from historical and existing land uses.

The soil sample and groundwater monitoring wells locations (including kilometre points (KPs) and alignment options) are shown in Figure A3, A5 and A7 in Appendix A-A.

### **Existing conditions – acid sulfate soils (ASS)**

A review of the ASRIS ASS mapping indicates there is potential for ASS to be encountered during construction of the Project. The following pipeline sections were identified as having a high probability of occurrence, as defined in ASRIS ASS map:

- KP18.8 – 19.0
- KP19.0, 19.1 – 19.2
- KP31.9 – 33.4.0
- KP35.5 – 36.3
- KP36.4 – 50.7.

A map of the Project Area (including KPs and alignment options) overlaying the ASRIS ASS classification is presented Figure A2 in Appendix A-A.

Intrusive ASS investigations undertaken confirmed that:

- ASS is present throughout the study area, with net acidity in soil in 78 of 180 samples exceeding the 'Action Criteria' of 0.03%S, for soil disturbance exceeding 1,000 tonnes (EPA Victoria Publication IWRG655.1).
- Potential ASS (PASS) was identified at MW09 (KP17.8), MW10 (KP19.4), BH207 (KP32.4), BH209 (KP32.6) and BH34 (KP35.4).
- An approved ASS Management Plan(s) would be required for both Pipeline Works and the Gas Import Jetty works based on the estimated soil disturbance during construction of the Project. It is noted that EPA Victoria was consulted on 19 August 2019, and it was agreed that the Pipeline Works would not require an EPA Victoria approved ASSMP. Instead, an ASS Management Protocol would be developed and included in the Pipeline Works Construction Environment Management Plan (CEMP) which would be approved in accordance with the *Pipelines Act 2005*, in consultation with EPA Victoria. The Gas Import Jetty Works, however, would require an ASSMP that is approved by EPA Victoria.

It is noted that sample point frequency does not comply with the recommendation made in Table 1 of Victorian EPA publication IWRG655.1 which specifies sampling at 100 metre intervals for a pipeline, except at the ASS targeted sampling locations. However, the investigation has confirmed that ASS management and mitigation measures must be applied throughout the Project and therefore further investigation, other than to calculate or refine liming rates, is not considered necessary.

The ASS sample locations (including KPs and alignment options) and classification in accordance with IWRG655.1 are shown in Figure A6 in Appendix A-A.

### **Existing conditions – contaminated sediments**

The Crib Point Jetty was established in 1965 to provide berthing facilities for import of crude oil to the former BP refinery (also known as [REDACTED]). After the refinery was closed and dismantled in 1985, the jetty facility continues to be used to import refined petroleum products. Limited sediment

investigation undertaken by Jacobs (2017) reported that arsenic, benzo(a)anthracene, fluoranthene, phenanthrene, pyrene and tributyltin (TBT) exceeded the Australian and New Zealand Environment Conservation Council (ANZECC) & Agricultural and Resource Management Council of Australia and New Zealand ARMCANZ (2000) Interim Sediment Quality Guideline (ISQG) trigger values in the vicinity of Berth 1.

Field investigation undertaken as part of this assessment indicated that contamination from historical and/or existing activities at the Crib Point Jetty is limited to Berth 1, where concentrations of TBT exceeded the Sediment Quality Guidelines Values (SQGV).

It is concluded that the existing beneficial use of protecting water dependent ecosystems and species at Berth 2 is protected and therefore risk and impacts assessment associated with the disturbance of contaminated marine sediment is not addressed further in this report.

### Impact assessment

Assessment of risks to beneficial uses of land, surface water and groundwater (as specified in the State Environment Protection Policy (Prevention and Management of Contamination of Land) (SEPP (PMCL)) and the SEPP (Waters)) from construction and operation of the Project in accordance with Australian/New Zealand Standard AS/NZS ISO 31000:2009 Risk Management Process, was undertaken using information obtained through desktop and limited field investigation.

The targeted field investigation coupled with desktop review undertaken for the EES is considered sufficient to provide an indication of the potential for contamination and the presence or absence of ASS within the study area, and therefore sufficient to inform robust risk and impact assessment. Where there are data gaps, requirement for further assessment have been included as part of the mitigation measures for the Project.

The key risks and their risk rating associated with Gas Import Jetty Works and Pipeline Works are:

- Disturbance, handling, storage or disposal of contaminated soils that affects human health and the environment was assessed as **Low** risk.
- Disturbance, handling, storage or disposal of ASS that affects human health and the environment was assessed as **Low** risk.
- Generation of acid leachate through oxidation of previously submerged soils (dewatering from trenches and bell holes) leads to generation of acidic waters that affects vegetation, surface water and/or groundwater quality was assessed as **Very Low** risk.
- Unknown contamination encountered and disturbed during construction results in impact to human health and the environment was assessed as **Low** risk.
- Leaks or spillages during construction from machinery/plant, fuel and chemical storage that affects human health and the environment was assessed as **Low** risk.
- Mismanagement of other waste streams (solid inert, liquid, organic, packaging and food scraps) that affects human health, aesthetics and the environment was assessed as **Low** risk.
- Generation of dust from contaminated soil or stockpile blown by wind affects human health and the environment was assessed as **Low** risk.

The key risks and their risk rating associated with the construction of the Pipeline Works only are:

- Disturbance, handling, storage and disposal of contaminated groundwater that affects human health and the environment was assessed as **Low** risk.
- Discharge or dewatering of non-contaminated, acid and/or brackish trench water that affects soil and/or surface water quality was assessed as **Low** risk.
- Mobilisation of unknown contaminant plumes from outside the Project Area that affects beneficial uses was assessed as **Low** risk.
- Inappropriate handling, storage and disposal of drilling mud that affects human health and the environment was assessed as **Low** risk.

- Inappropriate handling, storage and disposal of contaminated water from hydrostatic test that affects human health and the environment was assessed as **Low** risk.

The key risks and their risk rating associated with operation of the Gas Import Jetty Works and Pipeline Works are:

- Leaks or spillages from fixed machinery/plant/pipeline, fuel and chemical storage that affects human health and the environment was assessed as **Low** risk.
- Mismanagement of other waste streams (solid inert, liquid, organic, packaging etc.) affects human health, aesthetics and the environment was assessed as **Low** risk.

Overall, construction and operation of the Project presents limited risks to soil, groundwater and receiving surface water due to the limited extent of contamination. In terms of ASS, the risk is limited by the shallow depth of trenching and horizontal boring, and the short duration of stockpiling and dewatering activities (where groundwater is intersected). Where dewatering is required the reductions in groundwater levels are also estimated to be of limited magnitude and limited lateral extent (assessed in EES Technical Report D: *Groundwater impact assessment*). The proposed construction methodologies would confine potential impacts within the Project Area thus have very limited effect upon the surrounding area.

The risk of potential impacts on human health via direct and secondary contact with soils, groundwater and surface water were identified as being low or very low and can be mitigated as outlined below.

It was concluded that the Project is consistent with the scoping requirements and the draft evaluation objective with respect to potential impacts on the environment and human health from disturbance of contaminated soil or ASS, waste materials/streams generated by the Project works, and spills or other incidents during Project construction or operation, with mitigation measures that are commonly applied and have proven effective in major construction projects in place. As the risk assessment for potential contamination and ASS impacts did not identify any initial risks with a rating of medium or higher, no additional mitigation measures have been deemed necessary.

### Recommended mitigation measures

The following mitigation measures are recommended for the Project.

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
MM-C01	<p><b>Contaminated Soils</b></p> <p>a. Contaminated soil should be managed in accordance with the SEPP (Prevention and Management of Contaminated Land) and EPA Victoria interim Position Statement on PFAS. All Project personnel should be made aware of the presence of contaminated soils at the following locations during the site(s) induction:</p> <ul style="list-style-type: none"> <li>- The Crib Point Receiving Facility</li> <li>- The Esplanade adjacent to the former BP refinery</li> <li>- The former BP refinery</li> <li>- within the railway corridor between High Street and Cool Store Road in Hastings</li> <li>- Between KP7.3 and KP7.9 in Hastings (if intrusive investigation confirms presence of contaminated soils).</li> </ul> <p>b. An intrusive investigation should be undertaken in the area between KP7.3 and KP7.9 prior to commencing pipeline construction, to confirm the presence or absence of contaminated soils, due to historical and existing land uses. Should</p>	Gas Import Jetty Works and Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p>contamination of soil and/or groundwater be encountered, consider additional mitigation measures (if required).</p> <p>c. Construction works during wet weather should be avoided unless conditions are such that property damage, contaminated soils, and surface water issues can be managed.</p> <p>d. Stockpile of trench spoil should be managed in accordance with EPA Victoria Publication 480 – <i>Best Practice Environmental Management: Environmental Guidelines for Major Construction Sites</i>.</p> <p>e. Where excess soils, including HDD screened cuttings, are required to be disposed off-site, these should be sampled and categorised in accordance with EPA Victoria Publications IWRG702 – <i>Soil Sampling</i> and IWRG621 – <i>Soil Hazard Categorisation and Management</i>.</p> <p>f. Handling and transport of contaminated spoil for off-site treatment/disposal should be in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>.</p> <p>g. Any material imported for use as backfill should comply with the EPA Victoria Publication IWRG621 – <i>Soil Hazard Categorisation and Management</i> for 'Fill Material', and should be accompanied by relevant documentation confirming its compliance to the 'Fill Material' criteria.</p>		
MM-C02	<p><b>Acid Sulfate Soils Management Protocol</b></p> <p>An Acid Sulfate Soils Management Protocol should be developed in accordance with the <i>Industrial Waste Management Policy (Waste Acid Sulfate Soils)</i> 1999 and EPA Victoria Publication IWRG655.1 – <i>Acid Sulfate Soil and Rock</i>, and the <i>Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils</i> (CASS BPMG, 2010). As agreed with EPA Victoria, the Pipeline Works ASS Management Protocol should be developed and included in the Pipeline Works CEMP which should be approved in accordance with the <i>Pipelines Act 2005</i>, in consultation with EPA Victoria. The Pipeline Works ASS Management Protocol should include:</p> <p>a. All soils be managed as AASS or PASS in accordance with CASS BPMG (2010).</p> <p>b. A risk assessment together with proposed risk mitigation and management measures across the Project Area including justification of why certain areas may be excluded from treatment by liming.</p>	Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<ul style="list-style-type: none"> <li>c. Monitoring of the performance of mitigation and management measures, including potential remedial measures where/if required.</li> <li>d. All relevant site-based personnel should be made aware of the locations where PASS (MW09 at KP17.8, MW10 at KP19.4, BH207 at KP32.4, BH209 at KP32.6 and BH34 at KP35.4) has been identified.</li> <li>e. Relevant site-based personnel must be trained on the requirements of the acid sulfate materials management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010).</li> <li>f. Construction works should not occur during wet months unless conditions are such that land degradation and surface water management problems can be avoided or appropriate mitigation measures implemented.</li> <li>g. Minimise the duration of stockpiling of untreated ASS by staging soil excavations in a manner that takes in constraints on stockpile duration where treatment of ASS may not be required, as per the CASS BPMG (2010).</li> <li>h. Include a procedure for managing unexpected discovery of ASS/PASS in the ASS Management Protocol.</li> <li>i. If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile.</li> <li>j. Run-off that has the potential to be impacted by stockpile material should be directed into the open trench (where practicable).</li> <li>k. Minimise activation of PASS by minimising duration (less than 10 days) and extent of dewatering activities, such as dewatering immediately prior to installation of pipe and minimise the time that trench sections and bell holes are open.</li> <li>l. Implement a monitoring program in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils.</li> </ul>		
MM-C03	<b>Acid Sulfate Soil Management Plan</b> An Acid Sulfate Soil Management Plan (ASSMP) should be developed in accordance with the <i>Industrial Waste Management Policy (Waste Acid</i>	Gas Import Jetty Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p><i>Sulfate Soils</i>) 1999 and EPA Victoria Publication IWRG655.1 – <i>Acid Sulfate Soil and Rock</i>, and the <i>Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils</i> (CASS BPMG, 2010). The ASSMP shall be approved by the Authority.</p> <ol style="list-style-type: none"> <li>Relevant site-based personnel must be trained on the requirements of the acid sulfate materials management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010).</li> <li>The duration of stockpiling of untreated ASS should be minimised by taking into consideration the constraints on stockpile duration where treatment of ASS may not be required, as per the CASS BPMG (2010).</li> <li>Include a procedure for managing unexpected discovery of ASS/PASS in the ASSMP.</li> <li>If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile.</li> <li>Run-off that has the potential to be impacted by stockpile material should be captured (where practicable) and managed in accordance with the CASS BPMG (2010).</li> <li>A monitoring program should be implemented in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils.</li> </ol>		
MM-C04	<p><b>Contaminated groundwater/trench water</b></p> <ol style="list-style-type: none"> <li>Contaminated groundwater/trench water should be managed in accordance with: <ul style="list-style-type: none"> <li>SEPP (Waters)</li> <li>PFAS National Environmental Management Plan.</li> </ul> </li> <li>All Project personnel should be made aware of the presence of contaminated groundwater containing PFAS east of the former Tyabb landfill.</li> <li>Disturbance of saturated soil and groundwater within the PFAS affected area should be minimised. The management plan should include measures to prevent migration of PFAS into the surrounding soil or surface water.</li> </ol>	Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p>d. An intrusive groundwater investigation should be undertaken in the area between KP7.3 and KP7.9 prior to commencing pipeline construction, to confirm presence or absence of contaminated groundwater within the area, due to historical and existing land uses.</p> <p>e. Water from areas that have been identified as contaminated must not be discharged to the environment (land, waterways, sewer).</p> <p>f. Contaminated water should either be treated onsite, depending on contaminant encountered (this may require approval from the EPA Victoria) or disposed offsite to an EPA Victoria licensed facility. Alternatively, adopt a construction approach where contaminated groundwater may be left in-situ (i.e. not abstracted or disturbed).</p>		
MM-C05	<p><b>Drilling muds disposal</b></p> <p>Drilling muds/additives used in horizontal directional drilling should be selected to avoid impact to sensitive environments during drilling activities as per EES Technical Report D: <i>Groundwater impact assessment</i>.</p> <p>Place bunds and/or drainage channels around the upper edges of the drill site and work area, to divert natural runoff around and away from the drill site and avoid cross contamination of the drilling compound runoff as per EES Technical Report C: <i>Surface water impact assessment</i>.</p> <p>a. Monitor circulation of drilling muds throughout the HDD operation for indication of an inadvertent drilling mud release.</p> <p>b. Drilling muds should be disposed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and EPA Victoria <i>Industrial Waste – Classification for Drilling Mud</i>, Victoria Government Gazette G37.</p> <p>c. Records of HDD mud disposal should be maintained.</p>	Pipeline Works	Construction
MM-C06	<p><b>Hydrostatic test water</b></p> <p>a. Hydrostatic test water must be managed in accordance with SEPP (Waters).</p> <p>b. Water should be reused where practicable to conserve water and minimise the number of discharge locations.</p> <p>c. If oxygen scavengers and biocides are used during hydrostatic testing, they should be neutralised before disposal, in accordance with manufacturer guidelines, to ensure that the water is free from any remaining active biocide and oxygen scavengers before discharge land.</p>	Pipeline Works	Construction



Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	d. Dams and hydrostatic test water may remain for landholders' beneficial use with landholder and regulatory approval if water quality requirements are met.		
MM-C07	<b>Unknown contamination</b>  In the event that unknown contamination (including asbestos containing material) is encountered during construction: <ol style="list-style-type: none"> <li>Cease ground disturbance at the unknown contamination location and within the immediate vicinity.</li> <li>Assess site contamination and identify appropriate remedial action.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction
MM-C08	<b>Fuel and Chemical Leaks/Spills</b> <ol style="list-style-type: none"> <li>Diesel generators must be bunded.</li> <li>Routine and scheduled maintenance of vehicles and plant/machinery/equipment should be undertaken to minimise the potential for leaks/spills to occur.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction and operation
MM-C09	<b>Construction Waste Management</b> <ol style="list-style-type: none"> <li>Waste should be managed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>, including establishment of appropriate and secured waste storage locations on-site, as required.</li> <li>Waste management procedures should be developed and implemented.</li> <li>Identification of suitable waste disposal locations should occur prior to construction commencing in consultation with local waste sub-contractors.</li> <li>Waste materials should be reused or recycled where practicable, or collected and transported by licenced contractors for disposal at appropriately licenced facilities.</li> <li>Portable toilet facilities should be available for work construction crews on the construction footprint.</li> <li>Waste containers should be available for different types of waste generated onsite.</li> <li>Waste containers should be located at each worksite to enable collection of waste, with regular removal from worksites to designated areas.</li> <li>Refuse containers should be lidded to mitigate fauna access.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction
MM-C10	<b>Operation Waste Management</b> <ol style="list-style-type: none"> <li>Prescribed waste should be managed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>,</li> </ol>	Gas Import Jetty Works and Pipeline Works	Operation

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p>including establishment of appropriate and secured waste storage locations on-site, as required.</p> <p>b. Waste management procedures should be developed and implemented.</p> <p>c. Waste materials should be stored appropriately, reused or recycled where practicable, or collected and transported by licenced contractors for disposal at appropriately licenced facilities.</p> <p>d. Waste containers should be available for different types of waste generated onsite.</p> <p>e. Waste containers should be lidded to mitigate fauna access.</p> <p>f. Waste generated outside of the operation of the pipeline/facilities must not be received at the site for storage, treatment, processing or disposal.</p>		

## Abbreviations

Abbreviation	Definition
AAASS	Atlas of Australian Acid Sulfate Soils
AASS	Actual acid sulfate soils
ACL	Added Contaminant Limits
ACM	Asbestos containing material
AECOM	AECOM Australia Pty Ltd
AGL	AGL Wholesale Gas Limited
AHD	Australian Height Datum
AMG	Australian Mapping Grid
ANC	Acid Neutralising Capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
APA	APA Transmission Pty Limited
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASC	Assessment of Site Contamination
ASLP	Australian Standard Leaching Procedure
ASRIS	Australian Soil Resource Information System
ASS	Acid sulfate soil
ASSMP	Acid Sulfate Soils Management Plan
BPMG	Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils
BTEX	Benzene, toluene, ethylbenzene & xylene
BTOC	Below top of casing
CASS	Coastal acid sulfate soils
CEC	Cation Exchange Capacity
CMA	Catchment Management Authority
COPC	Contaminants of Potential Concern
CRS	Chromium Reducible Sulfur
CUN	Clean up Notice
DBYD	Dial Before You Dig
DDT	Dichlorodiphenyltrichloroethane

Abbreviation	Definition
DEWLP	Department of Environment, Land, Water and Planning
DQI	Data Quality Indicators
ECD	Site Ecological Character Description
EES	Environment Effects Statement
EILs	Ecological investigation levels
EMF	Environmental Management Framework
EOLSS	End of line scraper station
ERS	Environment reference standard
ESLs	Ecological Screening Levels
FSRU	Floating storage and regasification unit
GDEs	Groundwater dependent ecosystems
GQRUZ	Groundwater Quality Restricted Use Zones
GW	Groundwater well
HDD	Horizontal directional drilling
HILs	Health Investigation Levels
ILs	Investigation Levels
ISQG	Interim sediment quality guideline
IWRG	Industrial Waste Resource Guidelines
KP	Kilometre point
LDP	Longford Dandenong Pipeline
LNG	Liquefied natural gas
LOR	Limit of reporting
LTV	Long term value
MAHs	Monocyclic aromatic hydrocarbons
mbgl	Metres below ground level
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
ML	Megalitre
MLA	Marine loading arm
MLs	Management Limits
MLV	Mainline valves

Abbreviation	Definition
MW	Monitoring well
NA	Net Acidity
NAGD	National Assessment Guidelines for Dredging
NAPL	Non-aqueous phase liquid
NDD	Non-destructive digging
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
OCP	Organochlorine pesticide
PAHs	Polycyclic aromatic hydrocarbons
PAN	Pollution Abatement Notice
PASS	Potential Acid Sulfate Soils
PCBs	Polychlorinated biphenyls
PIG	Pipeline Inspection Gauge
PMCL	Prevention and Management of Contaminated Land
PFAS	Per- and polyfluoroalkyl substances
PFHxS	Perfluorohexane Sulphonic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane sulfonate
pH <sub>f</sub>	Field pH
pH <sub>fox</sub>	Field peroxide pH
PID	Photo-Ionisation Detector
PIW	Prescribed Industrial Wastes
PMCL	Prevention and Management of Contaminated Land
PoHDA	Port of Hastings Development Authority
QA/QC	Quality assurance/Quality control
ROW	Right of way
RPD	Relative Percent Difference
SEPP	State Environment Protection Policy
SQGVs	Sediment quality guidelines values
SPOCAS	Suspension Peroxide Oxidation – Combined Acidity and Sulfate
TAA	Titrateable Actual Acidity

Abbreviation	Definition
TBM	Tert-Butyl mercaptan
TBT	Tributyltin
TDS	Total dissolved solids
THT	Tetrahydrothiophene
TPHs	Total petroleum hydrocarbons
VOC	Volatile organic compound
VLR	Victorian Landfill Register
VTs	Victorian Transmission System

## Glossary of terms

Term	Definition
%S	A measure of reduced inorganic sulfur (using the SCR or SPOCAS methods) expressed as a percentage of the weight of dry soil analysed.
Acid Neutralising Capacity (ANC)	A measure of the ability of the ASS material to neutralise acidity.
Acid sulfate soil (ASS)	Acid sulfate soils are naturally occurring soils, sediments or organic substrates that are formed under waterlogged conditions. These soils contain iron sulphide minerals or their oxidation products. When exposed, these soils oxidise and they can generate acidic water (if in contact with rainfall or other water source).
Action Criteria	The measured level of potential plus existing acidity beyond which management action is required, if a soil or sediment is to be disturbed. The trigger levels vary for texture categories and the amount of disturbance. The extent of management required would vary with the level of acidity and the volume of the disturbance, among other factors.
Actual acid sulfate soil (AASS)	Soils containing highly acidic soil horizons resulting from the oxidation of soil materials are rich in reduced inorganic sulfur primarily pyrite. When this oxidation of reduced inorganic sulfur produces acidity in excess of the soil material's capacity to neutralise this acidity, the soil material will often acidify to a pH 4 or less, forming an Actual Acid Sulfate Soil (AASS). The recognition of AASS materials can be confirmed by the presence of jarosite in these materials, or the location of other AASS or Potential ASS (PASS) materials within or in the nearby vicinity to the sampling location.
Actual Acidity	The soluble and exchangeable acidity already present in the soil, often as a consequence of previous oxidation of reduced inorganic sulfur. It is this acidity that will be most mobilised and discharged following a rainfall event. It is measured in the laboratory using the Titratable Actual Acidity (TAA) method. It does not aim to include the less soluble acidity (that is Retained Acidity) held in hydroxy-sulfate minerals such as jarosite.
Alignment	The centreline of the ROW selected for assessment in the EES.
Bell hole	A widened area of trench, which enables horizontal boring to be undertaken.
Beneficial use	A use of the environment or any element or segment of the environment which is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits, or of the emission of noise; or is declared in the State Environment Protection Policy to be a beneficial use.
Contaminated land (Potentially)	Land used or known to have been used for industry, mining or the storage of chemicals, gas, wastes or liquid fuel; as defined



Term	Definition
	in the <i>Ministerial Direction No. 1 – Potentially Contaminated Land</i> .
Contaminated soil	Soil is considered to be contaminated when concentrations of compounds can be detected above naturally occurring (where applicable) background concentrations.
Construction right of way (ROW)	Corridor generally of 30m width.
Decommissioning	The process by which a pipeline is made inoperative at the end of its useful life.
Environment Effects Statement	An Environment Effects Statement provides a comprehensive framework for the assessment of the potential environmental impacts or effects of a proposed development under the <i>Environment Effects Act 1978</i> .
End of Line Scraper Station	An underground delivery facility situated at the connection point to the Longford Dandenong Pipeline east of Pakenham and used to launch and receive pipeline inspection gauges (PIGs) into and from the pipeline system.
Horizontal Directional Drilling (HDD)	A 'trenchless technology' by which a pipeline tunnel is drilled at a shallow angle under a crossing (e.g. a waterway, wetland, road or railway) through which the pipe is then threaded.
Hydrostatic pressure testing	A pipeline testing process used to test welds and pipeline integrity in high pressure hydrocarbon pipelines. The process involves filling the newly constructed pipeline with pressurised water or other medium, enabling the detection of leaks.
KPs	Reference points alongside the proposed pipeline alignment, calculated according to the distance in kilometres from the Crib Point Receiving Facility.
Landholder	A general term used to refer to the legal owner or manager of a parcel of land. It may be a private landholder, Government or private utility, or a Government Agency responsible for management of a particular parcel of Crown land (e.g. National Parks or Forestry areas).
Liming rate	Liming rate is defined as the dose of neutralising agent needed to neutralise the calculated net acidity for a select sample.
Mainline Valve	MLVs are in-line block valves to allow for isolation and depressurisation. The valves can be closed to isolate sections of the pipeline for maintenance or during emergency conditions.
Net acidity	The measure of the acidity hazard of ASS materials. Determined from laboratory analysis, it is the result obtained when the values for various components of soil acidity and acid neutralising capacity (but only after corroboration of the ANC's effectiveness) are substituted into the Acid Base Accounting equation.
Tributyltin (TBT)	An organotin compound used as a biocide in anti-fouling paint applied to ship hulls to prevent hull fouling and thereby decrease drag and fuel consumption. TBT appears to be highly toxic to

Term	Definition
	non-target aquatic organisms, is linked to imposex and immuno-suppression in snails and bivalves, and can be persistent..
pH <sub>FOX</sub>	pH measurement based on peroxide test results in the field.
Pigging	The act of forcing a PIG through a pipeline for the purposes of displacing or separating fluids, and cleaning or inspecting the line.
Potential ASS (PASS)	Soils that contain appreciable amounts of reduced inorganic sulfur that have not oxidised but will acidify to a pH of less than 4.0 after oxidation. The soils are also known as hypersulfidic soil materials. The field pH of these soils in their undisturbed state is pH 4 or more, and may be neutral or slightly alkaline. Potential ASS pose an environmental hazard if disturbed, as they can generate considerable acidity if mismanaged.
Priority Site	Sites for which EPA Victoria has issued a clean-up notice, or a pollution abatement notice (relevant to land and/or groundwater).
Reinstatement	Reinstatement is the process of re-establishing a pre-existing physical condition, and usually involves bulk earth works and structural replacement of pre-existing attributes of a site, such as soil, surface topography, drainage, culverts, fences and gates.
Total dissolved solids	The total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water.
Trenching	Excavation of a trench for burial of a pipeline.
Trench water	Water (usually shallow groundwater, rainwater or runoff) in the pipeline trench.

## 1.0 Introduction

This report presents the assessment of potential impacts to human health and the environment associated with disturbance of contaminated soils, groundwater and marine sediment, and acid sulfate soils (ASS), as well as potential contamination associated with the construction and operation of the proposed Gas Import Jetty and Pipeline Project (the Project).

The Project would provide an additional supply of natural gas into the south-eastern Australian gas market for industrial, commercial and residential customers.

The Australian Energy Market Operator has predicted potential supply gaps in Victoria's gas market from 2024 (AEMO, 2019). The Project would improve energy security for industrial, commercial and domestic customers and would increase competition in the market.

The joint proponents of the Project are AGL Wholesale Gas Limited (AGL) and APA Transmission Pty Limited (APA).

The Project would establish a gas import jetty and pipeline comprising:

- a floating storage and regasification unit (FSRU) at Crib Point Jetty - the Gas Import Jetty Works
- a gas pipeline between Crib Point and Pakenham to connect to the Victorian Transmission System (VTS) east of Pakenham – the Pipeline Works.

The Project was referred by AGL and APA to the Victorian Government under the *Environment Effects Act 1978* (Vic) on 13 September 2018 as two separate projects consisting of the Gas Import Jetty Works and Pipeline Works.

On 8 October 2018 the Minister for Planning issued a decision determining that an Environment Effects Statement (EES) was required for the Project due to the potential for a range of significant environmental effects.

The Gas Import Jetty Works and the Pipeline Works were also referred to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as separate projects.

Each project was designated as a controlled action requiring impact assessment under the EPBC Act. The EES process is the accredited environmental assessment for the controlled action decisions under the EPBC Act in accordance with the bilateral agreement between the Commonwealth and Victorian governments.

### 1.1 Purpose

This report provides a contamination (soils, groundwater, and marine sediment) and ASS impact assessment for the EES and sets out mitigation measures for potential impacts of the Project. The contamination assessment addresses both existing contamination and potential contamination arising from Project activities. This report will inform the development of an Environmental Management Framework (EMF) for the Project. The mitigation measures listed in the EMF would be implemented in the approvals and management plans for the Project.

#### 1.1.1 Why understanding contamination and acid sulfate soils is important

**Potentially contaminated land** is defined in *Ministerial Direction No. 1 – Potentially Contaminated Land*, as land used or known to have been used for industry, mining or the storage of chemicals, gas, wastes or liquid fuel (if not ancillary to another use of land). This practice note also deals with land that may have been contaminated by other means such as by ancillary activities, contamination from surrounding land, fill using contaminated soil or agricultural uses.

**Acid sulfate soil** is defined in the EPA Victoria *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999*, as any soil, sediment, unconsolidated geological material or disturbed consolidated rock mass containing metal sulfides which exceeds criteria for acid sulfate soils specified in EPA Victoria Publication 655 entitled *Acid Sulfate Soil and Rock* published by the Authority in 1999, and amended from time to time or republished by the Authority.

The Project is located within the Western Port catchment. A large portion of the Western Port is listed as a Ramsar Site of international significance, supporting a diversity of plants, animals and ecosystems, including several unique and threatened species, four marine national parks, large tracts of mangroves and seagrasses (Sharp et al., 2013). The construction of infrastructure has the potential to disturb contaminated soils, groundwater and/or ASS. This could result in mobilisation of contaminants and has the potential to impact human health and the environment.

Understanding the condition of existing land and the Western Port environment, and the beneficial uses that require protection, enables construction methods to be developed to minimise or prevent impacts to onsite and offsite receptors. The impacts of mobilised contaminants and ASS can be costly to manage or remediate if they arise because the existing conditions of land and Western Port environment is not properly understood, and appropriate mitigation measures are not in place.

The Project Area is largely surrounded by open agricultural or farmland where potential for contamination is generally considered to be low, although still possible. Areas of commercial and industrial land use, including a former landfill, that may give rise to contamination are present within the study area. The Gas Import Jetty Works are not anticipated to encounter groundwater, therefore potential impacts from the disturbance of contaminated groundwater at the land adjacent to Crib Point Jetty is not addressed in this report.

The presence of actual or potential acid sulfate conditions does not relate to contamination, but rather the underlying geology. ASS are soils affected by iron sulphide minerals. ASS can occur naturally in coastal environments such as estuarine systems, mangrove swamps and backswamps, and in inland environments such as river and stream channels, lakes, wetlands, billabongs, floodplains and marshes (Fitzpatrick, R. and Shand, P., 2008).

Operation of the FSRU and liquefied natural gas (LNG) carriers may disturb marine sediment. Understanding the existing conditions of marine sediment is therefore important as redistribution of potentially contaminated marine sediment may cause impacts to the local marine ecosystem.

## **1.2 Project description**

The Project comprises two sets of works: the Gas Import Jetty Works and the Pipeline Works.

### **1.2.1 Gas Import Jetty Works**

The Gas Import Jetty Works would consist of a liquefied natural gas (LNG) import facility comprising:

- continuous mooring of an FSRU at Berth 2 of the existing Crib Point Jetty to store LNG and regasify LNG into natural gas
- Jetty Infrastructure on the Crib Point Jetty including marine loading arms (MLAs) and gas piping to transfer the gas from the FSRU to the Crib Point Receiving Facility
- Crib Point Receiving Facility, including metering, odorant injection and nitrogen injection, which would be located on land adjacent to the Crib Point Jetty.

The FSRU vessel for the Project would be approximately 300 metres long and 50 metres wide. It would have capacity to store 170,000 cubic metres (m<sup>3</sup>) of LNG. Visiting vessels carrying LNG (LNG carriers) would berth alongside the FSRU to transfer their LNG to the FSRU, which could take up to 36 hours.

The FSRU would store the LNG as a liquid and when required, return LNG back into a gaseous state by heating the LNG using either seawater or gas-fired boilers (a process known as regasification).

Following regasification, the natural gas would be transferred through gas piping along the jetty from the FSRU to the Crib Point Receiving Facility.

The Crib Point Receiving Facility would include treatment facilities to inject odorant and nitrogen (as required) into the natural gas to meet VTS gas quality specifications.

### **1.2.2 Pipeline Works**

The Pipeline Works would comprise a bi-directional gas transmission pipeline to transport gas from the Crib Point Receiving Facility to the VTS east of Pakenham.

The pipeline would be approximately 57 kilometres long with a nominal diameter of 600 millimetres. The pipeline would be buried at a depth of generally 1.2 metres below ground (to the top of the pipe).

The Pipeline Works would also comprise the following facilities:

- the pigging facility at the Crib Point Receiving Facility to enable in-line inspections of the pipeline with a pipeline inspection gauge (pig)
- the above-ground Pakenham Delivery Facility situated adjacent to the Pakenham East rail depot to monitor and regulate the gas
- the below-ground End of Line Scraper Station (EOLSS) located at the connection point to the VTS, north of the Princes Highway in Pakenham
- two above-ground mainline valves (MLVs) located at different points along the pipeline alignment to enable isolation of the pipeline in an emergency.

### **1.2.3 Construction**

The key construction activities for the Gas Import Jetty Works would include:

- establishment of construction sites including laydown areas
- installation of Jetty Infrastructure on the Crib Point Jetty, including MLAs, gas piping mounted to the jetty, electrical and instrumentation equipment and a firefighting system
- construction of the Crib Point Receiving Facility.

Construction for the Gas Import Jetty Works would take approximately 18 to 27 months, depending on weather conditions.

The key construction activities for the Pipeline Works would include:

- establishment of laydown areas
- construction of the pigging facility at Crib Point Receiving Facility, Pakenham Delivery Facility, two MLVs and the EOLSS
- pipeline construction using construction techniques such as trenching, horizontal directional drilling (HDD) or boring, typically within a 30-metre-wide pipeline construction right of way (ROW).

Construction for the Pipeline Works would take approximately 18 to 24 months, depending on weather conditions.

Pending on the staging of the works outlined above, construction for the entire Project is expected to take approximately 18 to 27 months.

### **1.2.4 Operation and maintenance**

When commissioned, the FSRU would be operated by an experienced third-party operator. The Crib Point Receiving Facility and associated Jetty Infrastructure would be owned and operated by AGL or an experienced third-party operator. The Pipeline Works would be owned and operated by APA.

The FSRU may leave Western Port during the Project lifetime for activities such as scheduled maintenance and extreme weather events.

The gas import jetty would initially receive approximately 12 LNG carriers per year with capacity to increase to approximately 40 LNG carriers per year. The number and frequency of LNG carriers arriving each year would depend on their storage capacity and gas demand.

The Crib Point Receiving Facility is designed to be automated and may be operated unmanned under normal operating conditions.

An operational easement of generally 15 metres wide would apply to the pipeline alignment. The pipeline easement would be routinely inspected for any operational or maintenance issues in accordance with APA procedures.

The pipeline would also be designed and constructed so that pigging could be undertaken to inspect the integrity of the pipeline as required. Pigging would be undertaken around 10 years after construction and then at a frequency determined by the first inspection.

The Pakenham Delivery Facility is also designed to be automated and operate unmanned under normal operating conditions.

The EOLSS would be buried with valves contained within concrete pits. The connection to the VTS would operate unmanned. Excavation of the site to access the EOLSS would be required for the pigging activities.

#### **1.2.5 Decommissioning**

The FSRU is proposed to operate for 20 years, although this may be shortened or extended to address security and stability of gas supply to south-eastern Australia. When the Project was no longer required, the FSRU would leave Western Port.

The Jetty Infrastructure installed on the Crib Point Jetty and the Crib Point Receiving Facility would be decommissioned and removed when no longer required. The Crib Point Jetty would remain as an operational jetty under the management of the Port of Hastings Development Authority (PoHDA).

The pipeline would have a design life of 60 years. If the Pipeline Works were no longer required, they would be decommissioned in accordance with Australian Standard AS2885 *Pipelines – gas and liquid petroleum* and relevant legislative and approval requirements at the time of decommissioning.

#### **1.2.6 Contamination and acid sulfate soils considerations in Project design**

##### **Pipeline Works construction**

Pipeline installation is expected to occur primarily during summer when ephemeral streams are less likely to be flowing and surface water runoff into open trenches would be minimised. Groundwater levels would also be deepest at this time, minimising the likelihood of encountering potentially contaminated groundwater during pipeline construction.

The pipeline would be installed using three techniques: trenching, Horizontal Directional Drilling (HDD), and boring. These are discussed below.

##### *Trenching:*

Trenching is the principal pipeline construction method, with 48.5 kilometres of the total 57 kilometres (85 per cent) of pipeline designed to be installed with this method. In a number of areas with potentially sensitive features, or for logistical reasons, HDD and boring installation techniques would be used.

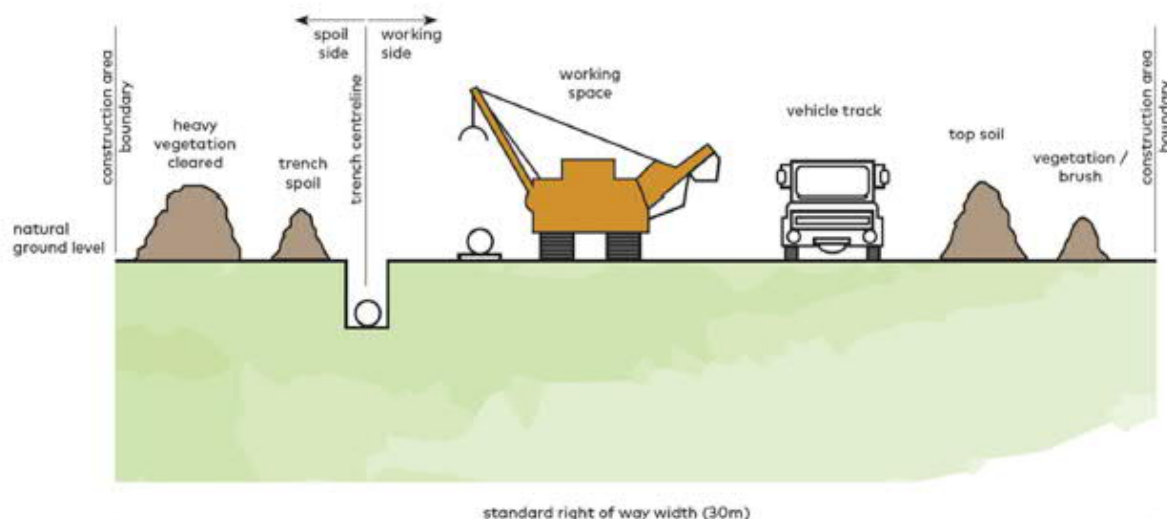
The trenching process would involve excavating an open cut trench that would typically be two metres deep and a minimum of 0.9 metres wide (0.6 metres pipe diameter plus 0.15 metres each side). The trench width is increased to 1.8 metres (0.6 metres pipe diameter plus 0.6 metres each side) where in-situ concrete slab protection is required above the pipe. Where the trench crosses sealed roads, the depth may increase to 2.6 to three metres. The pipeline trench may be open for several days before the pipe is installed and is backfilled.

Immediately prior to the pipe being installed, the trench would be dewatered to remove any water which has collected during the time it has been open. This water may be groundwater, rainwater or a combination of both. It is anticipated that pumping from the trench and installation of the pipe would be completed on the same day (where possible), minimising the risk for oxidation of Potential ASS (PASS) due to groundwater table draw down. Groundwater table draw down from dewatering activities is discussed in the EES Technical Report D: *Groundwater impact assessment*.

The trench would be backfilled using the excavated spoil (non-contaminated), and excess excavated material would be mounded over the trench to compensate for subsidence or removed from site. Depending on the location, bedding and padding material (sieved soil or sand) may be placed around the pipe to protect the pipe coating from damage due to materials in the excavated spoil. Bedding and padding material may be either imported using trucks or, where the excavated material is suitable, produced by sieving the excavated material on site. Selected sections, such as beneath the roads, would be excavated and filled with stabilised sand.

Pipeline construction would be undertaken in stages to minimise spoil stockpile exposure duration, such that ASS are exposed to oxygen/surface water for the minimum amount of time possible, thus reducing the potential for acid and leachate generation. Any contaminated soils and trench water (groundwater, direct rainfall and surface water runoff collected within the open trench) and ASS would be managed within the Project Area in accordance with relevant regulatory requirements and guidelines, and have been considered in this impact assessment report.

The typical layout of the open trench construction is shown in Figure 1 .



**Figure 1 Typical layout of the open trench construction**

#### *Horizontal directional drilling (HDD):*

HDD would typically be used to install the pipeline beneath major roads, major watercourses and other sensitive features. The construction design involves approximately 6.9 kilometres of the total 57 kilometre pipeline length (12 per cent) using HDD methods.

HDD involves drilling at a shallow angle from the surface to a set depth, continuing at a specified depth to another set chainage, before angling back up to an exit point on the other side of the sensitive feature (road, waterway, vegetation). Entry and exit pits are typically constructed (approximately five metres long, three metres wide and two metres deep) and used as mud pits. Due to the addition of the mud, these pits are not dewatered.

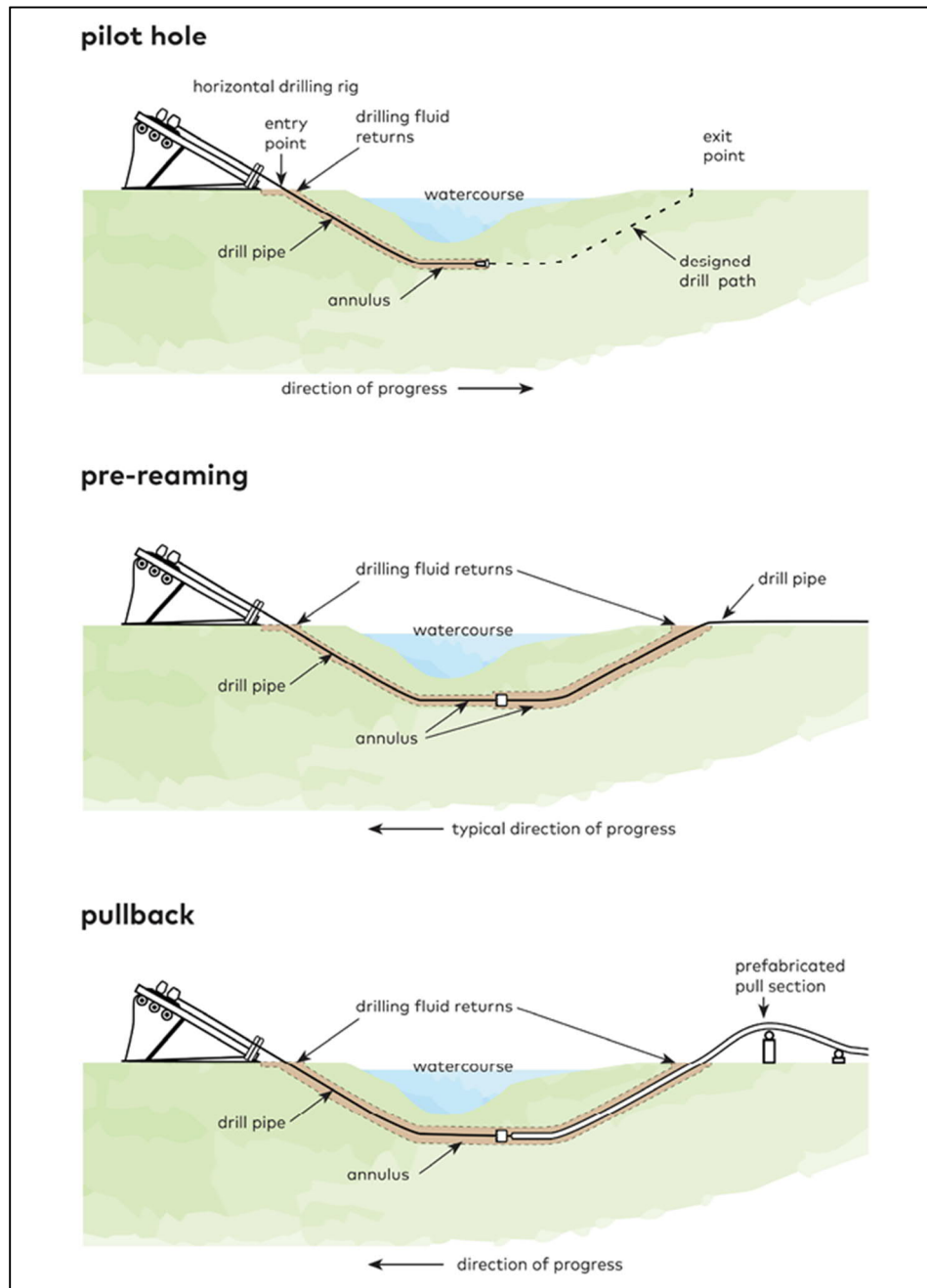
No trenches need to be excavated for this installation method and no dewatering is necessary during drilling and pipeline construction. After drilling and installation of the pipe along the HDD section, bell holes would be constructed at the entry and exit points to facilitate joining of the pipe (known as tying-in). These HDD tie-in bell holes would be approximately five metres long, five metres wide, and two and half metres deep. These may require short-term dewatering if groundwater is intersected. It is anticipated that pumping from the bell hole and tying-in of the pipe would be completed on the same day where possible.

Drilling mud (typically bentonite) is used to hydraulically drive the drilling head, as a coolant, to wash in-situ material (cuttings) from the drilled hole and to seal and line the hole to facilitate insertion of the pipe. Cuttings are screened, removed at the HDD rig and the drilling mud is recycled. Screened cuttings are diverted to skip bins prior to disposal off-site. Drill cuttings and drilling mud would be disposed of off-site in accordance with the Pipeline Works CEMP.

Change in groundwater quality from use of HDD drilling fluids is discussed in the EES Technical Report D: *Groundwater impact assessment*. The potential impacts from an unplanned release of drilling fluids and disposal would be managed in accordance with relevant regulatory requirements and guidelines, and have been considered in this impact assessment report.

The typical layout of the HDD construction is shown in Figure 2.





**Figure 2 Typical layout for HDD construction**

#### *Thrust/horizontal Boring:*

Thrust boring (also referred to as horizontal boring or micro-tunnelling) would be used to install the pipeline at some road, rail and water crossings. The preference is to utilise mini-HDD techniques at these locations, with horizontal thrust boring used where mini-HDD is deemed to be unsuitable. The drilling methodology would be determined by the contractor.

Thrust boring would involve excavating an entry bell hole approximately ten metres long, four metres wide, and up to four metres deep. The exit bell hole would typically be seven metres long, four metres wide and up to four metres deep. The boring machine drills horizontally from the entry bell hole beneath the sensitive feature until it reaches the bell hole at the end of the boring section. Thrust bore bell holes would need to be dewatered prior to drilling if groundwater has seeped in.

The entry and exit bell holes associated with the mini-HDD technique are approximately five metres long, five metres wide and two and half metres deep, with the duration of dewatering activities being less than that of the thrust boring technique.

The construction design involves approximately 1.6 kilometres of the total 57 kilometres pipeline length (three per cent) using thrust boring methods.

Contaminated soils and water (groundwater and direct rainfall) collected within the bell holes, and ASS would be managed within the Project Area in accordance with relevant regulatory requirements and guidelines, and have been considered in this impact assessment report. Groundwater table draw down from dewatering activities is discussed in the EES Technical Report D: *Groundwater impact assessment*.

The typical site setup for a thrust bored crossing is shown in Figure 3.

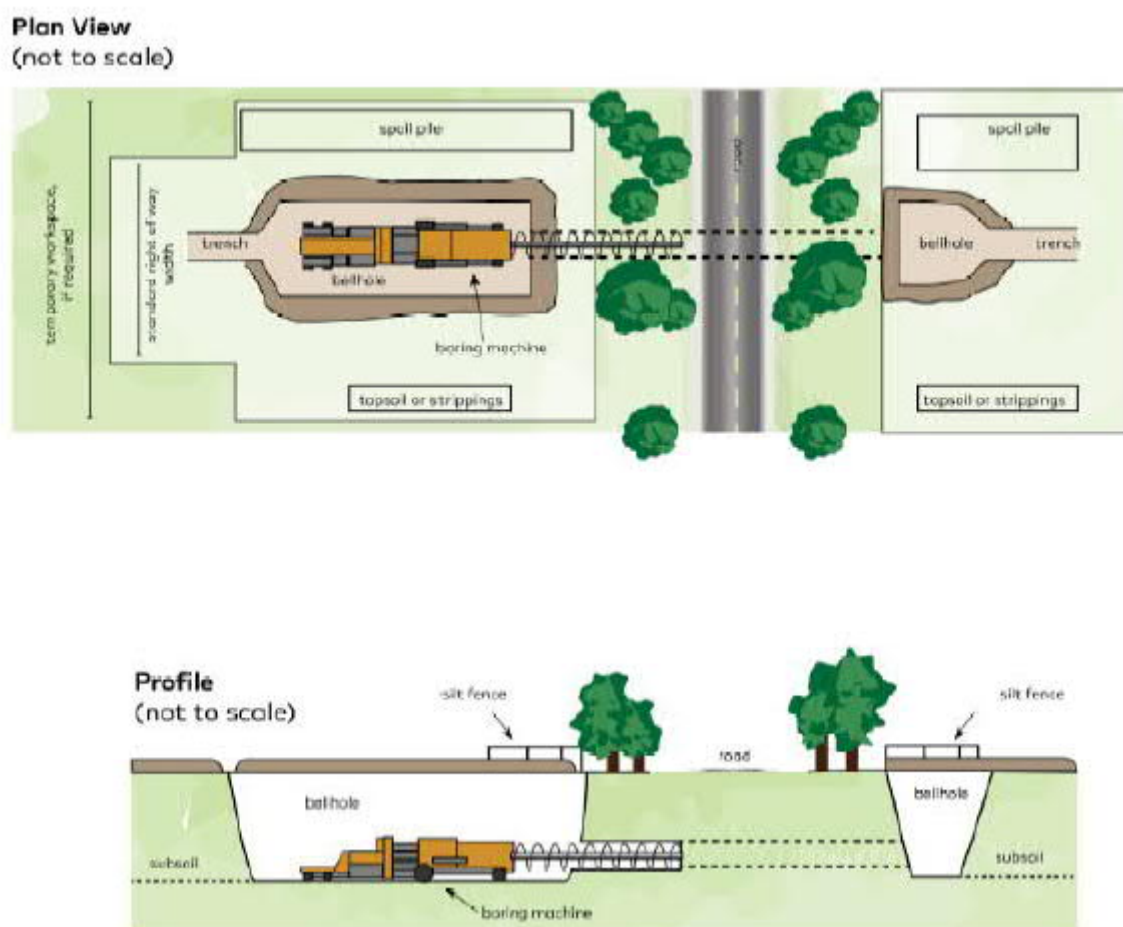


Figure 3 Typical thrust bore site setup

#### End of line scraper station (EOLSS)

The EOLSS is where the pipeline connects to the VTS, via the Longford Dandenong Pipeline (LDP) and LDP loop line. These works would include hot tap works involving the excavation of large holes typically six metres wide, 10 metres long and three metres deep to allow for welding onto the existing pipeline and drilling into it. The deepest part of the excavation at the EOLSS may be up to 5.5 metres deep. Additional excavations would be required to install the buried pipework, concrete retaining wall, concrete foundations and the large concrete valve pits that enable the EOLSS to remain buried under normal operation, by allowing operation of the valves to be accessible from the surface. The hot tap works and the EOLSS construction would take about 16 weeks to complete and it is unlikely that groundwater would be intersected based on the site's elevation and regional data.

Any contaminated soils and water (direct rainfall and surface water runoff collected within the open excavation) and ASS would be managed within the Project Area in accordance with relevant regulatory requirements and guidelines, and have been considered in this impact assessment report.

#### *Pakenham Delivery Facility*

The construction of the Pakenham Delivery Facility is not anticipated to encounter groundwater, therefore potential impacts from the disturbance of contaminated groundwater not addressed in this report.

### **Pipeline testing and commissioning**

Once installed, the pipeline is pressure tested prior to commissioning to ensure that the pipeline passes strength and leak tests. This is done through a process called hydrostatic testing, whereby sections of the pipeline (test sections) are filled with water and then pressurised.

It is anticipated that the pipeline would be hydrostatically tested in a minimum of four and possibly up to eight sections of variable lengths; requiring approximately 10 megalitres (ML) of water in total. It is assumed that water would be reused between two adjacent test sections, and break tanks would be used to transfer water between test sections. Depending on the final configuration of hydrostatic test sections and the availability of water, chemicals to control biological growth and corrosion of the pipe may be added to the hydrostatic test water.

Water for hydrostatic testing would be obtained from dams, groundwater bores, irrigation channels or watercourses near the pipeline alignment under agreements and/or licences/permits with relevant landholders and authorities. At the conclusion of testing, and subject to confirmation of the water quality, the water would be released to adjoining land with permission from landholders. Water that is not able to be disposed of onto adjoining land would be disposed of in accordance with relevant legislation and policy requirements.

Hydrotest water would be managed in accordance with relevant regulatory requirements and guidelines, and have been considered in this impact assessment report.

### **Gas Import Jetty Works construction**

Potential impacts to human health and the environment associated with disturbance of contaminated soils, ASS, as well as potential contamination associated with the construction and operation of the Gas Import Jetty have been considered in this impact assessment report. The potential impacts from the disturbance of contaminated groundwater, however, is not addressed as the construction of the Gas Import Jetty Works is not anticipated to encounter groundwater.

## **1.3 Project Area**

The Project Area is situated between Crib Point and Pakenham East in Victoria within the local government areas of Mornington Peninsula Shire, the City of Casey and Cardinia Shire.

The Project Area includes the construction and operation footprints for the Gas Import Jetty Works and the Pipeline Works. The Project Area also includes the locations of previous pipeline alignment options that were assessed over the course of the EES which are no longer being considered.

The Project Area is detailed in EES Attachment VII *Map book*. An overview of the Project showing the proposed pipeline alignment and current options is shown in Figure 4.

The Gas Import Jetty Works would be located within Western Port at the existing Crib Point Jetty and on land immediately adjacent. The Crib Point Jetty is located within the Port of Hastings and within an area designated as a wetland of international significance under the Ramsar Convention on Wetlands of International Importance (the Western Port Ramsar site).

The Pipeline Works would be located on land between the Crib Point Receiving Facility and a connection point to the VTS east of Pakenham.

The pipeline alignment was selected to minimise impacts on sensitive land uses and where possible follows existing pipeline easements.

The pipeline would be located on land used for various purposes including rural residential living, road corridors, industry, conservation reserves, hobby farming, horse studs and agriculture. The pipeline would generally follow the Stony Point rail reserve through Hastings. Towards Pakenham, the pipeline would cross the Gippsland rail line before reaching the proposed Pakenham Delivery Facility adjacent to the Pakenham East rail depot and connecting to the VTS north of the Princes Highway.

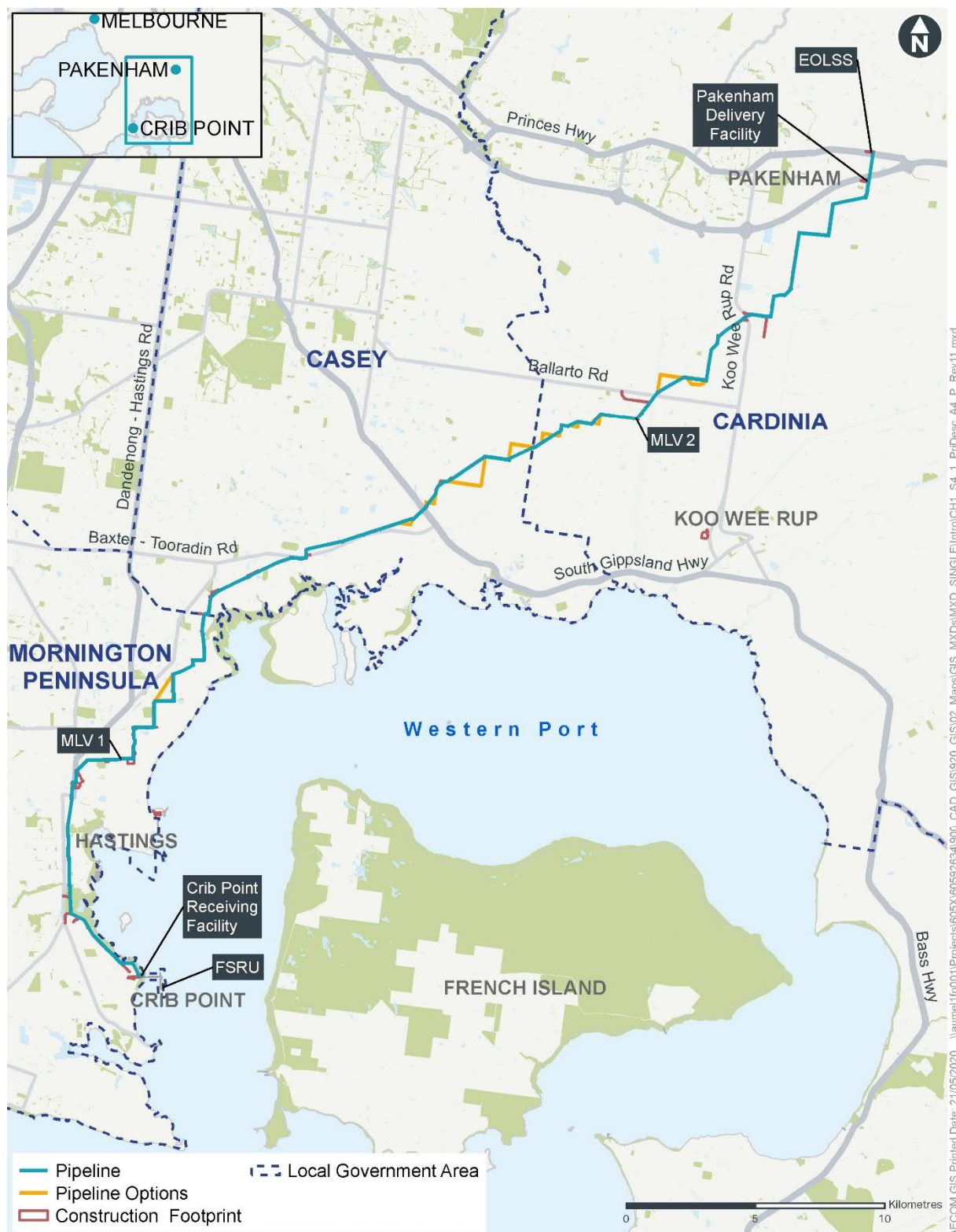


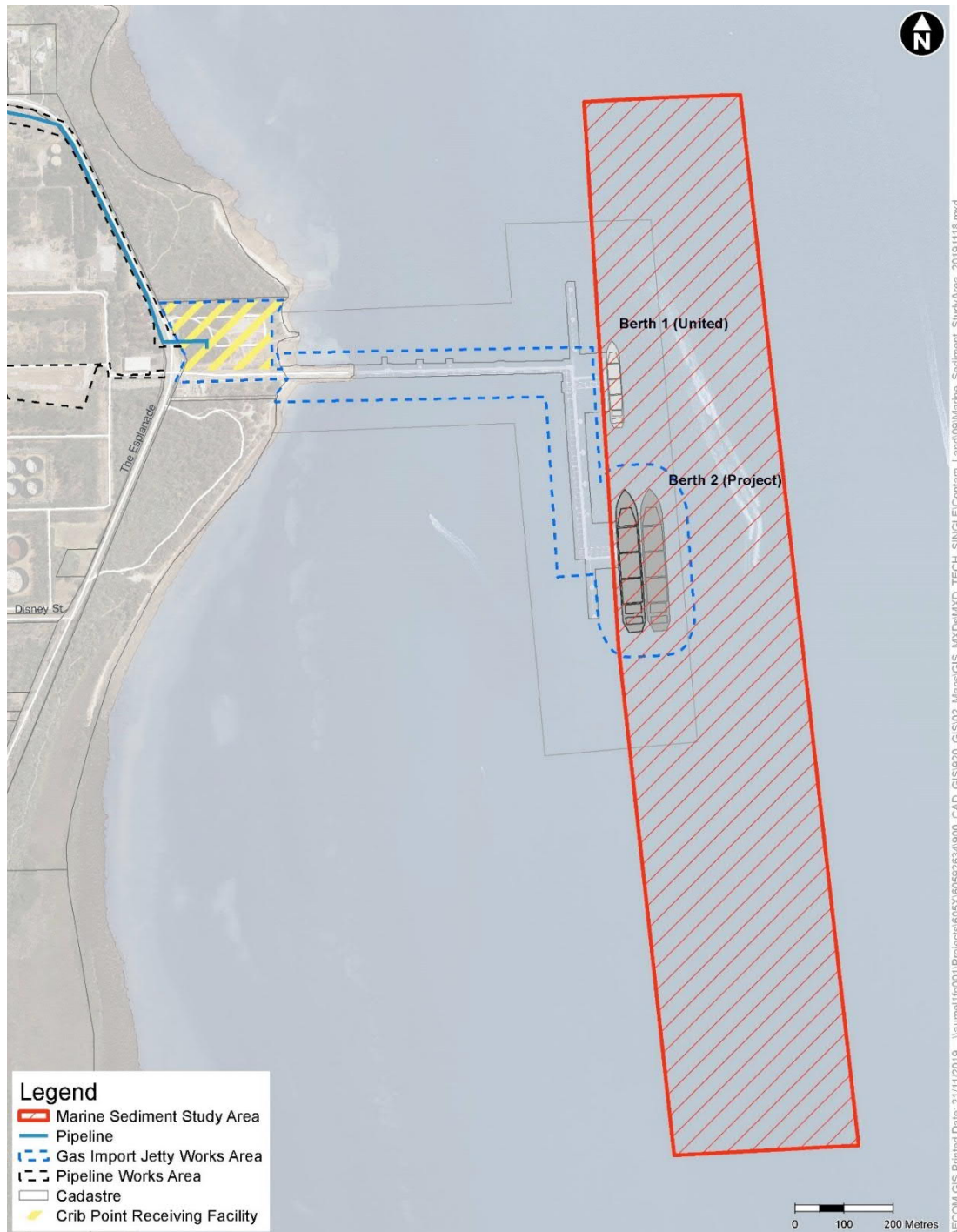
Figure 4 Project Area overview



### 1.3.1 Study area

The study area, for the purpose of soil and groundwater contamination investigation, and ASS investigation, includes the pipeline ROW and alignment alternative and a buffer area of 50 metres either side of the ROW, the Pakenham Delivery Facility, the EOLSS, and the landside component of the Gas Import Jetty Works, which includes the gas piping and the Crib Point Receiving Facility.

The study area, for the purpose of marine sediment contamination investigation, includes Berth 1 and 2 and a buffer area of approximately 200 metres east of the berths, as shown in Figure 5.



## 2.0 Scoping requirements

The EES scoping requirements for the Project were issued by the Victorian Minister for Planning in February 2019, and augment the key matters listed in the Minister's decision to require an EES.

The scoping requirements set out the specific matters to be investigated and documented in the EES in the context of the *Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978*.

The EES is an accredited assessment process for the purposes of the assessment of the Project under the EPBC Act, and the EES scoping requirements also include matters to be assessed under the EPBC Act.

### 2.1 Evaluation objectives

The following draft evaluation objective is relevant to contamination and ASS and identifies the desired outcomes in the context of potential Project effects. The draft evaluation objectives, as set out in the final scoping requirements, provide a framework to guide integrated assessment of the environmental effects of the Project. These draft evaluation objectives are to be used in the context of the relevant legislative requirements set out in Section 3.0.

#### Draft evaluation objectives for contamination and acid sulfate soil

**Water and catchment values** – To minimise adverse effects on water (including groundwater, waterway, wetland, estuarine, intertidal and marine) quality and movement particularly as they might affect the ecological character of the Western Port Ramsar Site.

**Waste** – To minimise generation of wastes by or resulting from the project during construction and operation, including accounting for direct and indirect greenhouse gas emissions.

### 2.2 Assessment of specific environmental effects

The following extracts from the scoping requirements, issued by the Minister for Planning, are relevant to the draft evaluation objectives listed above.

**Table 2-1 Scoping requirements for contaminated soil, groundwater, marine sediment and acid sulfate soil impact assessment**

Aspect	Scoping requirement	Refer
Key Issues	The potential for adverse impacts on water-related values due to spills or other incidents during construction or operation.	Section 7.0 (Impact assessment)
Priorities for characterising the existing environment	Characterise the local groundwater quality and behaviour, including the protected beneficial uses and values and identifying any groundwater dependent ecosystems (GDEs) that might be affected by the project.	Section 5.0 (Existing conditions) EES Technical Report B: <i>Terrestrial and freshwater biodiversity impact assessment</i> EES Technical Report C: <i>Surface water impact assessment</i> EES Technical Report D: <i>Groundwater impact assessment</i>
Design and mitigation measures	Identify and evaluate aspects of project works and operations, and proposed design refinement options or measures that could avoid or minimise significant effects on water, waterway or wetland environments.	Section 6.0 (Risk assessment) Section 7.0 (Impact assessment) Section 8.0 (Mitigation measures)

Aspect	Scoping requirement	Refer
	Describe further potential and proposed design options and measures that could avoid or minimise significant effects on beneficial uses of surface water, groundwater and downstream water environments during the project's construction and operation, including response measures for environmental incidents.	EES Technical Report C: <i>Surface water quality and hydrology impact assessment</i>  EES Technical Report D: <i>Groundwater impact assessment</i>
Assessment of likely effects	Identify and evaluate effects of the project and relevant alternatives on groundwater and surface water near the project works, including the likely extent, magnitude and duration (short and long term) of changes to water quality, water level or flow paths during construction and operation, considering appropriate climate change scenarios.	Section 7.0 (Impact assessment)  EES Technical Report C <i>Surface water impact assessment</i>  EES Technical Report D: <i>Groundwater impact assessment</i>
Approach to manage performance	Describe any further methods that are proposed to manage risks of effects on groundwater and surface water and catchment values, as well as water quality, to form part of the EMF.	Section 8.0 (Mitigation measures)  EES Technical Report A: <i>Marine biodiversity</i>  EES Technical Report B: <i>Terrestrial and freshwater biodiversity impact assessment</i>  EES Technical Report C: <i>Surface water impact assessment</i>  EES Technical Report D: <i>Groundwater impact assessment</i>
	Describe any further methods that are proposed to manage risks of effects as a result of nearby projects impacting on water inflow to water environments and catchment values, as well as water quality.	
	Describe and evaluate the approach to monitoring and the proposed contingency measures to be implemented in the event of adverse residual effects on water quality and catchment values requiring further management.	
	Describe and evaluate the approach to monitoring and the proposed ongoing management measures to be implemented to avoid adverse residual effects on the Western Port Ramsar Site.	
Key Issues	Potential for adverse environmental or health effects from waste materials/streams generated from project works.	Section 7.0 (Impact assessment) EES Technical Report A: <i>Marine biodiversity impact assessment</i>  EES Technical Report B: <i>Terrestrial and freshwater biodiversity impact assessment</i>  EES Technical Report C: <i>Surface water impact assessment</i>
	Potential for disturbance of contaminated soil or acid sulphate soil.	



Aspect	Scoping requirement	Refer
		EES Technical Report D: <i>Groundwater impact assessment</i> EES Technical Report G: <i>Air quality impact assessment</i>
Priorities for characterising the existing environment	Identify the potential occurrence of contaminated or potential acid sulphate soils within the area where project works may occur.	Section 5.0 (Existing conditions)
Design and mitigation measures	Describe available options for treatment or disposal of solid and liquid wastes generated by the project.	Section 6.0 (Risk assessment) Section 7.0 (Impact assessment) Section 8.0 (Mitigation measures)
	Describe how the waste hierarchy will be applied to control and manage waste.	EES Technical Report C: <i>Surface water impact assessment</i> EES Technical Report D: <i>Groundwater impact assessment</i> EES Technical Report G: <i>Air quality impact assessment</i>
	Identify suitable off-site disposal options for waste materials.	
Assessment of likely effects	Identify potential environmental effects resulting from the generation, storage, treatment, transport and disposal of solid waste, including contaminated or potential acid sulphate soil from project construction and operation.	Section 7.0 (Impact assessment) EES Technical Report C <i>Surface water impact assessment</i> EES Technical Report D <i>Groundwater impact assessment</i> EES Technical Report G: <i>Air quality impact assessment</i>
Approach to manage performance	Describe proposed management approach for solid waste.	Section 8.0 (Mitigation measures)
	Describe measures for emergency and spill response.	
	Describe contingency measures for responding to unexpected impacts resulting from waste management or discharges.	

In the context of this report, 'effects' includes all potential direct, indirect, on-site and off-site environmental impacts resulting from the Project. The description and assessment of effects is not confined to the immediate area of the Project but also considers the potential of the Project to impact on adjacent or other areas that could be affected, in the context of a systems-based approach.

### 3.0 Legislation, policy and guidelines

Table 3-1 summarises the relevant legislation that applies to the Project in the context of this contamination and ASS impact assessment, as well as the implications and required approvals.

**Table 3-1 Primary environmental legislation and associated information on contaminated soils and ASS**

Document	Description	Implications for the Project	Work Areas
<b>Commonwealth</b>			
<i>National Environment Protection Act 1994</i> <b>(National Environment Protection Act)</b>	<p>The National Environment Protection Act allows the National Environment Protection Council (<b>NEPC</b>) to issue National Environment Protection Measures (<b>NEPMs</b>). These measures are framework documents containing national environmental protection objectives.</p> <p>National Environment Protection (Assessment of Site Contamination) Measure, 1999 (<b>ASC NEPM</b>) as amended in 2013 ensures there is a nationally consistent approach to the assessment of contamination and this NEPM is adopted on a State level through the SEPP (Prevention and Management of Contamination of Land) (<b>SEPP (PMCL)</b>).</p>	<p>Site contamination assessment for the Project must be in accordance with the amended ASC NEPM 2013, as adopted by the SEPP (PMCL).</p> <p>The Pipeline Works CEMP would be used to manage any contaminated soils encountered during construction of the Pipeline Works and to ensure soils are handled and disposed of to a licensed premise.</p> <p>The EMP included in the Incorporated Document in the Planning Scheme Amendment required for the Gas Import Jetty Works (including the FSRU) would also incorporate measures to manage contaminated soils encountered during construction.</p>	Gas Import Jetty Works and Pipeline Works
<b>State</b>			
<i>Environment Effects Act 1978</i> <b>(Environment Effects Act)</b>	<p>The Environment Effects Act provides a regime where projects with potentially significant environmental impacts may require the preparation of an EES for assessment by the Minister for Planning. An EES may be required for declared 'public works' or works determined by the Minister for Planning to require an EES following referral. Where an EES is required, the Minister for Planning will issue scoping requirements to guide preparation of the EES. Once the EES is prepared it is placed on exhibition for</p>	<p>On 8 October 2018, the Victorian Minister for Planning determined that an EES was required for the Gas Import Jetty Works and Pipeline Works (as a single joint project). In February 2019, the Minister for Planning issued the scoping requirements for the Project. The EES has been prepared in accordance with these scoping requirements, which require the assessment of a range of specific environmental effects. The EES would be placed on public exhibition and an inquiry would be appointed to</p>	Gas Import Jetty Works and Pipeline Works

Document	Description	Implications for the Project	Work Areas
	<p>public comment (typically for 20 to 30 days).</p> <p>The Minister for Planning may appoint an inquiry to assess the impacts of the project, taking into account the EES studies and any public submissions. This can involve a formal hearing.</p> <p>The Minister for Planning subsequently provides an assessment (typically within 25 business days of the inquiry report being received), having considered the proponent's response, public submissions, EES documents and the inquiry report. The relevant statutory decision-makers must consider the Minister for Planning's Assessment when deciding whether to approve the project and, if so, on what conditions.</p>	<p>consider the environmental effects of the projects. At the conclusion of the EES assessment process the Minister for Planning's Assessment Report would be provided to the relevant statutory decision-makers to inform their decisions whether to grant approvals for the projects.</p>	
<i>Environment Protection Act 1970</i> <b>(Environment Protection Act)</b>	<p>The Environment Protection Act provides a legal framework to protect the environment in Victoria, including the protection of air, land and water from pollution. The Act is outcome oriented, with a basic philosophy of preventing pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them.</p> <p>The Environment Protection Act establishes the EPA Victoria to administer the Act and any regulations and orders made under the Act, including orders declaring SEPPs.</p>	<p>Any discharge to land, waterway or groundwater; and disposal of waste (including contaminated soil and acid sulfate soil) must be in accordance with the requirements of the Environment Protection Act.</p> <p>The Pipeline Works CEMP and Acid Sulfate Soil Management Plan would be used to manage any acid sulfate or contaminated soils encountered during construction of the Pipeline Works and to ensure soils are handled and disposed of to a licensed premise.</p> <p>The Pipeline Works CEMP would be approved by the Minister for Energy and administered by the Pipeline Regulator (in consultation with EPA Victoria).</p> <p>The EMP included in the Incorporated Document in the Planning Scheme Amendment required for the Gas Import Jetty Works</p>	Gas Import Jetty Works and Pipeline Works

Document	Description	Implications for the Project	Work Areas
		<p>(including the FSRU) would also incorporate measures to manage contaminated soils encountered during construction.</p> <p>The EMP must be approved by EPA Victoria for the Gas Import Jetty Works if soil disturbance exceeds 1,000 tonnes (EPA Victoria publication 655.1 – Acid sulfate soil and rock).</p>	
Environment Protection (Industrial Waste Resource) Regulations 2009 ( <b>Industrial Waste Resource Regulations</b> )	<p>The Industrial Waste Resource Regulations:</p> <ul style="list-style-type: none"> <li>include a definition of prescribed waste and prescribed industrial waste</li> <li>sets rules for transporting prescribed industrial waste</li> <li>include provision for exemptions based on beneficial re-use.</li> </ul>	<p>These Industrial Waste Resource Regulations are given effect under the Environment Protection Act and currently govern the handling and assessment of industrial wastes.</p> <p>The Pipeline Works CEMP would be used to manage any industrial wastes to ensure soils are handled and disposed of to a licensed premises.</p>	Gas Import Jetty Works and Pipeline Works
<i>Pipelines Act 2005</i> ( <b>Pipelines Act</b> )	The Pipelines Act is the primary Act governing the construction and operation of pipelines in Victoria. The Pipelines Act covers 'high transmission' pipelines for the conveyance of gas, oil and other substances. DELWP and Energy Safe Victoria are responsible for administering the Act and the Pipelines Regulations 2017.	<p>The Project requires a Pipeline Licence under the Pipelines Act for the construction and operation of the Pipeline Works.</p> <p>An Acid Sulfate Soils Management Protocol would be developed and incorporated into the Pipeline Works CEMP.</p>	Pipeline Works
<i>Planning and Environment Act 1987</i> ( <b>Planning and Environment Act</b> )	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria. The Act provides for the preparation of planning schemes in each municipality consistent with the VPPs and procedures by which planning schemes may be amended and planning permits obtained to govern land use and development.	<p>The Planning and Environment Act is relevant as it seeks to ensure contaminated land is suitable for its intended future use and development, and that contaminated land is used safely.</p> <p>A Planning Scheme Amendment is proposed for the land affected by the Gas Import Jetty Works including the FSRU, which would need to meet the requirements of Ministerial Direction Number</p>	Gas Import Jetty Works and Pipeline Works

Document	Description	Implications for the Project	Work Areas
	Ministerial Direction No.1 (Contaminated Land) directs that contamination be considered as part of relevant planning approvals.	1 - Potentially Contaminated Land. The proposed Incorporated Document would include requirements for a construction phase EMP. While the Pipeline Works are exempt from needing planning approval, the Pipeline Works CEMP would ensure contaminated soils are handled and disposed of correctly.	
<b>Policy / guidelines / standards</b>			
SEPP (Prevention and Management of Contamination of Land)	SEPP (Prevention and Management of Contamination of Land) provides a framework for the protection of current and future beneficial uses of land.  Contamination concentrations are set for protection of beneficial uses (maintenance of ecosystems, human health buildings and structures, aesthetics, production of food, flora and fibre). The SEPP applies to historically contaminated land as well as current activities.	Regulatory authorities would have regard for the SEPP (Prevention and Management of Contamination of Land) when assessing the potential land contamination aspects of the Project.  The Project would seek to minimise the potential for adverse impacts on land, surface waters and groundwater to ensure that existing beneficial uses are protected, and the Pipeline Works CEMP would address the management of any contaminated soils encountered during construction.  The EMP included in the Incorporated Document in the Planning Scheme Amendment required for the Gas Import Jetty Works (including the FSRU) would also incorporate measures to manage contaminated soils encountered during construction.	Gas Import Jetty Works and Pipeline Works
SEPP (Waters)	SEPPs are subordinate to the Environment Protection Act. SEPP (Waters) provides a framework for the protection and management of water resources in Victoria, covering surface waters, estuarine and marine	Regulatory authorities would have regard for SEPP (Waters) when assessing the Project's potential for contamination impacts on fresh and marine water quality.  The Project would seek to minimise the potential for	Gas Import Jetty Works and Pipeline Works

Document	Description	Implications for the Project	Work Areas
	<p>waters and groundwater across the State.</p> <p>SEPP (Waters) aims to protect the beneficial uses of water resources, set water quality indicators and objectives, and establish rules and obligations to achieve these objectives.</p>	adverse impacts on land, surface waters and groundwater so that existing beneficial uses are protected.	
<p>Industrial Waste Resource Guidelines (IWRGs):</p> <ul style="list-style-type: none"> <li>• IWRG600.2 - Waste Categorisation (December 2010)</li> <li>• IWRG611.2 - Asbestos Transport and Disposal (June 2017)</li> <li>• IWRG621 - Soil Hazard Categorisation and Management (June 2009)</li> <li>• IWRG655.1 - Acid Sulfate Soil and Rock (July 2009)</li> <li>• IWRG701 - Sampling and analysis of waters, wastewaters, soils and wastes (June 2009)</li> <li>• IWRG702 - Soil Sampling (June 2009)</li> </ul>	<p>The IWRGs have been developed by EPA Victoria to provide guidance for the management of waste, including waste soil, in Victoria.</p> <p>The IWRGs explain how to determine the waste category of excavated material based on site history and testing for contaminants to determine a hazard category and reasonably expected to be present and defining the categories of 'fill material' and 'prescribed industrial waste'.</p>	Management, transport and disposal of waste (including asbestos, contaminated soil and acid sulfate soil) must be in accordance with the requirements of the IWRGs.	Gas Import Jetty Works and Pipeline Works
Industrial Waste – Classification for Drilling Mud, Victoria Government Gazette G37 published on 17 September 2015	<p>Drilling mud (liquid waste) is a Category A prescribed industrial waste (PIW) under the Environment Protection (Industrial Waste Resource) Regulations 2009.</p> <p>The classification allows for drilling mud generated during directional drilling or non-destructive hydro-excavation</p>	<p>Disposal of drilling mud must be in accordance with Environment Protection (Industrial Waste Resource) Regulations 2009.</p> <p>The Industrial Waste – Classification for Drilling Mud should be adopted where there is low risk to the environment (i.e. no</p>	Pipeline Works

Document	Description	Implications for the Project	Work Areas
	of soil where there is a low risk to the environment to be classified as non-PIW.	contamination and acid sulfate soil).	
Industrial Waste Management Policy (Waste Acid Sulfate Soils) Special Gazette S125 published on 18 August 1999	<p>The Industrial Waste Management Policy was introduced into the Environment Protection Act by the Environment Protection (Industrial Waste) Act 1985 to improve the management of industrial wastes.</p> <p>This policy aims to protect human health and the environment from acid sulfate soils by providing a framework for management, disposal or reuse of waste acid sulfate soil.</p>	<p>Management, reuse and disposal of acid sulfate soil must be in accordance with the requirements of the Industrial Waste Management Policy.</p> <p>An acid sulfate soil management plan (ASSMP) would be required for the Pipeline Works and would be included as part of the Pipeline Works CEMP, approved by the Minister for Energy, Environment and Climate Change and administered by DELWP and Energy Safe Victoria (in consultation with EPA Victoria).</p> <p>The CEMP approved by EPA Victoria would be required for the Gas Import Jetty Works if soil disturbance exceeds 1,000 tonnes (EPA publication 655.1 Acid sulfate soil and rock).</p>	Gas Import Jetty Works and Pipeline Works



## 4.0 Methodology

A systematic risk-based approach has been applied to understand the existing environment, the potential impacts of the Project and how to avoid, minimise or manage the risk of impact.

The following sections outline the method for the contamination and ASS impact assessment.

### 4.1 Existing conditions assessment

A desktop review of existing readily available information and targeted field investigations were completed to assess for presence of contaminated soils, groundwater and marine sediment, and ASS conditions within the study area. Key elements of the desktop review and field investigations are summarised below.

The targeted field investigations coupled with desktop review undertaken for the EES is considered sufficient to provide an indication of the potential for presence or absence of contamination and ASS within the study area, and therefore sufficient to inform robust risk and impact assessment. Where there are data gaps, requirement for further assessment have been included as part of the mitigation measures for the Project.

#### 4.1.1 Desktop review

Key elements of the desktop review were as follows:

- Review of current and historic land uses, utilising literature that is publicly available, to identify potentially contaminating land uses and areas of interest. This includes review of:
  - General history of the study area (suburb scale), via online search engines.
  - A series of historical and current aerial photographs and Melway maps of the study area to identify likely industrial and commercial sites, quarries, landfills or other areas suspected to have the potential for contamination.
  - EPA Victoria Victorian Landfill Register (VLR) to identify the potential for current/historic landfills and quarries within the study area.
  - Selected sites where historic and current land use could not be ascertained, via online search engines.
- Review of Groundwater Quality Restricted Use Zones (GQRUZ) located within the study area, as declared by EPA Victoria.
- Review of the EPA Victoria list of issued Certificates and Statements of Environmental Audit.
- Review of the EPA Victoria Priority Sites Register.
- Review of the Atlas of Australian Acid Sulfate Soils (AAASS), a web-based hazard assessment tool, to assess the potential for ASS conditions. The tool is available on the Australian Soil Resource Information System (ASRIS), which provides information about the distribution and properties of coastal and inland ASS across Australia.
- Review of the Western Port Ramsar Site Management Plan and the Western Port Ramsar Site Ecological Character Description (ECD) Addendum to understand current condition and threats to the Ramsar Site.
- Review of previous contamination and ASS investigations reports for the study area, including:
  - Jacobs, 2017, *Baseline Environmental Contamination Investigation*, report for Port of Hastings Development Authority, IS193200-005-RPT, Revision 0, dated 1 June 2017.
  - Jet Environmental 2018, *Soil Contamination Assessment, Port of Hastings Crib Point Facility, Crib Point, Victoria*, report for Port of Hastings Development Authority, J1056-R1.0, Draft, dated 8 November 2018.



- Monarc 2018, *Acid Sulfate Soil Assessment Report*, report for APA Transmission Pty Limited, 31-02984.00, dated 28 August 2018.
- Construction Sciences, 2019, *Acid Sulfate Soils Factual Report – Crib Point Receiving Facility*, report for APA Group, 5044/P1389.6, dated 11 February 2019.

#### 4.1.2 Field investigations

Key elements of field investigations were as follows:

- A site walkover along the study area, in particular areas that have been identified through desktop review to have high potential for contamination. The walkover was undertaken on 3 December 2018. The aim of the walkover was to view the condition of the study area, to relate desktop observations to site conditions, to assess proposed groundwater and soil bore locations and to observe current land use practices. The inspection was conducted within publicly accessible land only.
- A soil sampling program, which included drilling and logging of 99 soil bores across the study area to assess for presence of contamination and ASS. Soil sampling consisted of grid and targeted sampling as outlined below:
  - Collection of samples on a grid basis from 58 soil bores along the pipeline alignment at a density of approximately one soil bore per kilometre of pipeline, including samples collected during installation of 26 groundwater monitoring bores. The sampling density was adopted to assess the potential for widespread/regional contamination of soil, based on the largely rural setting. Assessment of ASS was also completed at a density of one soil bore per kilometre, except the targeted ASS sampling locations, described below. This approach is considered sufficient to provide an indication of the potential for the presence or absence of soil contamination and ASS within the study area.
  - Collection of samples from 11 soil bores, targeting areas that had been identified during desktop review to have higher potential for contamination, e.g. near industrial/commercial areas, shared pipeline corridor and former landfill.
  - Collection of samples from three soil bores on 31 March 2020, targeting the proposed pipe stringing area in the former BP Refinery site following its inclusion in the Project.
  - Collection of samples from 27 soil bores targeting areas where the desktop review identified that ASS is more likely to be present (as per Commonwealth Scientific and Industrial Research Organisation (CSIRO) ASRIS soil database), at a density of one soil bore per 100 metres of a pipeline, in accordance with guidance in the EPA Victoria Publication *IWRG655.1 – Acid Sulfate Soil and Rock*.
  - Soil samples were analysed for a combination of:
    - EPA Victoria Publication *IWRG621 – Soil hazard Categorisation and Management* suite of analytes including Australian Standard Leaching Procedure (ASLP) leach (selected samples only)
    - Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS)/Chromium Reducible Sulfur (CRS)
    - Per- and polyfluoroalkyl substances (PFAS) (selected locations only).
- A groundwater sampling program, including installation of four groundwater monitoring wells in areas that have been identified, through desktop review, to have higher potential for contamination. Groundwater gauging and sampling was completed at 26 groundwater monitoring wells (with 22 groundwater monitoring wells installed as part of EES Technical Report D: *Groundwater impact assessment*).
- A marine sediment sampling program near the Crib Point Jetty, which consisted of 20 marine sediment samples, from four locations (Berth 1, Berth 2, and reference sites 500 metres north of Berth 1 and 500 metres south of Berth 2), for the purpose of establishing baseline characteristics.

The marine sediment sampling was undertaken by Consulting Environmental Engineers Pty Ltd (CEE).

Marine sediment sampling and analysis were undertaken in general accordance with the CSIRO's Handbook for Sediment Quality Assessment (Simpson et al., 2005), the Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Water Quality Guidelines (ANZECC & ARMCANZ 2000), the Revision of ANZECC & ARMCANZ Sediment Quality Guidelines (Simpson Batley & Chariton, 2013), and the National Assessment Guidelines for Dredging (NAGD) (2009).

It is noted that, although the NAGD (2009) was referenced for guidance in developing the scope of work and undertaking the marine sediment assessment, complete adherence to the NAGD (2009) was not applicable as the purpose of this investigation is not to inform a dredging application.

Refer to the *Contamination and Acid Sulfate Soils Field Investigations* report (Appendix A) for detailed descriptions of methodologies used to undertake the field investigations.

## 4.2 Risk assessment method

The EES scoping requirements for the Project require that a risk-based approach is adopted for assessment of the potential impacts of the Project. A risk assessment was carried out using an approach that is consistent with Australian/New Zealand Standard AS/NZS ISO 31000:2018 *Risk Management Process*.

The risk assessment process provides a method for:

- facilitating a consistent approach to risk assessment across the various specialist studies in the EES
- identifying key Project risks to inform where detail investigations are required
- ensuring the level of investigation is proportionate to the relative environmental risk
- assessing the effectiveness of proposed mitigation measures and whether additional measures may be required.

Risk can be defined as a combination of:

- the magnitude of potential consequences of an event
- the likelihood of the event occurring.

The risk assessment process developed for the Project involved the assignment of consequence and likelihood ratings which combined to give an overall risk level for each identified risk.

The initial findings of the impact assessment were used to identify and describe cause-and-effect pathways for the Project to determine links between Project activities and their subsequent environmental consequences (known as risk pathways). These risk pathways were identified considering the assets, values and uses requiring protection identified during the existing conditions assessment.

### Assigning consequence of risks

In this risk assessment, the consequences of a risk occurring were assigned using a consequence guide. Specific consequence categories were developed considering existing conditions in the study area. The consequence rating criteria used in the risk assessment specifically for risks relating to contamination and ASS are shown in Table 4-1.

**Table 4-1 Contamination and acid sulfate soil consequence rating criteria**

Level	Qualitative description
Negligible	The release of contaminant(s) has no measurable effect on the environment.
	No disturbance of contaminated soils/rock, contaminated groundwater, contaminated marine sediment or ASS.

Level	Qualitative description
Minor	The release of contaminant(s) is measurable but does not result in a loss of one or more beneficial uses of the environment.
	Disturbance and handling (including transportation, treatment and/or disposal) of contaminated soils/rock, contaminated groundwater, contaminated marine sediment or ASS with negligible risk to human health and/or the environment.
Moderate	The release of contaminant(s) into the environment causes temporary and reversible loss of one or more beneficial uses of the environment.
	Disturbance and handling (including transportation, treatment and/or disposal) of contaminated soils/rock, contaminated groundwater, contaminated marine sediment or ASS with localised risk to human health and/or the environment.
Major	The release of contaminant(s) into the environment causes permanent loss of one or more beneficial uses of the environment on a localised scale.
	Disturbance and handling (including transportation, treatment and/or disposal) of contaminated soils/rock, contaminated groundwater, contaminated marine sediment or ASS with risk to human health and/or the environment in a number of localised areas.
Severe	The release of contaminant(s) into the environment causes permanent loss of one or more beneficial uses of the environment across a large geographic area.
	Widespread, irreversible risk to human health and/or the environment from disturbance and handling (including transportation, treatment and/or disposal) of contaminated soils/rock, contaminated groundwater, contaminated marine sediment or ASS.

### Assigning likelihood of risks

A likelihood rating for each identified risk pathway has been assigned using the guide in Table 4-2. The likelihood criteria in the risk assessment range across a scale from 'almost certain' where 'the event is expected to occur in most circumstances or is planned to occur' to 'rare' where 'the event may occur only in exceptional circumstances'.

**Table 4-2 Likelihood guide**

Level	Description
Rare	The event may occur only in exceptional circumstances
Unlikely	The event could occur but is not expected
Possible	The event could occur
Likely	The event will probably occur in most circumstances
Almost certain	The event is expected to occur in most circumstances or is planned to occur

### Risk assessment matrix and risk rating

The consequence and likelihood were combined to arrive at a risk rating, using the risk assessment matrix shown in Table 4-3.

Table 4-3 Risk assessment matrix

		Consequence ratings				
		Negligible	Minor	Moderate	Major	Severe
Likelihood rating	Rare	Very low	Very low	Low	Medium	Medium
	Unlikely	Very low	Low	Low	Medium	High
	Possible	Low	Low	Medium	High	High
	Likely	Low	Medium	Medium	High	Very high
	Almost Certain	Low	Medium	High	Very high	Very high

Further information about the risk assessment process, and the risk register for the Project, is provided in EES Attachment III *Environmental risk report*.

#### Application of mitigation measures

An initial set of mitigation measures have been developed as part of this impact assessment. These mitigation measures are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of similar type, scale and complexity.

As the Pipeline Works design, construction methodology and operation strategies were well progressed at the commencement of this impact assessment, mitigating measures that were already incorporated in the Pipeline Works design have been included as initial mitigation measures.

Initial risk ratings were applied to each identified risk pathway assuming that these initial mitigation measures were in place.

Additional mitigation measures were developed where the initial risk ratings were categorised as medium or higher.

The initial and additional mitigation measures have been incorporated into the Project description and design (where relevant) by AGL and APA and included in the EMF to effectively manage the environmental performance of the Project during construction and operation. See Chapter 25 *Environmental Management Framework* for further detail on how the mitigation measures are proposed to be implemented.

The risk and impact assessment process is iterative. Potential impacts were reassessed after the risk assessment and after mitigation measures were refined. The level of residual risk was reassessed using the same methodology to confirm the mitigation measure is effective in mitigating or managing potential impacts so the Project is able to satisfy the draft evaluation objectives set out in the EES scoping requirements.

### 4.3 Impact assessment method

The contamination and ASS impact assessment focuses on the potential impacts on human health, with respect to nearby residents and general public, and the environment (including the Western Port Ramsar Site) associated with disturbance of contaminated soils, groundwater and marine sediment; and ASS during construction and operation of the Project.

The potential impacts on human health and the environment from Project construction and operational activities, including the management of spoil, have been considered with reference to the Beneficial Uses identified in the SEPP (PMCL) and SEPP (Waters).

The methodology for the contamination and ASS impact assessment includes:

- Summarising of the existing information pertaining to contaminated land, groundwater and marine sediment, and ASS conditions within the study area, including specific information on potential sources of contamination. Potential impact to surface waters (drawing on information from the EES Technical ReportC: *Surface water impact assessment*) has also been addressed.
- Assessing potential risks to beneficial uses that are relevant to the Project by comparison of soil, groundwater and marine sediment laboratory analytical results to the adopted investigations levels (ILs) derived from the relevant environmental indicators and quality objectives nominated in SEPP (PMCL) and SEPP (Waters); and comparison of ASS laboratory analytical results to the EPA Victoria Publication IWRG655.1.
- Identification of potential impacts to human health and the environment during Project construction and operation including disturbance, treatment and disposal of contaminated soils, groundwater, marine sediment and ASS, fuels and chemical spills or leaks, and management of waste encountered or generated during Project construction.

It is noted that although the Pipeline Works and the Gas Import Jetty Works are assessed as a full Project under the EES, the construction works would be undertaken separately under separate approvals and management plans. Therefore, for the purpose of ASS classification, specifically the requirement for an ASSMP, the classification has been completed for both sets of works independently.

#### 4.4 Assumptions and limitations

Assumptions and limitations relating to this contamination and ASS impact assessment are provided below:

- The desktop assessment was limited to publicly and readily available information; and is based on conditions that existed at the time the assessment was completed. Its findings and conclusions may be affected by the passage of time, by man-made events (e.g. construction on or adjacent to the Project Area boundary and by new releases of hazardous substances into the environment).
- Historic land use information presented herein is limited to information obtained from a series of aerial photographs taken between 1939 and 2017 (one aerial photograph for each decade) and Melway maps, sourced from a service provider, which cover broader areas; as such it is likely that there is potentially contaminated land that has not been identified as part of this assessment.
- The compiled data does not necessarily include all landfill sites. As acknowledged by EPA Victoria, there is a lack of consolidated data on the past life cycles of Victorian landfills. It is noted that landfill sites in and around Melbourne are predominantly former quarry sites (i.e. clay pits, sand pits, and other large voids), and have tended to ultimately be converted to parks or reserves (Taylor E., 2013).
- As noted by CSIRO, the classification of ASS via Atlas of Australian Acid Sulfate Soils map is provisional for areas where analytical data was not available when the map was prepared. As such, further assessment of ASS conditions may be required.
- The Priority Sites Register (based on EPA Victoria data dated 31 July 2019) does not list all known contaminated sites in Victoria. Therefore, a site should not be presumed to be free of contamination if it does not appear on this Register.
- The assessment of existing commercial/industrial operational activities was limited to the results of a brief internet search and a site walkover along the study area within publicly accessible land, undertaken on 3 December 2018.
- Properties that appeared to be used for residential purposes were generally assumed to have a low potential for contamination of soil and groundwater.
- Information contained in this report should only be used as a guide. Detailed investigations should be carried out as part of the detailed design and construction phases to supplement the information contained in this report.

- Interpretation of subsurface conditions and the nature and extent of contamination is based on field observations and laboratory analytical data from a limited number of widely spaced sample locations (both grid and targeted). It is possible that contamination of soil and/or groundwater may be present but has not been detected as part of this assessment.

The targeted field investigation coupled with desktop review undertaken for the EES is considered sufficient to provide an indication of the potential for contamination and the presence or absence of ASS within the study area, and therefore sufficient to inform robust risk and impact assessment. Where there are data gaps, requirement for further assessment have been included as part of the mitigation measures for the Project, provided in Section 8.0.

## 4.5 Stakeholder engagement

A program of stakeholder and community engagement has been undertaken to assist with Project development (see EES Chapter 26 *Stakeholder engagement*).

Specific stakeholder engagement undertaken as part of this impact assessment is summarised in Table 4-4.

**Table 4-4 Stakeholder engagement – Contamination and acid sulfate soils**

Activity	When	Key issues discussed	Engagement outcome
Consultation with EPA Victoria	19 August 2019	<p>The management approach for acid sulfate soils and clarification on approval for an Acid Sulfate Soils Management Plan (ASSMP) associated with the Pipeline Works.</p> <p>Approval requirements and applicable guidelines for one-off discharge of dewatered water from open trenches and bell holes, and hydrostatic test water to land.</p>	<p>The Pipeline Works ASS Management Protocol would be developed and included in the Pipeline CEMP, which would be approved in accordance with the <i>Pipelines Act 2005</i>, in consultation with EPA Victoria.</p> <p>The ASS Management Protocol would include:</p> <ul style="list-style-type: none"> <li>- risk assessment together with proposed risk mitigation and management measures across the Pipeline Works area, including justification of why certain areas may be excluded from treatment by liming.</li> <li>- monitoring of the performance of mitigation and management measures, including proposing remedial measures where/if required.</li> </ul> <p>Non-contaminated groundwater or hydrostatic testing water can be discharged to land where prior agreement with landowners is obtained. The CEMP must include:</p> <ul style="list-style-type: none"> <li>- a description of the post-test (for hydrostatic testing) or post-extraction (for groundwater) treatment of the water.</li> </ul>

Activity	When	Key issues discussed	Engagement outcome
			- a description of how it would be confirmed that there is no contamination in the water prior to discharge.
General enquiry	May 2019	Question on the effect of a spill/leak of odorant chemicals on soil and water	The potential risks and impacts from spill/leak during operation are considered in Section 7.2.1 of this report
AGL Advoc8	March 2020	Concern about ASS and the impact the open trench time period may have on Western Port and the productive soils	The potential risks and impacts from the disturbance of ASS including the preferred management option which would limit the time period over which the open trench is opened are presented in Section 7.1.2

#### 4.6 Linkage to other EES technical reports

The contamination and ASS impact assessment should be read in conjunction with other relevant technical reports forming part of the EES. Other impacts relating to groundwater have been considered in detail in other technical reports.

The outcomes of the contamination and ASS impact assessment were used as inputs to:

- EES Technical Report A: *Marine biodiversity impact assessment*
- EES Technical Report B: *Terrestrial and freshwater biodiversity impact assessment*
- EES Technical Report C: *Surface water impact assessment*
- EES Technical Report D: *Groundwater impact assessment*
- EES Technical Report O: *Agriculture impact assessment*
- EES Technical Report G: *Air quality impact assessment*.

This report also considered the outcomes from:

- EES Technical Report A: *Marine biodiversity impact assessment*
- EES Technical Report C: *Surface water impact assessment*
- EES Technical Report D: *Groundwater impact assessment*
- EES Technical Report L: *Land use impact assessment*
- EES Technical Report O: *Agriculture impact assessment*.

Where relevant to contaminated soils, contaminated groundwater, contaminated marine sediment and ASS, other technical reports are considered and referenced.

## 5.0 Existing conditions – desktop and intrusive investigations

The existing conditions of the study area are discussed below, where they are relevant to understanding potential impacts from disturbance of contaminated soils, groundwater and marine sediment, and ASS as a result of the Project. Information gathered through desktop review are detailed in sections below, along with a summary of findings from the field investigations. The detailed field investigations report is provided in Appendix A.

### 5.1 Contaminated soils and groundwater

#### 5.1.1 Desktop review

##### Topography and surface water

The Project is located within the Western Port catchment and a large portion of Western Port is listed as a Ramsar Site of international significance, supporting a diversity of plants, animals and ecosystems, including several unique and threatened species, four marine national parks, large tracts of mangroves and seagrasses (Sharp et al., 2013).

The Western Port catchment varies from the hilly regions near the Bunyip State Park and Strzelecki Ranges to the low lying, flat to undulating terrain of the former Koo Wee Rup swamp with surface water draining from these topographic highs to Western Port.

The catchment has an area of around 3,700 square kilometres and contains over 2,200 kilometres of rivers and creeks. Seventeen waterways enter Western Port including major rivers and creeks such as Bunyip, Tarago, Cardinia, Yallock, Lang Lang and Bass River networks, all of which discharge directly into the Western Port Ramsar Site. The marine ecosystem within Western Port is of regional, national and international importance and supports mangrove, saltmarsh, seagrass, reef and soft seabed habitats. Several of the rivers and creeks within the Bunyip River catchment flow into Western Port creating estuaries that provide habitat for estuary dependant species.

Much of the catchment has been modified to support rural and green wedge land use. Historically, the Koo Wee Rup swamp covered large areas in the Western Port hinterland but was drained for development and has resulted in a number of watercourses in the lower catchment becoming channelised drains. Although the area contains a mix of land uses, the predominant land use is agriculture consisting of dairying, grazing and horticulture.

The Project Area includes coastal floodplains in the lower reaches of the catchment where the relief is mostly low lying and generally flat to gently undulating. The ground surface elevation ranges from approximately one to two metres above sea level in the southern portion to 10 – 25 metres above sea level over the northern portion, where the gently sloping topography grades up to the north.

The proposed Pipeline Works crosses seven main watercourses, as follows:

- Warringine Creek
- Rutherford Creek
- Watson Creek
- Cardinia Creek
- Lower Gum Scrub Creek
- Toomuc Creek
- Deep Creek.

In addition to the above watercourses, the pipeline alignment would also cross another 57 other watercourses and surface drains. The watercourses characteristics and the proposed construction methodology for each of the watercourses are described in EES Technical Report C: *Surface water impact assessment*. The assessment indicated that the watercourses are ephemeral with the exception of Watson Creek and Cardinia Creek.



Further information on the surface water of the Project Area can be found in EES Technical Report C: *Surface water impact assessment*.

### **Regional geology and hydrogeology**

The Project Area is located within Western Port Basin (the Basin), which is a relatively shallow, structurally controlled sedimentary basin consisting of sediments and volcanic flows. The western side of the Basin coincides with the Clyde Monocline-Tyabb Fault System, and the eastern extent is controlled by the Heath Hill Fault. Basin sediments pinch out to the north against uplifted basement (SRW, 2010), and extend offshore to the south.

The sediments and volcanic flows of the basin form a multilayered aquifer system, which is dominated by a Tertiary Age sedimentary sequence that thickens to approximately 200 meters in the Koo Wee Rup area, and pinches out along Basin margins.

The Tertiary Age sediments are overlain by a relatively thin veneer of Quaternary sediments, including coastal and inland dune deposits, swamp and lake deposits and alluvial deposits; although these sediments thicken to between 10 and 50 meters in the Koo Wee Rup area. The outcropping units in the study area are shown on Figure A1, Appendix A-A.

The maximum depth of excavation for the trench and horizontal thrust boring sections are expected to be three meters. The geology expected to be encountered to this depth is unconsolidated material that includes clay, silt, and sand with occasional gravels. This sediment may be overlain by fill in places.

Regional groundwater flow is generally from the Basin margins towards Western Port. The presence of shallow aquitards, surface water features and groundwater extraction locally affect depths to groundwater. The groundwater table across the Basin would generally be a subdued version of topography, with the depth to groundwater increasing beneath topographical highs and shallow groundwater in the lower reaches of the Basin.

There is no long-term groundwater level data available and therefore the seasonal water level fluctuations are unknown. However, it is typical in shallow aquifers to have seasonal fluctuations of 0.5 to 2 meters. Water levels tend to be shallowest in late winter and spring, and deepest in late summer. Longer term fluctuations also occur due to changes in climate e.g. drought periods.

Further information on the geology and hydrogeology of the Project Area can be found in EES Technical Report D: *Groundwater impact assessment*.

### **Western Port Ramsar site**

The Crib Point Jetty is located within the Western Port Ramsar Wetland, designated as a wetland of international significance in 1982. The Western Port Ramsar Site covers 59,297 hectares and consists of large shallow intertidal areas dissected by deeper channels, and a narrow strip of adjacent coastal land in some areas.

The *Western Port Ramsar Site Ecological Character Description* (ECD) (Kellogg Brown and Root, 2010), which had an addendum issued in 2017 (Hale, 2016), describes the critical components, processes and services for the Ramsar Site. The critical components and processes include:

- wetland bathymetry
- geomorphology and sedimentation
- seagrass
- mangrove and saltmarsh
- significant flora species
- waterbirds
- marine invertebrates
- fish
- significant fauna species.

and, the critical services include:

- commercial port
- commercial fishing
- recreational fishing
- passive recreation
- spiritual and inspirational
- biodiversity—wetland type/habitat availability
- biodiversity—high diversity of waterbird species
- distinct or unique wetland species—seagrass, mangrove and saltmarsh communities
- threatened wetland species, habitats and ecosystem
- priority wetland species and ecosystems.

The *Western Port Ramsar Site ECD* (2010) report has established baseline values for the Western Port wetlands against which potential impacts can be assessed.

The *Western Port Ramsar Site Management Plan* (Department of Environment, Land, Water and Planning, 2017) identifies increased sediments and toxicants as one of the high priority threats to Western Port. The Kellogg, Brown and Root (2010) report indicated that when the Western Port site was Ramsar listed in 1982, total sediment loads were 40,000 tonnes per year however this had increased to 62,000 tonnes per year in 2003. The main source of sediments to Western Port is catchment derived rural lands, with agriculture (cropping and dairy) accounting for the largest loads (Melbourne Water 2009). The dominant catchment source for fine sediment is channel and gully erosion of Lang Lang River and, to a lesser extent, Bunyip River (Department of Environment, Land, Water and Planning, 2017). Distribution of sediments in Western Port is illustrated in Figure 6 . The sediments are transported around the embayment as a result of the complex pattern of water circulation (Figure 7). The sediments deposited within Western Port are subject to resuspension and dispersal by the tides, waves and wind, resulting in persistently high turbidity (Wallbrink et al., 2003).

Further information on current conditions at Crib Point can be found in EES Technical Report A: *Marine biodiversity impact assessment*.

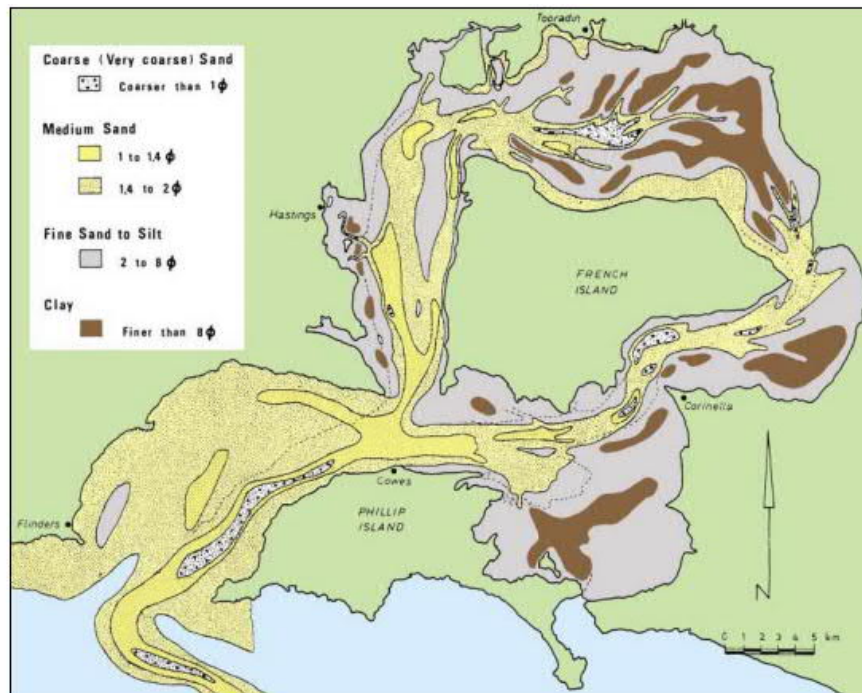


Figure 6 Distribution of sediments in Western Port (Source: Marsden et al. 1979, cited in Wallbrink and Hancock 2003 and DELWP 2017)

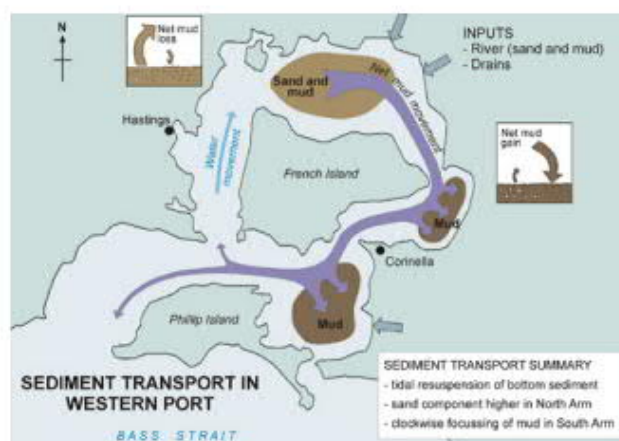


Figure 7 Schematic summaries of (a) bay-wide circulation and (b) sediment transport in Western Port (Source: Hancock et al. 2001, cited in DELWP 2017)

The *Understanding the Western Port Environment 2018* report (Melbourne Water, 2018) indicated that toxicants in Western Port sediments were found to be at low levels and unlikely to impact resident flora and fauna except in localised areas, generally confined to estuarine sediments and areas that receive flows from catchment tributaries, where several toxicants were at levels of concern. Risks from heavy metals, hydrocarbons and organotins were comparatively low, with the exception of isolated areas receiving catchment inflows or high boating activity. Elevated organotin concentrations were reported in areas of high boating activity, however, a comparison of 2012 survey concentrations with historical results, by the Centre for Aquatic Pollution Identification and Management (CAPIM) (University of Melbourne) on behalf of Melbourne Water, indicates that organotin concentrations may be declining in Western Port since controls on their use were implemented (Melbourne Water, 2018).

### Existing and historic land uses

Review of publicly available information and aerial photographs indicated that existing land uses within the study area include:

- residential
- agricultural, farmlands and market gardens
- Western Port Ramsar Site, rivers, parks and reserves
- community and sporting facilities
- the former BP refinery and import jetty facilities
- other commercial/industrial sites along the Project Area, in particular along Frankston-Flinders Rd, Hastings
- [REDACTED] (former Tyabb landfill)
- abattoir near Koo Wee Rup Rd, Pakenham
- Stony Point, Bairnsdale and Leongatha (closed except heritage operations between Nyora – Leongatha) railway lines
- freeways, arterial and municipal roads.

The existing land uses are considered to have a relatively low potential for soil and groundwater contamination with the exception of the former BP refinery and import jetty facilities, [REDACTED] (former Tyabb landfill), commercial/industrial areas, railway corridor, and market gardens.

Representative aerial photographs for each decade between 1939 and 2017, and historical Melway maps (from 1930) covering the entire study area were obtained and reviewed to identify historic land uses. Copies of the aerial photographs, Melways maps and a table detailing the findings, are presented in Appendix B.

Review of the historical information indicated that there are no significant changes in land use within the study area since the 1940s, with majority of the study area - especially between KP15 and KP56.7 - remaining as farmland. Areas where prominent changes were noted and relevant to contaminated land assessment are summarised in Table 5-1. It is noted that image resolution of aerial photographs can vary significantly and as a result, there are uncertainties in interpretation.

**Table 5-1 Areas of significant changes to historical land uses**

KP	Change in historical land uses
0.0 – 1.0	The former BP refinery (also known as [REDACTED] established in 1965, with berthing facilities for the import of crude oil. The former BP refinery was closed and dismantled in 1985, however, the jetty facilities (Berth 1) continue to be used for the import of refined petroleum products.
3.6	Previously a farmland, there appears to be a market garden/nursery/horticulture present in 2010 aerial photograph. The 2017 aerial photograph, however, indicated that the greenhouse has been dismantled with only the frame visible.

KP	Change in historical land uses
5.0 – 9	<p>Land along the Frankston-Flinders Road in Hastings appears to be historically used as farmland and orchard. Aerial photographs between 1957 and 2017 indicated that the area was progressively developed with residential and commercial/industrial properties including automotive service/repair centre, fuel service stations, bus depot, Hastings State Emergency Services, clinics, garden supplies, metal recycling, reclaimed timber, retail, food and beverages.</p> <p>A building structure, potentially a fuel service station, located adjacent to the existing [REDACTED] fuel service station was observed in the 1957 aerial photograph. The existing [REDACTED] and [REDACTED] service stations were constructed in 2013 and between 1991 and 2009, respectively; while the [REDACTED] and [REDACTED] service stations were constructed between 1985 and 1991, respectively.</p> <p>The Stony Point Rail line, running between Stony Point and Frankston, is evident on the 1930s historical aerial photographs and maps. Information obtained from the internet indicated that the sections between Baxter station and Stony Point were opened in September 1889.</p>
10.2 – 13.2	<p>Land along the Denham Road in Tyabb appears to be historically used as farmland and orchard.</p> <p>The existing [REDACTED] (previously known as [REDACTED]) was constructed between 1974 and 1978. A cold storage facility and a houseboat builder and maintenance facility ([REDACTED]) were constructed between 1978 and 1985, and between 1989 and 2009, respectively.</p> <p>A gardening products and services centre (currently owned by [REDACTED]) located at corner of Thornells and Mckirdys Rd was built on a former orchard plantation. Construction of the facility was evident in 1978 aerial photograph.</p>
13.2 – 14.3	<p>In this area the pipeline alignment is adjacent to the [REDACTED] (former Tyabb landfill), which is located on a former orchard plantation. Landfilling activities commenced in 1988 and ceased in 1995. In 2002, the site became a green waste recycling facility and continues to operate in this capacity.</p>
48.2	<p>The existing [REDACTED] meat packer facility located on a former farmland appears to have been constructed between 1974 and 1979. The facility is surrounded by farmland with [REDACTED] Water Recycling Plant located approximately 800 metres north east of the Project Area.</p>
53.7 – 55.7	<p>Pakenham East train depot was constructed on former farmland, with major construction works commencing in mid-2017 and completed in December 2018.</p>

### Contaminated land register search

The EPA Victoria Priority Sites Register lists sites that have been issued with a formal Clean up Notice (CUN) or Pollution Abatement Notice (PAN). At these sites, EPA Victoria considers that the condition of the site requires assessment/management to reduce risks to human health or the environment.

The EPA Victoria issues CUNs and PANs for a broad range of sites, not only focusing on industrial and commercial sites, but also existing and former landfills and sites where they suspect that contamination has occurred.

A search of the EPA Priority Sites Register indicates that, as of 31 July 2019, there is only one current priority site located within of the study area. The priority site is a former landfill (owned by the Mornington Peninsula Shire) located at the [REDACTED], [REDACTED], Tyabb, shown in Figure 8.





Figure 8 [REDACTED] (former Tyabb landfill)

Table 5-2 lists sites located within the study area that have been or are currently listed on the Priority Site Register.

Table 5-2 Priority Sites Register

KPs	Location	Notice Number	Issue	Proximity to the Project Area
0.1 – 1.0	[REDACTED] (CPT002) The Esplanade, Crib Point <sup>1</sup>	NO2548	Legacy EPA database Pollution Abatement Notice, issued 16/11/2001; former industrial site requires ongoing management	0 m
		90002897	Previous Pollution Abatement Notice, 2005; former industrial site requires ongoing management	
		90006084	Previous Pollution Abatement Notice, issued 29/07/2015; former industrial site requires ongoing management	
12.6	[REDACTED] Tyabb <sup>2</sup>	90008213	Previous Pollution Abatement Notice, issued 20/10/2017	120 m west of the Project Area
13.2 – 14.3	Mornington Peninsula Shire, [REDACTED] Tyabb	90007677	Current Monitoring Rehab & Aftercare PAN; former landfill requires ongoing management	160 m north between KP13.2 and 14.0; and 25 m west of the Project Area between KP14.0 and 14.3
		90008880	Previous Monitoring Rehab & Aftercare PAN, issued 13/07/2018; former landfill requires ongoing management	

<sup>1</sup> No longer listed on the EPA Victoria Priority Site Register.

KPs	Location	Notice Number	Issue	Proximity to the Project Area
		90007505	Previous Monitoring Rehab & Aftercare PAN, issued 7/06/2018; former landfill requires ongoing management	

### Statutory environmental audits

Statutory Environmental Audits are undertaken by an EPA appointed independent Environmental Auditor, typically at the request of a site owner. The fact that an audit has been undertaken on a site is not an indicator of contamination, although it is likely to be an indicator of historic industrial and commercial land use with potential for contamination.

A search of the EPA Victoria Interaction Portal, for properties issued with a Certificate or Statement of Environmental Audit as part of a Section 53X audit, or with an audit report prepared in accordance with Section 53V of the Environment Protection Act 1970, indicates that, as of 29 September 2019, there are two properties located within the study area that had been issued with a Statement or Certificate of Environmental Audit. These sites are listed in the Table 5-3.

A Section 53X ('condition of a segment of the environment') Audit is most frequently required by the planning authorities to satisfy themselves that specified parcels of land are suitable for their proposed use (with respect to contamination). As part of a 53X Audit, the Auditor verifies that a specified parcel of land is suitable for a range of land uses (or no land uses), either with or without conditions (such as an ongoing management plan, maintaining a capping layer or not permitting contact with surface soils).

**Table 5-3 Statutory environmental audits within the study area**

KPs	Location	Key findings	Proximity to the Project Area
0 (land adjacent to Crib Point Jetty)	<p>Crib Point easement and Jetty, The Esplanade, Crib Point.</p> <p>Audit Type: 53X Statement</p> <p>CARMS No: 33177-1</p> <p>Date completed: 19 September 1998</p>	<p>An audit requested by the Department of Treasury and Finance undertaken as part of management contract, where the State Government contracted out the management rights of the Port of Hastings. The State Government undertook to provide a Certificate or Statement of Environmental Audit with respect to potentially contaminated land (including seabed) pertaining to specified areas under the contract.</p> <p>The Auditor issued a Statement of Environmental Audit due to aesthetic issues and concentration of arsenic and chromium in soil, and lead in groundwater exceeded the environmental assessment criteria.</p> <p>The Auditor concluded that the site is suitable for Port use subject to:</p> <ul style="list-style-type: none"> <li>Public access remains restricted within current fenced area</li> <li>No development for more sensitive beneficial uses occurs.</li> </ul>	0 m



KPs	Location	Key findings	Proximity to the Project Area
13.2 – 14.3	<p><b>[REDACTED] Tyabb</b></p> <p>Audit Type: 53V CARMS. No: 64917-1, 64917-4 and 64917-5</p> <p>Date completed: 1 Oct 2002, 11 Jan 2017 and 21 Jan 2019</p>	<p>An operational audit for the Tyabb Landfill in accordance with the site's EPA Licence 74219.</p> <p>The risk assessment undertaken as part of the audit identified:</p> <ul style="list-style-type: none"> <li>• Medium risk of inadequate containment, treatment or disposal of leachate impacting on groundwater beneficial uses of 'Stock Watering'. The Auditor rated the risk as Medium based on the interpreted groundwater flow directions (towards the south and south-east) and the quality of groundwater, impacting this beneficial use with regards to TDS.</li> <li>• Medium risk of sub-surface landfill gas migration and accumulation impacting on the health of workers undertaking works in underground mains or trenches. The Auditor rated the risk as Medium due to insufficient monitoring data to fully characterise the risk.</li> <li>• All other potential impacts on beneficial uses of groundwater were considered low risk.</li> </ul>	25 m

Based on the review of the Environmental audit reports listed in Table 5-3, it is considered that:

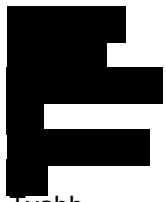

- The Project is not expected to change the existing risk profile of the land adjacent to the Crib Point Jetty (the location where Crib Point Receiving Facility is proposed) as:
  - access to the Crib Point Jetty would remain restricted to authorised personnel only
  - the proposed Gas Import Jetty Works are consistent with the beneficial uses identified during the audit.
- Based on the interpreted groundwater flow directions (towards the south and south-east), adjacent to the former Tyabb landfill, it is possible that groundwater beneath the study area is impacted by groundwater and/or leachate migration from the landfill.
- During the construction activities adjacent to the former Tyabb landfill, in particular trenching along the boundary of the former Tyabb landfill, air quality should be monitored to ensure that the trench workers are not exposed to landfill gas that may have potentially migrated from the landfill site.

#### EPA Victoria licence register

The *Environment Protection (Scheduled Premises) Regulations 2017* require scheduled premises to apply for an EPA licence, unless the premises are exempted. The licence covers the actual operation of the site, and set operating conditions, waste discharge limits and waste acceptance conditions, as appropriate.

A search of the EPA Victoria Interaction Portal, for properties issued with an EPA licence, indicates that as of 29 September 2019, there is two scheduled premises located within the study area. The scheduled premises are listed in Table 5-4.

Table 5-4 Scheduled premises within the study area

KPs	Address	Licence No.	Scheduled Categories	Description	Proximity to the Project Area
12.6	 Tyabb	200956	A07 Organic waste processing	The licence holder operates an organic waste processing facility. This licence allows for up to 25,000 tonnes of pine to be treated at the premises within a 12 month period.	120 m
48.2	 Pakenham	1140	D01 – Abattoirs, D02 – Rendering	The licence holder operates a rendering facility and manufactures products from mixed abattoir material. Wastewater from the abattoir and rendering plant is treated in a lagoon system and either irrigated or discharged to sewer. This licence allows for discharges to air and the discharge of treated wastewater to land.	0 m

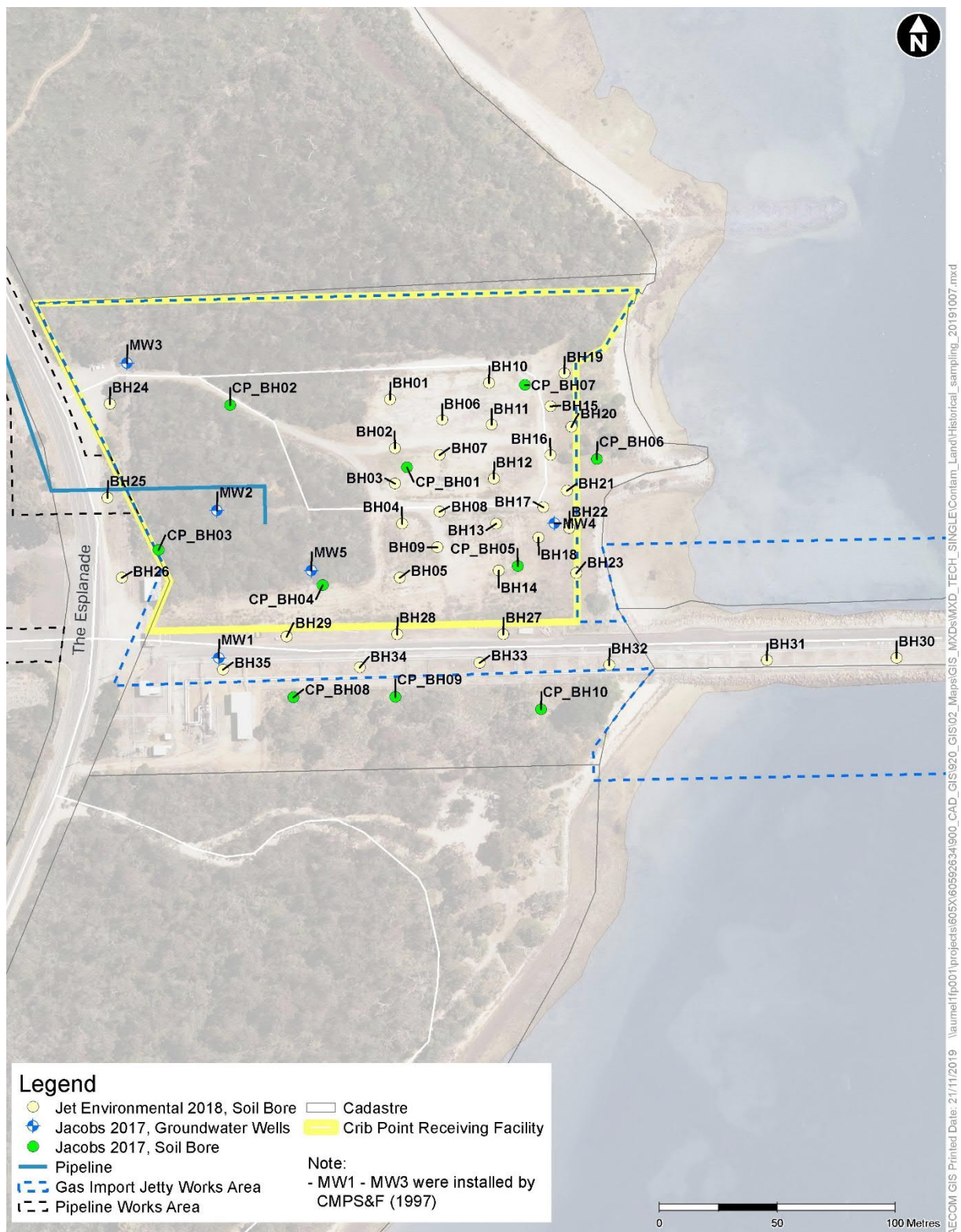
#### Groundwater quality restricted use zones (GQRUZ)

Groundwater Quality Restricted Use Zones (GQRUZ) are areas where groundwater pollution is present, as a result of previous industrial or other activities, and the site has been assessed as part of a Section 53X Environmental Audit, in accordance with the Environment Protection Act 1970. These zones have been subject to clean-up, in line with the relevant environmental standards, but not all beneficial uses of groundwater have been restored. As such, restrictions remain on what the groundwater can be used for, if it is abstracted or discharges to a surface water body. The presence of contaminated groundwater in the study area may present constraints during excavation activities.

A search of the EPA Victoria GQRUZ map indicates, that as of 29 September 2019, there are no GQRUZs located within the study area.

#### Previous site contamination investigation reports - Crib Point Jetty

Jacobs Group (Australia) Pty Limited (Jacobs) and Jet Environmental undertook contamination investigations, on behalf of PoHDA, for Crib Point Jetty in 2017 and 2018, respectively. The findings from both investigations are summarised below. Soil and groundwater bores sampled during the site investigations are shown in Figure 9.



**Figure 9 Soil and groundwater sampling locations for previous contamination investigations undertaken at Crib Point Jetty**

*Baseline Environmental Contamination Investigation – Crib Point Jetty for Port of Hastings Development Authority (Jacobs, June 2017)*

Baseline environmental contamination investigation of the Crib Point Jetty was undertaken by Jacobs in 2017 for PoHDA. As part of the investigation, Jacobs reviewed the following reports and undertook field investigations comprising redevelopment and sampling of five existing groundwater monitoring wells, and collection and analysis of soil from ten soil bores.

- Statement of Environmental Audit, Port of Hastings Sites (No. 78J155A-pr29999d M7314), PPK Environment & Infrastructure Pty Ltd, 1998
- Environmental Site Assessment Works Port of Hastings (No. VP7753.001:Rev0, 14-2273), CMPS&F Pty Ltd, 1997
- Preliminary Assessment of Soil and Harbour Sediment Quality at the Port of Hastings, Stage 2 – Sampling and Analysis of Soils and Sediments (Final Report No. J2078/2), Energetics Environmental Pty Ltd, 1997.

A summary of soil and groundwater conditions at Crib Point Jetty, including adjacent land, as gathered by Jacobs through review of the above reports, is presented below. It should be noted that the labels of the groundwater wells and soil bores discussed below do not correlate with those labels adopted as part of the Project contamination investigations.

- PPK (1998) reported that an above ground fuel tank associated with the pumping station formerly existed at the Crib Point Jetty. The northern portion of the site has historically been used as a laydown area, with the north-eastern area being cleared and north-western portion being vegetated with scrub and trees. During the construction of the pier structure, the foreshore was reclaimed by placement of fill material. The nature and extent of the filling, however, was not well understood. No spills had been reported at the site.
- Contamination, including phase separated hydrocarbon, has been reported at the former BP refinery. The site had previously been issued with a PAN by the EPA Victoria in 2001, with a notice amendment issued in 2005, relating to groundwater contamination of lead and hydrocarbons (see Table 5-2 for updated information).
- CMPS&F (1997) reported groundwater to be influenced by the presence of the underground petroleum pipeline along the Crib Point Jetty western boundary, and the Western Port tide.
- Groundwater sampling undertaken by CMPS&F (1997) identified the presence of lead, with maximum concentration of 0.014 mg/L at CB-BH2/MW2 and CB-BH3/MW3.
- Metals (arsenic, chromium and lead only), TPH and MAH were identified in groundwater.
- Soil sampling undertaken by Energetics Environmental (1997) and CMPS&F (1997) reported:
  - arsenic at a maximum concentration of 67 milligrams per kilogram (mg/kg) in a composite sample (Energetics Environmental, 1997)
  - lead at a maximum concentration of 13 mg/kg at a depth of 0.5 metres below ground level (mbgl) (CMPS&F, 1997)
  - chromium (total) at a maximum concentration of 120 mg/kg at a depth of 6 mbgl (CMPS&F, 1997)
  - hydrocarbons and pesticides concentration in soil samples were reported below the laboratory detection limits (LOR).
- Soil sampling was limited to the analysis of metals including arsenic, chromium (VI and total) and lead, hydrocarbons (BTEX, TRH and PAH), Organochlorine Pesticides (OCPs) and Polychlorinated biphenyls (PCBs).
- Soil sampling undertaken by Energetics Environmental (1997) were limited to shallow soils above the underground petroleum pipelines.

A summary of key findings from Jacobs (2017) contamination investigation on soil and groundwater conditions at Crib Point Jetty are summarised below, and the samples locations are shown in Figure 9. It should be noted that the labels of the groundwater wells and soil bores discussed below do not correlate with those labels adopted as part of the Project contamination investigations.

- Fill was encountered at all locations at depths ranging from 0.4 mbgl to 1.0 mbgl (the maximum borehole extent), inferred to be reworked natural soils and described as gravelly silt, silty sands and silty clays.
- Arsenic was detected in four soil samples (CP\_SS01\_0.8 at 62 mg/kg, CP\_SS06\_1.0 at 20 mg/kg, CP\_SS07\_1.0 at 21 mg/kg and CP\_SS09\_1.0 at 25 mg/kg) exceeding the ASC NEPM 2013 Table 1B (1-5) EIL for National park and areas with high ecological value.
- Zinc was detected in three soil samples (CP\_SS01\_0.1 at 338 mg/kg, CP\_SS06\_0.1 at 472 mg/kg and CP\_SS07\_0.1 at 1,190 mg/kg) exceeding the ASC NEPM 2013 Table 1B (1-5) EIL for National park and areas with high ecological value.
- TRH fractions C<sub>10</sub>-C<sub>16</sub> less Naphthalene in two of the soil samples (CP\_SS02\_0.1 at 80 mg/kg and CP\_SS08\_0.1\_1.0 at 90 mg/kg) exceeded the ASC NEPM 2013 Table 1B(6) ESL, Coarse Soil – National park and areas with high ecological value.
- TRH fractions C<sub>10</sub>-C<sub>16</sub> less Naphthalene in one soil sample (CP\_SS10\_0.5 at 250 mg/kg) exceeded the ASC NEPM 2013 Table 1A(3) HSL-B (High Density Residential), Sand – for Vapour Intrusion.
- Perfluorooctanesulfonic acid (PFOS) was detected in one (CP\_SS01\_0.1) of the two samples analysed for PFAS at concentration of 0.0004 mg/kg exceeding Department of Health – Health Based Guideline Value (in the absence of PFAS NEMP when the report was prepared).
- Benzo(a)pyrene detected in one soil sample (CP\_SS06\_01 at 0.9 mg/kg) exceeding ASC NEPM 2013 Table 1B(6) ESLs, Coarse soil – National park and areas with high ecological value.
- Jacobs considered the exceedances were generally low and may be considered acceptable for current use subject to further assessment.

Key findings on groundwater conditions include:

- Depth to groundwater measured from five existing groundwater monitoring wells recorded depth between 1.37 metres below top of casing (mBTOC) and 7.68 mBTOC.
- Metals including arsenic, copper, lead, manganese, nickel and zinc were detected in the majority of groundwater samples; and TRH fraction C<sub>34</sub> – C<sub>40</sub> was detected at concentration of 170 mg/L at MW5.
- Copper and zinc in all groundwater samples exceeded the ANZECC & ARMCANZ (2000) Marine Water 99 % protection level.
- Nickel in groundwater sampled from MW1, MW2 and MW5 exceeded the Australian Drinking Water Guidelines (ADWG) 2015 – Health guideline; and groundwater sampled from MW5 exceeded the World Health Organisation Drinking Water Guidelines.
- Lead in groundwater sampled from MW5 exceeded the ADWG 2015 – Health guideline.
- Chloride, sodium and TDS in samples collected from MW1, MW2 and MW5 exceeded the ADWG 2015 – Aesthetic.
- The exceedances recorded were considered to be generally representative of background conditions in groundwater at the site; however further monitoring and assessment would be required to confirm.

*Soil Contamination Assessment, Port of Hastings Crib Point Facility, Crib Point, Victoria, report for Port of Hasting Development Authority (Jet Environmental 2018)*

Jet Environmental completed a soil contamination assessment at Crib Point Jetty, in 2018, for PoHDA. The field investigation included collection and analysis of soil from 35 soil bores. A summary of key findings are summarised below, and samples locations are shown in Figure 9. It should be noted that the labels of the soil bores discussed below do not correlate with those labels adopted as part of the Project soil contamination investigation.

- Seven soil samples (BH01\_0.1, BH06\_01, BH10\_01, BH11\_0.1, BH15\_0.1, BH16\_0.1 and BH19\_0.1) reported zinc at concentrations exceeding the EILs for commercial/industrial land use.
- Three samples (BH23\_0.1, BH27\_0.1 and BH27\_0.25) reported Benzo(a)pyrene at concentrations exceeding the adopted EILs for commercial/industrial land use.
- One sample (BH23\_0.1) reported TRH (>C<sub>10</sub>-C<sub>16</sub>) concentration of 1,700 mg/kg exceeding the adopted EILs for commercial/industrial land use.
- One of four samples (BH33\_0.1) analysed for PFAS compounds reported PFOS concentration at 14 µg/kg, an order of magnitude below the adopted ecological criteria for indirect exposure.
- No detectable asbestos fibres were reported for the seven soil samples analysed for asbestos in soils.
- Soil samples were categorised as Category C under the EPA Victoria Publication IWRG621 due to arsenic, zinc, benzo(a)pyrene, total PAH and TRH (>C<sub>10</sub>-C<sub>16</sub>) exceeding the Fill Material upper limit.

### Summary of potential sources of contamination

Potential sources of contamination, their locations (with reference to the kilometre point (KP) of the pipeline alignment), impact pathways i.e. how the potential contamination could be interacted with and the associated potential contaminants of concern, identified through desktop review are summarised in Table 5-5.

**Table 5-5 Potential sources of contamination**

Potential source of contamination	Relevant locations	Potential impact pathway	Potential contaminant of concern
operations at Berth 1 of the Crib Point Jetty. Potential loss of hydrocarbons (petrol and diesel fuels) throughout the importation, pipelines and other operational activities.	Gas Import Jetty Works	Oil spills; and anti-fouling paints used on ship hulls entering the marine environment	TPHs, BTEX, PAHs, organotin compounds (e.g. tributyltin)
The former BP refinery (historical operation between 1966 and 1985) and jetty facilities. Potential loss of hydrocarbons throughout the importation, transport, processing and storage (including underground and above ground tanks, pipelines and other operational activities); and use of firefighting foam containing PFAS for testing, training or emergency response.	KP0.0 – KP1.0  Gas Import Jetty Works and the Esplanade	Excavation of soil to construct the Crib Point Receiving Facility and pipeline (thrust boring under the Esplanade and trenching along the Esplanade)	Total petroleum hydrocarbons (TPHs), monocyclic aromatic hydrocarbons (MAH) (benzene, toluene, ethylbenzene & xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), metals (e.g. lead, zinc, copper, nickel, chromium, cadmium, barium, arsenic, mercury), cyanides, PFAS



Potential source of contamination	Relevant locations	Potential impact pathway	Potential contaminant of concern
<p>Existing gas and oil pipeline – pipeline leaks</p> <ul style="list-style-type: none"> <li>• [REDACTED] (Crib Point to Hastings carrying motor spirit and automotive diesel)</li> <li>• [REDACTED] pipeline (Hastings to Altona and Geelong, carrying light crude oil);</li> <li>• [REDACTED] (Longford to Long Island Point carrying crude oil)</li> <li>• [REDACTED] (Long Island Point to Altona (Qenos) carrying ethane)</li> <li>• [REDACTED] (Long Island Point to Crib Point) – carrying crude currently disused</li> <li>• [REDACTED] (Crib Point to Dandenong) – currently disused</li> <li>• [REDACTED] (Lang Lang to Pakenham carrying methane)</li> </ul>	Crib Point Jetty, KP0.0 – 17.5, KP20.9 – 29.5, KP50.8, KP56.7	Excavation and dewatering	TPHs, BTEX, PAHs
Automotive service/repair centre and car rental facilities adjacent to the Project Area – leaks and spills from use and storage of fuels and chemicals	KP5.0 – KP5.6, KP5.9 – 6.8, KP7.3 – 8.8	Dewatering during trenching	Metals (such as copper, chromium, lead, zinc), solvents including chlorinated hydrocarbons TPHs, BTEX, PAHs, phenol, chlorofluorocarbons, acids, alkalis, asbestos from brake replacement activities and antifreeze (ethyl-alcohol, ethylene glycol, isopropyl alcohol, methyl alcohol), asbestos containing materials
Rail corridors – chemicals treatment of railroad ties, fuel/chemical spills and leaks	KP5.0 – KP5.6, KP5.9 – 6.8	Excavation and dewatering	TPH, BTEX, phenols, metals (e.g. arsenic, lead, zinc, cadmium, chromium, iron), creosote, carbamates, organochlorine pesticides, organophosphate pesticides, herbicides, asbestos containing materials



Potential source of contamination	Relevant locations	Potential impact pathway	Potential contaminant of concern
Metal recycling yard adjacent to the Project Area – leaks and spills from equipment to be recycled (e.g. vehicles, lubricating oil and coolant), parts cleaning and wash down bay	KP7.4	Dewatering during trenching	TPHs, BTEX, metals (such as arsenic, copper, cadmium, chromium, zinc, lead, nickel, manganese), PAHs, PCBs, ethylene glycol
██████████ vehicle yard – leaks and spills from vehicles; and from use and storage of fuel/chemical	KP7.6	Dewatering during trenching	TPHs, BTEX, PAHs, metals (such as copper, chromium, lead, zinc), solvents including chlorinated hydrocarbons, phenol
██████████ adjacent to the Project Area (bin hire, waste recycling and asbestos removal)	KP8.3	Dewatering during trenching	TPHs, BTEX, PAHs, metals (arsenic, copper, cadmium, chromium, zinc, lead, nickel, manganese), solvents, asbestos
Boat building and maintenance adjacent to the Project Area	KP10.6	Dewatering during trenching	Metals (e.g. copper, chromium, lead, mercury, zinc), antifouling paints (e.g. organotin, tributyltin)
██████████ (former Tyabb Landfill) licenced to accept domestic waste including putrescible waste and solid inert waste and asbestos of domestic origin – landfill gas, leachate and groundwater migrating off-site	KP13.2 – KP14.3	Trenching on the boundary of the lot adjacent to the landfill site, dewatering, and landfill gas migration	Landfill gas (methane, carbon dioxide, hydrogen sulphide and carbon monoxide), asbestos containing materials, heavy metals, nutrients (ammonia, nitrate), TPHs, BTEX, PAHs, MAHs, PFAS
Intensive agricultural, market gardens, orchard	KP6 – KP16.8, KP29.5	Excavation and dewatering	Carbamates, organochlorine pesticides, organophosphate pesticides, herbicides (e.g. triazine, atrazine), nitrates, nutrients (e.g. nitrogen, phosphorus), arsenic

### 5.1.2 Field investigation

Details of intrusive soil, marine sediment and groundwater investigations are detailed in Appendix A.

#### 5.1.2.1 Soil sampling program

The soil sampling program was completed between 29 November 2018 and 26 April 2019, and 31 March 2020 (targeting the proposed pipe stringing area in the former BP refinery site following its inclusion in the Project), and included drilling of soil bores to collect samples for the assessment of contaminated soils and ASS within the study area.

Collection of soil samples for the purpose of assessing potential contamination was undertaken in general accordance with the following guidelines and protocols:

- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM), as amended in 2013
- Standards Australia, 2005. Australian Standard, *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds*. AS 4482.1 – 2005
- Standards Australia, 1999. Australian Standard, *Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances*. AS 4482.2 – 1999.

The locations of the soil bores are shown in Figure A3, Appendix A-A. The targeted sampling locations listed in Table 5-6, were identified through desktop review as requiring field investigation to confirm presence or absence of contamination resulting from existing and/or historical land use. These targeted locations supplemented data collected from the grid basis soil bores located along the pipeline alignment at a density of approximately one soil bore per kilometre of pipeline.

**Table 5-6 Targeted sampling locations due to existing and/or historical land uses**

Potential source of contamination	Relevant locations	Bore ID
The former BP refinery and jetty facilities.	KP0.0 – KP1.0	BH108 – BH111
Rail corridor and adjacent automotive service/repair centre and car rental facilities	KP5.9 – 6.8	BH103 – BH106
Metal recycling yard and industrial sites	KP7.3 – 7.9	Access restricted due to dense vegetation. Intrusive soil and groundwater investigation must be undertaken prior to construction commencing.
██████████ an EPA Victoria prescribed industrial waste site licensed to transport lead and lead compound, contaminated soil (Category A, B and C) and asbestos (all forms)	KP8.3	BH107
Commercial and industrial areas in Hastings automotive sale/service/repair centre and fuel service station	KP6.5, KP6.9	GW02 and GW03
██████████ (former Tyabb Landfill) licensed to accept domestic waste including putrescible waste and solid inert waste and asbestos of domestic origin – landfill gas, leachate and groundwater migrating off-site	KP13.2 – KP14.3	GW04 and GW05 (soils and groundwater)

The adopted criteria to assess risk to protected beneficial uses of land, for the study area, are summarised in Table 5-7. It is noted that the assessment of risks to buildings and structures was

undertaken as part of the geotechnical investigation for the Project, thus has not been considered as part of this investigation.

**Table 5-7 Protected beneficial uses of land and the adopted investigation levels**

Beneficial Uses	Adopted Criteria
Maintenance of ecosystems	<ul style="list-style-type: none"> <li>The Amended ASC NEPM 2013 Ecological Investigation Levels (EILs) for Areas of Ecological Significance and Commercial/Industrial land use</li> <li>The Amended ASC NEPM 2013 Ecological Screening Levels (ESLs) for Areas of Ecological Significance, Urban Residential and Public Open Space and Commercial/Industrial land use (coarse soil)</li> <li>The Amended ASC NEPM 2013 Management Levels (MLs) for Residential, parkland and public open space, and commercial and industrial land use</li> </ul>
Human Health	<ul style="list-style-type: none"> <li>The Amended ASC NEPM 2013 Health Investigation Levels (HILs) for Residential A and Commercial/Industrial D</li> <li>The Amended ASC NEPM 2013 Health Screening Levels (HSLs) for Residential A/B (Sand)</li> </ul>
Aesthetics	<ul style="list-style-type: none"> <li>Field observation of soil odours and staining</li> </ul>
Production of food, flora and fibre	<ul style="list-style-type: none"> <li>As per the beneficial use 'maintenance of ecosystems'</li> </ul>

A total of 145 primary soil samples from 72 soil bores were analysed for the EPA Victoria Publication IWRG621 suite of analytes. Tabulated results are provided in Tables B6 – B10, Appendix A-B; and statistical analysis of analytical laboratory results for elements that exceeded the adopted screening criteria and/or EPA Victoria Publication IWRG621 Fill Material upper limits (i.e. arsenic, copper, lead, zinc and fluoride) were undertaken and compared against the reported ambient background concentrations expected for soils of Brighton Group underlying the Greater Melbourne region (discussed in Section 4.3, Appendix A).

The investigation concluded that, based on broadly spaced and targeted intrusive investigations undertaken as part of this field assessment, soil contamination is limited in extent. Contaminated soils were identified at the following locations, noting that localised impacts may be present at other locations and may be encountered during Project construction works:

- the proposed location for the Crib Point Receiving Facility
- the Esplanade adjacent to the former BP refinery
- railway corridor in Hastings.

Soil samples collected from the former BP refinery reported concentrations below the adopted investigation level for commercial/industrial land use, however exceeded the EPA Victoria Publication IWRG621 Fill Material upper limit.

#### **Crib Point Receiving Facility**

Soil samples collected from the proposed Crib Point Receiving Facility reported concentrations of zinc and benzo(a)pyrene exceeding the EIL and ESL for commercial/industrial land use. The exceedances were detected in surface soil sample collected at BH108.

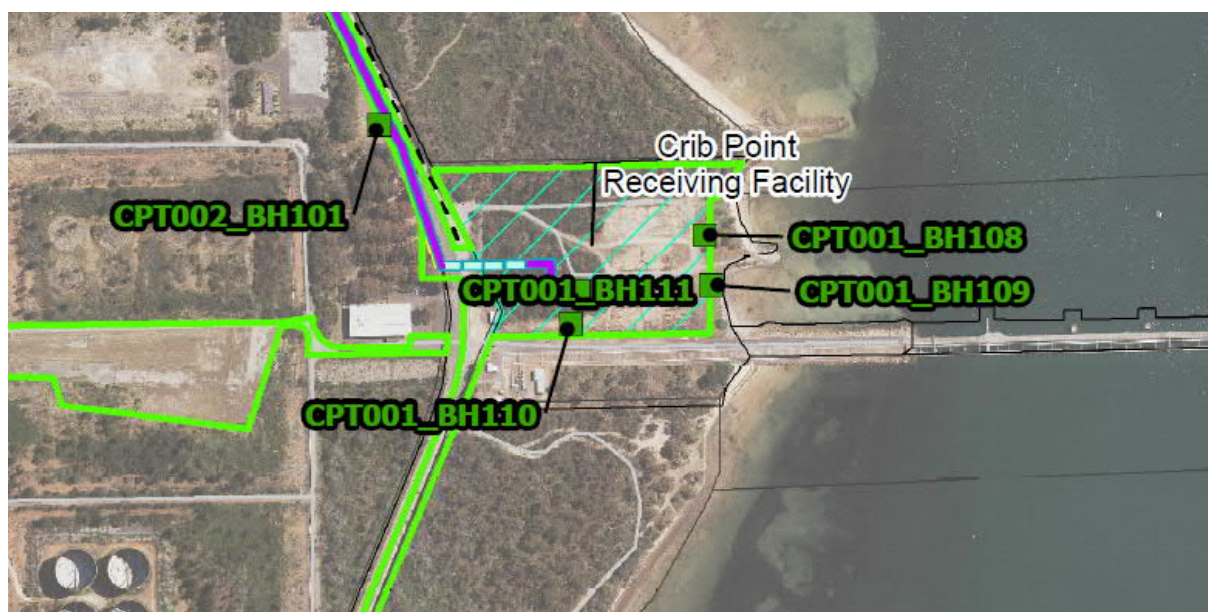
The elevated zinc concentration is considered unlikely to impact upon the ecology at the Crib Point Receiving Facility, as the sample was collected within imported crushed rock; and laboratory analysis results indicated that it has not leached into the underlined sample at 0.4 mbgl, thus it is considered unlikely to present risk to off-site receptors.

Based on the proposed industrial nature of the Crib Point Receiving Facility and the absence of sensitive vegetation, benzo(a)pyrene is also considered unlikely to present a risk to ecology at the

proposed facility and as it is not a leachable compound, it would also be unlikely to present a risk to off-site receptors.

10 soil samples were collected from four locations and analysed for the broad soil hazard categorisation suite under the EPA Victoria Publication IWRG621. A surface soil sample from BH108 was classified as Category B due to PAHs concentration exceeding the Category C upper limit, with zinc concentration reported exceeding the Fill Material upper limit. Two samples from BH108 and BH109 were classified as Category C due to arsenic concentrations in surface soil and natural soil respectively, exceeding the Fill Material upper limit. It is noted that the sample density does not comply with the recommendation made in the EPA Victoria publication IWRG702. Where contaminated soils are to be disposed off-site, soil sampling and categorisation in accordance with EPA Victoria Publication IWRG702 and IWRG621 must be undertaken.

Soil sampling locations at the proposed Crib Point Receiving Facility (BH108 – BH111) are shown in Figure 10. Review of historical aerial photographs and previous investigation reports listed in Section 5.1 indicated that historically the area may have been used as a laydown area during construction, and operation (1964 to 1985) and decommissioning of the former BP refinery (post 1985).



**Figure 10 Soil sampling locations at the Crib Point Receiving Facility and The Esplanade (adjacent to the former Western Port BP refinery)**

### **The Esplanade adjacent to the former Western Port BP refinery**

One soil sample collected from an area along The Esplanade, adjacent to the former BP refinery, reported a concentration of benzo(a)pyrene exceeding the ESLs for Coarse Soil, Urban Residential/Public Open Space and Commercial/Industrial land use. The exceedance was detected in gravelly sand surface soil collected at BH101 (Figure 10).

The elevated benzo(a)pyrene concentration is likely to be associated with asphalt and roadmaking materials. Based on the existing use and proposed Pipeline Works, it is considered unlikely to present risk to ecology at the site and as it is not a leachable compound, it would also be unlikely to present a risk to off-site receptors.

The surface soil sample at BH101 was classified under the EPA Victoria Publication IWRG621 as Category C due to concentrations of benzo(a)pyrene and PAHs exceeding the Fill Material upper limit. It is noted that the sample density does not comply with the recommendation made in the EPA Victoria publication IWRG702. Where contaminated soils are to be disposed off-site, soil sampling and categorisation in accordance with EPA Victoria Publication IWRG702 and IWRG621 must be undertaken.



### The former Western Port BP refinery

Soil samples (BH55, BH56 and BH58) collected from the former BP refinery reported concentrations below the adopted investigation level for commercial/industrial land use.

The surface soil sample at BH55 was classified under the EPA Victoria Publication IWRG621 as Category C due to concentrations of PCBs exceeding the Fill Material upper limit. It is noted that the sample density does not comply with the recommendation made in the EPA Victoria publication IWRG702. Where contaminated soils are to be disposed off-site, soil sampling and categorisation in accordance with EPA Victoria Publication IWRG702 and IWRG621 must be undertaken.

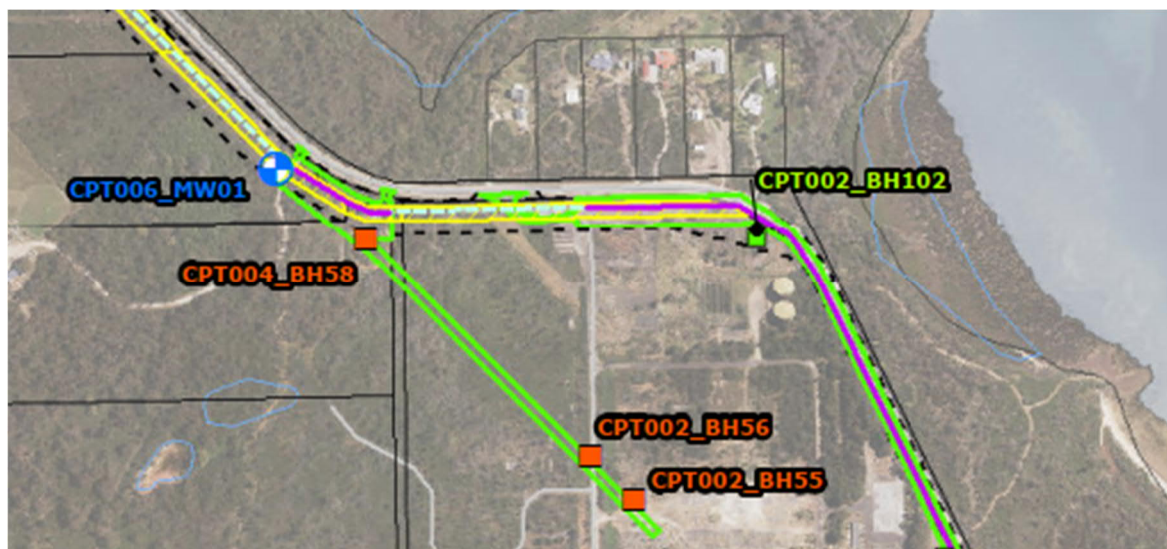


Figure 11 Soil sampling locations at the former Western Port BP refinery

### Railway corridor

The soil sample collected from the rail corridor between High Street and Cool Store Road in Hastings (KP6.0) reported a concentration of benzo(a)pyrene exceeding the ESLs for Coarse Soil, Urban Residential/Public Open Space and Commercial/Industrial. The exceedance was detected in gravelly silt surface soil collected at BH06. The elevated benzo(a)pyrene concentration is likely to be associated with operational activities historically undertaken within the rail corridor. Based on the existing use and proposed Pipeline Works, it is considered unlikely to present risk to ecology at the site and as it is not a leachable compound, it would also be unlikely to present a risk to off-site receptors.

The surface soil samples at BH06 and BH104 was classified under the EPA Victoria Publication IWRG621 as Category C due to concentrations of arsenic, copper, lead and zinc exceeding the Fill Material upper limit. It is noted that the sample density does not comply with the recommendation made in the EPA Victoria publication IWRG702. Where contaminated soils are to be disposed off-site, soil sampling and categorisation in accordance with EPA Victoria Publication IWRG702 and IWRG621 must be undertaken.

Soil sample locations within the rail corridor between High Street and Cool Store Road in Hastings (BH06, BH103 – BH106) are shown in Figure 12 .

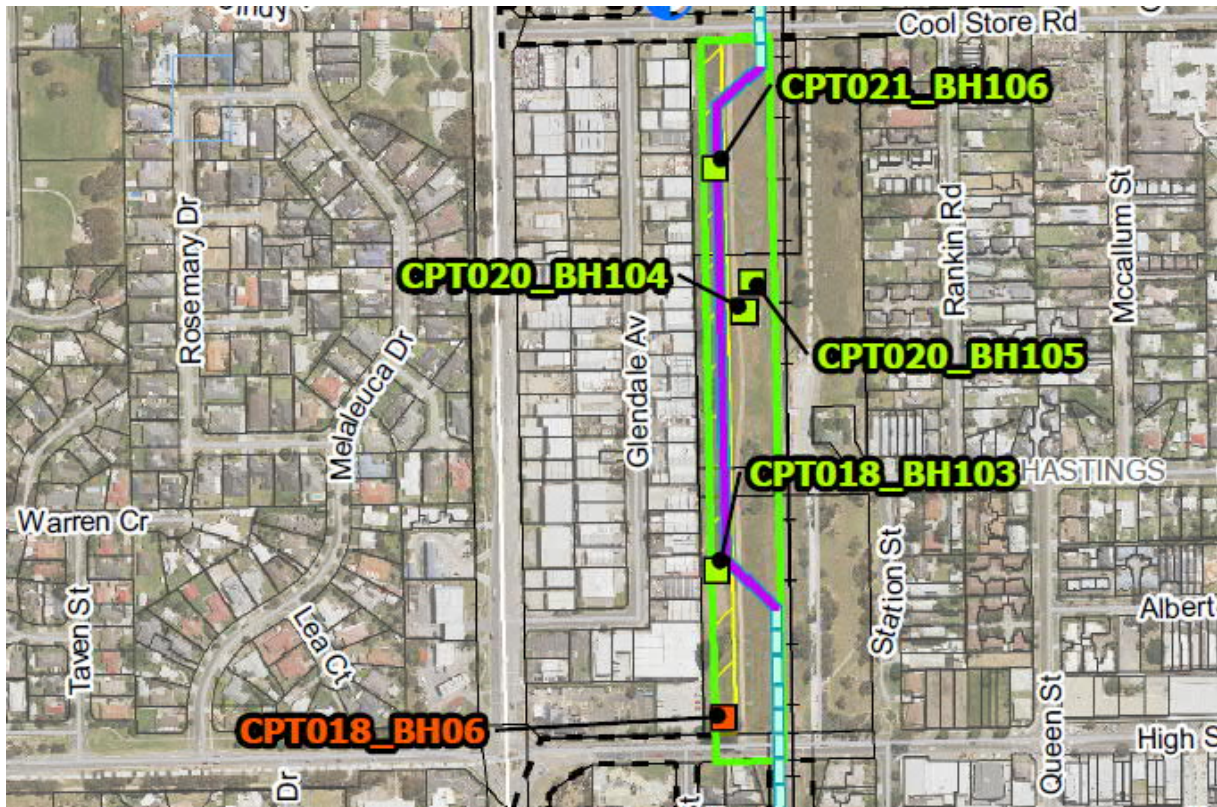


Figure 12 Soil sample locations within the rail corridor between High Street and Cool Store Road, Hastings

It is noted that due to dense vegetation restricting access to the study area between KP7.3 – 7.9 in Hastings (Figure 13), intrusive investigation was unable to be completed to assess potential impacts from the adjacent industrial premises (such as the metal recycling yard). Therefore, the Pipeline Works must undertake intrusive soil investigation prior to pipeline construction to confirm the presence or absence of contaminated soils within the area, due to historical and existing land uses.





Figure 13 Section of Project Area in Hastings requiring intrusive investigation prior to pipeline construction

#### 5.1.2.2 Groundwater sampling program

A total of 22 groundwater wells were installed as part of EES Technical Report D: *Groundwater impact assessment* and a total of four groundwater monitoring wells (GW02 to GW05) were installed as part of this contamination investigation, to target areas of potential environmental concern, identified through desktop review.

The groundwater sampling program included drilling and installation of groundwater monitoring wells, and subsequent groundwater gauging, sampling, and analysis to assess the existing groundwater



conditions within the study area. Drilling and installation of groundwater monitoring wells were completed between 3 December 2018 and 11 January 2019, and the subsequent gauging, sampling, and laboratory analysis was completed between 23 January 2019 and 30 January 2019.

All samples were collected in general accordance with EPA Victoria Publication 669, *Groundwater Sampling Guidelines*, 2000 (EPA Publication 669).

The locations of the groundwater monitoring wells installed across the study are shown in Figure A3, Appendix A-A.

It is noted that groundwater was not assessed within the land adjacent to the Crib Point Jetty (landside component of the Gas Import Jetty), as groundwater levels measured and reported by the following investigation reports for the Crib Point Jetty, indicated that the Project is unlikely to encounter regional groundwater beneath the area:

- *Acid Sulfate Soil Investigation – Crib Point Receiving Facility* (Construction Science, January 2019)
- *Baseline Environmental Contamination Investigation – Crib Point Jetty for Port of Hastings Development Authority* (Jacobs, June 2017)
- *Environmental Site Assessment Works Port of Hastings* (No. VP7753.001: Rev 0, 14-2273), CMPS&F Pty Ltd, 1997 (as an Appendix to the Statements of Environmental Audit, Port of Hastings Sites (No. 78J155A-pr29999d M7314), PPK Environment & Infrastructure Pty Ltd, 1998).

As outlined in EES Technical Report: D *Groundwater impact assessment* and in accordance with the SEPP (Waters), Segment B has been conservatively adopted as the groundwater segment for the study area. The adopted criteria for beneficial uses of the study area for groundwater assessment are summarised in Table 5-8.

**Table 5-8 Protected beneficial uses of groundwater and the adopted investigation levels**

Beneficial Use	Adopted Investigation Levels
Water dependent ecosystem and species (Western Port Segment- Entrance and North Arm)	Australian and New Zealand Environment and Conservation Council (ANZECC & ARMCAN) (2000), 99% level of protection for marine water. PFAS NEPM (2018), Aquatic ecosystems: freshwater and marine water guideline values, 99 % species protection – high conservation value systems.
Agriculture and irrigation (irrigation)	ANZECC & ARMCANZ (2000), Agricultural irrigation water long-term trigger value (LTV).
Agriculture and irrigation (stock watering)	ANZECC & ARMCANZ (2000), Livestock Watering (Beef Cattle, Poultry and Sheep).
Industrial and commercial	In accordance with ANZECC & ARMCANZ (2000), no criteria have been adopted to be protective of this beneficial use. Due to the varied requirements for industrial use it is considered that other coincidental environmental values would drive management of the resource.
Water-based recreation (primary contact recreation)	National Health and Medical Research Council (NHMRC) (2008), Guidelines for Managing Risks in Recreational Water.
Traditional Owner cultural values	In accordance with the SEPP (Waters), environmental quality objective for 'water dependent ecosystems'

Beneficial Use	Adopted Investigation Levels
	have been adopted to be protective of this beneficial use.
Cultural and spiritual values	In accordance with the SEPP (Waters), environmental quality objective for 'water dependent ecosystems' have been adopted to be protective of this beneficial use.
Buildings and structures	Not considered as part of this assessment.
Geothermal properties	Not applicable

Depth to groundwater ranged between 1.094 mbgl (MW22) and 3.996 mbgl (MW18), with four locations (MW04, MW23, MW17 and MW19) noted to be dry during the gauging round. Groundwater elevations ranged between -0.909 metres Australian Height Datum (mAHD) (MW18) and 22.907 mAHD (MW22), consistent with the general topography and ground elevations along the pipeline alignment. The gauging results and groundwater elevations are summarised in Table B4, Appendix A-B.

Stabilised groundwater field quality parameters are presented in Table B5, Appendix A-B and a summary of groundwater sampling parameters is presented in Table 5-9.

**Table 5-9 Groundwater Sampling: Field quality parameters**

Parameter	Minimum	Minimum Location	Maximum	Maximum Location
Temperature (°C)	16.8	MW03	19.3	MW22
Dissolved Oxygen (mg/L)	0.23	MW14	3.14	MW21
Electrical Conductivity (µS/cm)	1,927	MW07	25,252	MW11
pH	5.96	MW14	7.34	MW07
Redox Field (mV)	-10	MW10	170	GW05
Total Dissolved Solids	1,253	MW07	16,614	MW11
Redox Potential (Eh)	194	MW10	382	GW05
Note: - pH and Redox could not be measured due to inconsistencies in the measurement device at MW11 and MW15. - Total Dissolved Solids approximated as Electrical Conductivity x 0.65. - Corrected Redox Potential = Field Redox Potential + (224.98 - 0.7443* Temperature) (Redox potential converted from Ag/AgCl electrode to standard hydrogen electrode).				

A total of 15 primary groundwater samples were analysed for a broad range of analytes including dissolved metals (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg), major ions, TDS, nitrate, ammonia, Cr(III), Cr(VI), total phosphorous, TRH C<sub>6</sub>-C<sub>40</sub> and volatile organic compound (VOC)/semi-VOC (SVOC). Tabulated results are provided in Table B12, Appendix A-B.

The groundwater field investigation concluded that the extent of groundwater contamination is limited. No non-aqueous phase liquid (NAPL) (either dense (D) or light (L)) was encountered in any of the groundwater monitoring wells during gauging and groundwater sampling. Excluding compounds considered likely to be naturally sourced/ background (total dissolved solids (TDS), selected metals, sulfate, phosphorous, calcium, etc.), contamination was only encountered at the following locations, noting that while likely areas of concern were assessed as part of this investigation, localised groundwater contamination may be encountered during Project construction works:

- adjacent to the former Tyabb landfill (GW04 and GW05)
- adjacent to the metal recycling yard (MW05) in Hastings.

It is noted that the laboratory results reported an average TDS concentration of 6,217 mg/L, with all but one sample located at MW07 exceeding the adopted ANZECC & ARMCANZ (2000) - Livestock Watering (Beef Cattle, Poultry or Sheep) criteria. MW07 is located adjacent to the Mckirdys Road Drain and therefore likely to be influenced by surface water. Highest TDS concentrations were reported for MW9 (13,800 mg/L) and MW11 (18,700 mg/L) located adjacent to the Watson Creek, likely to be influenced by tidal interaction associated with the Watson Creek that discharge to Western Port. Based on the distribution of TDS along the proposed pipeline alignment, it is considered that TDS is naturally elevated within the aquifer and does not represent contamination but would restrict discharge to land and potentially receiving waters.

Field measured pH exceeded the NHMRC (2008) - Guidelines for Managing Risks in Recreational Waters criteria at eight out of 13 locations, ranging between 5.96 and 7.34. MW14 (pH 5.96) also exceeded the ANZECC & ARMCANZ (2000) - Irrigation LTV criteria. Acidic pH of groundwater is consistent with the presence of actual ASS as detected throughout the study area and is considered to be naturally occurring and does not represent contamination.

### **Former Tyabb Landfill**

The groundwater sample collected from GW05, located immediately east of the former Tyabb landfill, reported a concentration of PFOS exceeding the PFAS NEMP (2018) - PFAS Guidelines Freshwater and Marine water 99% criteria. The exceedance, however, was only detected in the triplicate sample at LOR. Noting that the LOR is higher than the criteria for PFOS, and other PFAS compounds were detected in the primary sample at trace concentrations, it is considered likely that PFOS is present and exceeds the Maintenance of Ecosystems criteria. It is noted that the criteria exceeded only applies upon discharge to surface water body. Groundwater at GW05 was measured at 1.744 mbgl, indicating that groundwater may be encountered when trenching along the eastern boundary of the former Tyabb landfill (see Figure 8).

An elevated concentration of nickel (0.019 mg/L) exceeding the ANZECC & ARMCANZ (2000) - Maintenance of Ecosystems Marine Water 99% protection level criteria was also detected in the groundwater sample from GW04, located south of the former Tyabb landfill. The concentration was observed to be higher than in other groundwater samples collected from the study area, indicating potential impact from historical and/or the adjacent land use. However, the HDD construction method proposed for the area (KP13.3 – KP13.7) means no dewatering is required, and nickel concentrations at the other two groundwater monitoring wells are below the adopted criteria (0.002 mg/L at MW07 and 0.003 mg/L at GW05). Therefore, it is considered unlikely to present a risk to ecology at the site and to off-site receptors and no additional management of groundwater would be required.

### **Metal recycling yard, Hastings**

The groundwater sample collected from MW05, located west (along Frankton-Flinders Road) of a metal recycling yard in Hastings, reported a concentration of nickel (0.012 mg/L) exceeding the ANZECC & ARMCANZ (2000) - Maintenance of Ecosystems Marine Water 99% protection level criteria. The concentration was higher than detected in other groundwater samples collected across the study area, indicating potential impact from historical and/or adjacent land use.

Local topography and surface water features would suggest a groundwater flow direction to the east to south east towards Western Port Bay. The potential exists for contaminants to migrate from the industrial premises towards the Project Area between KP7.3 and KP7.9 through the subsurface with groundwater flow. Based on shallow groundwater table measured at MW05 (1.406 mbgl), it is considered likely that groundwater would be encountered during open trench construction within this area.

Intrusive groundwater investigation between KP7.3 and KP7.9 was unable to be completed due to dense vegetation restricting access (Figure 13), therefore, the Pipeline Works must undertake intrusive groundwater investigation prior to pipeline construction to confirm presence or absence of contaminated groundwater within the area, resulted from historical and existing land uses.

## 5.2 Acid sulfate soils

### 5.2.1 Desktop review

The EPA Victoria *Industrial Waste Management Policy (Waste Acid Sulfate Soils)* 1999 defines 'acid sulfate soil' as:

'... any soil, sediment, unconsolidated geological material or disturbed consolidated rock mass containing metal sulphides, which exceeds criteria for acid sulfate soils specified in EPA Victoria Publication 655 entitled *Acid Sulfate Soil and Rock* published by the Authority in 1999, and amended from time to time or republished by the Authority'.

ASS are soils affected by iron sulphide minerals. ASS can occur naturally in coastal environments such as estuarine systems, mangrove swamps and backswamps and in inland environments such as river and stream channels, lakes, wetlands, billabongs, floodplains and marshes (Fitzpatrick, R. and Shand, P., 2008).

Generally, ASS is classified into two broad types:

- Potential Acid Sulfate Soils (PASS) – soil that contains unoxidised metal sulfides. This only exists under oxygen-free or waterlogged conditions. If disturbed, it can produce acid.
- Actual Acid Sulfate Soils (AASS) – soil that has been exposed to oxygen and water, and is already acidic.

Presence of AASS or PASS in sufficient amount can have a lasting effect on the soil characteristics, causing deoxygenation or release contaminants when the iron sulfide minerals are exposed to oxygen (Fitzpatrick, R. and Shand, P., 2008). They become a potential constraint to construction activities, requiring the implementation of controls to manage the spoil during excavation, trenching and drilling activities.

Table 5-10 lists ASS classification for the study area as defined in the ASRIS soil database. This data source indicates that 16 kilometres of the pipeline alignment intersects areas with a high probability of occurrence of ASS. A map of the Project Area overlaid over the ASRIS ASS classification is presented Figure A2, Appendix A-A.

**Table 5-10 ASRIS Acid Sulfate Soil Classification**

KP	Code	Classification	Description
0.0 – 18.8, 19.2 – 32.0, 33.4 – 35.5, 50.7 – 55.1	Cq(p4)	Extremely Low Probability occurrence	Area with extremely low probability of ASS occurrence (<1 % chance) generally within upper one metre in wet/riparian areas with Kandosols, Tenosols and Rudosols, with potential ASS. The classification is noted to be provisional, as analytical data was not available when the map was prepared, and the classifier has little knowledge or experience with ASS.
18.8 – 19.0	Ab(p4)	High Probability of occurrence	Area with high probability of PASS occurrence (>70 % chance) generally within upper one metre often with mangroves. The classification is noted to be provisional, as analytical data was not available when the map was prepared, and the classifier has little knowledge or experience with ASS.
19.0, 19.1 – 19.2	Aq(p4)	High Probability of occurrence	Area with high probability of ASS occurrence (>70 % chance) generally within upper one metre in wet/riparian areas with Kandosols, Tenosols and Rudosols, with potential ASS. The classification is noted to be provisional, as analytical data was not available when the map

KP	Code	Classification	Description
			was prepared, and the classifier has little knowledge or experience with ASS.
31.9 – 33.4 35.5 – 36.2	Ac(p1)	High Probability of occurrence	Area with high probability of ASS occurrence (>70 % chance) generally within upper one metre. Halophytes (mainly samphire), salt marsh, salt pans with potential ASS confirmed by analytical and morphological data.
36.5 – 50.7	Am(p4)	High Probability of occurrence	Area with high probability of ASS occurrence (>70 % chance) generally within upper one metre in wet/riparian areas with Hydrosols with potential ASS. The classification is noted to be provisional, as analytical data was not available when the plan was prepared, and the classifier has little knowledge or experience with ASS.
55.1 – 56.75	Bn(p4)	Low Probability of occurrence	Area with low probability of ASS occurrence (6 – 70 % chance) generally within upper one metre in wet/riparian areas with Hydrosols with potential ASS. The classification is noted to be provisional, as analytical data was not available when the plan was prepared, and the classifier has little knowledge or experience with ASS.

### Previous ASS investigation reports

Previous ASS investigations undertaken by other consultants for the Project are summarised below. It should be noted that the labels of the soil bores discussed below do not correlate with those labels adopted as part of this technical report.

#### *Acid Sulfate Soil Assessment Report (Monarc, August 2018)*

In August 2018, Monarc completed drilling of ten soil bores in selected low-lying areas along the APA pipeline alignment. The bores were drilled using a push tube or hand auger. Contaminant and ASS soil sampling were undertaken with a maximum depth of 3.6 mbgl. No preliminary screening of soil using field pH (pH<sub>f</sub>) and field pH peroxide (pH<sub>fox</sub>) was undertaken with a total of 12 soil samples (at various depths) undertaken for Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS) suite testing. The results reported a maximum net acidity of 0.09 %S at CPT006 BH2 at 2.3 mbgl.

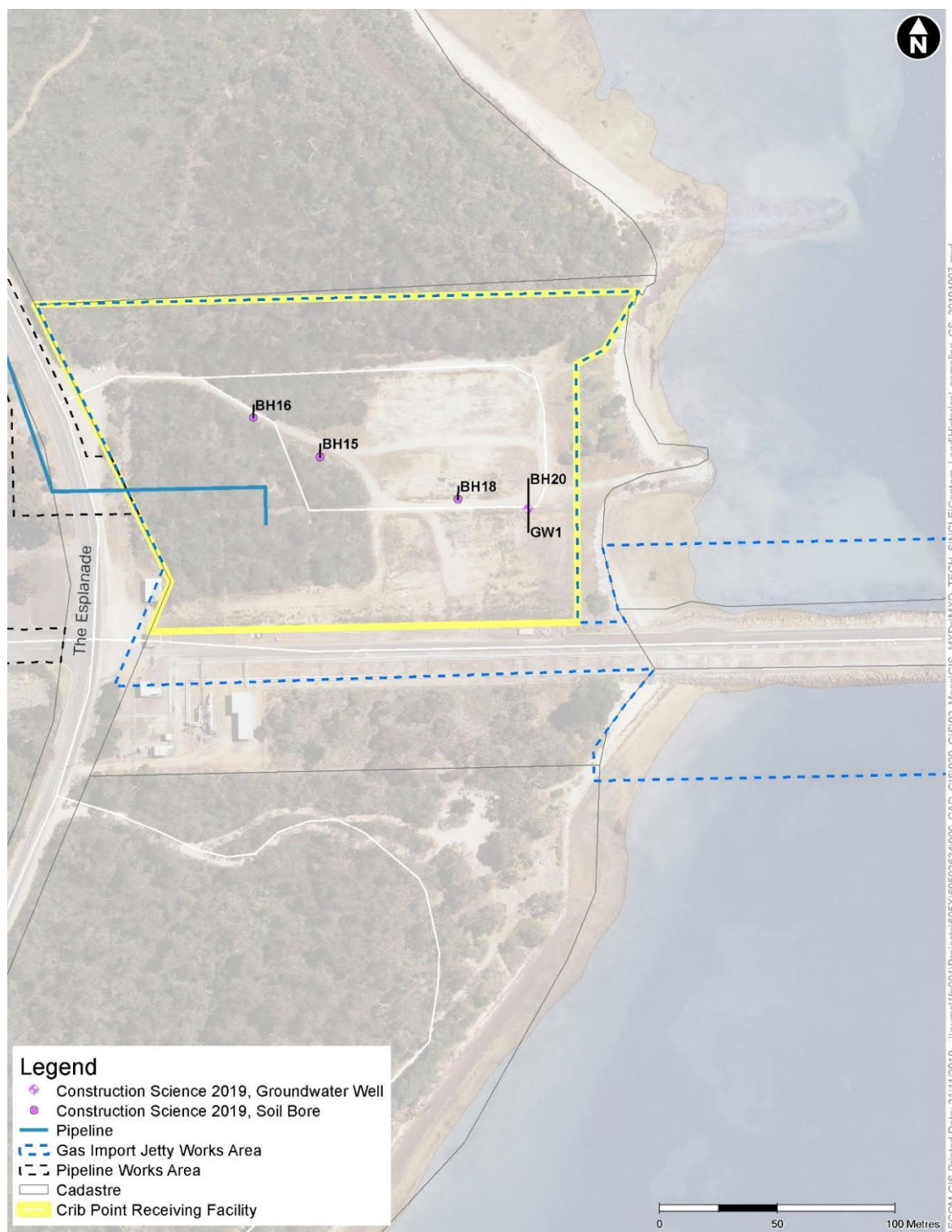
The investigation identified AASS and PASS soils at two locations located at Woolleys Road in Crib Point (near KP1.1 and KP1.8).

#### *Acid Sulfate Soil Investigation – Crib Point Receiving Facility (Construction Sciences, February 2019)*

In January 2019, Construction Sciences undertook ASS investigation at the Crib Point Receiving Facility. The investigation included collection of 24 soil samples from four soil bores (drilled using a solid flight auger to a maximum depth of 15.45 mbgl), shown in Figure 14. Soil samples were screened for pH<sub>f</sub> and pH<sub>fox</sub> with SPOCAS quantitative testing on all 24 soil samples. The analytical results reported maximum net acidity of 0.06 %S at CPT001 BH13 at 0.5mbgl, with 12 samples reporting net acidity values exceeding the action criteria for ASS management.

The investigation identified ASS and PASS soils at the Crib Point Receiving Facility.





**Figure 14 Acid sulfate soil sampling locations for previous acid sulfate soil investigation undertaken at Crib point Jetty**

### 5.2.2 Field investigation

Details of intrusive ASS investigations are detailed in Appendix A.

The ASS investigation was undertaken in conjunction with contaminated soil investigation completed between 29 November 2018 and 26 April 2019. It is noted that the samples point frequency does not comply with the recommendation made in Table 1 of the EPA Victoria Publication IWRG655.1, except

within the ASS targeted sampling area (defined in the ASRIS as an area with high probability of occurrence of ASS), which specifies 100 metre sample point frequency for a pipeline. This approach is considered sufficient to provide an indication of presence or absence of ASS within the study area.

The ASS samples locations across the study area are shown in Figure A6, Appendix A-A. The results were compared against the EPA Victoria Publication IWRG655.1 criteria for classification of ASS presented in Table 5-11.

**Table 5-11 Texture-based acid sulfate soil action criteria**

Type of Material		Sum of Existing and Potential Acidity			
Texture range (National Committee on Soil and Terrain 2009)	Approx. clay content (%)	1–1000 tonnes material disturbed		>1000 tonnes material disturbed	
		%S-equiv. (oven-dried basis)	Mol H <sup>+</sup> /t (oven-dried basis)	%S-equiv. (oven-dried basis)	Mol H <sup>+</sup> /t (oven-dried basis)
Fine: Medium to heavy clays and silty clays	>40	0.1	62	0.03	18
Medium: Sandy loams to light clays	5–40	0.06	36		
Coarse: Sands to loamy sands	<5	0.03	18		

A total of 180 soil samples were analysed for CRS suite of analytes. Tabulated results are provided in Table B11, Appendix A-B and presented in Figure A6, Appendix A-A.

The ASS investigation confirmed presence of AASS throughout the study area; and PASS was identified at:

- MW09 at depth of 3.0 mbgl
- MW10 at depth of 3 mbgl
- BH207 at depth of 0.5 mbgl
- BH209 at depth of 0.5 mbgl<sup>2</sup>
- BH34 at depth of 2.0 mbgl<sup>2</sup>

Net acidity exceeding the 'Action Criteria' of 0.03%S for disturbance exceeding 1,000 tonnes (BPMG, 2010) was exceeded in 78 (six soil samples within the Gas Import Jetty Works area, and 72 soil samples within the Pipeline Works area) of total 180 samples, with net acidity ranging between 0.02%S and 0.18%S and calculated liming rates to neutralise the calculated net acidity ranging between 1 kg CaCO<sub>3</sub>/tonne and 8 kg CaCO<sub>3</sub>/tonne. Therefore, soils must be managed in accordance with EPA Victoria Publication IWRG655.1. Further ASS assessment may be undertaken to comply with EPA Victoria Publication IWRG655.1 sampling density, however the distribution of ASS throughout the study area would suggest that this is not required, other than to calculate or refine liming rates, and that all soils be managed as AASS or PASS in accordance with Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG) (2010).

It is noted that although the Pipeline Works and the Gas Import Jetty Works are assessed as a full Project under the EES, the construction works will be undertaken separately under separate approvals and management plans. Therefore, for the purpose of ASS classification under the CASS BPMG

<sup>2</sup> Conservatively classified as PASS. Samples were analysed using the SPOCAS method for QA/QC data validation purposes.



(2010), specifically the requirement for an ASSMP, the classification would need to be completed for both sets of works independently.

It is estimated that the open trench sections of the Pipeline Works and the Gas Import Jetty Works would disturb approximately 91,500 m<sup>3</sup> and 2,500 m<sup>3</sup> of soil (in-situ), respectively. Therefore, both set of Works are classified as High hazard under the CASS BPMG (2010), which may only proceed with an approved environmental management plan.

EPA Victoria was consulted on 19 August 2019, and it was agreed that the Pipeline Works would not require an EPA Victoria approved ASSMP. Instead, an ASS Management Protocol would be developed and included in the Pipeline Works CEMP which would be approved in accordance with *Pipelines Act 2005*, in consultation with EPA Victoria (see Section 4.5 for further details). A separate ASSMP would be required for the Gas Import Jetty Works and would need to be approved by EPA Victoria.

## 5.3 Contaminated marine sediments

### 5.3.1 Desktop review

The Crib Point Jetty was established in 1965 to provide berthing facilities for import of crude oil to the former BP refinery. The jetty has two berths (Berth 1 and 2) which are located in the northern and southern portion of the jetty, respectively. Berth 1 is currently in operation for the import of refined petroleum products. Berth 2 ceased usage when the BP refinery was closed in the 1980s.

PoHDA would be undertaking Crib Point Jetty upgrade works prior to the commencement of the Gas Import Jetty Works, and the upgrade works would be assessed and approved as a separate project to the Gas Import Jetty and Pipeline Project.

The SEPP (Waters) defines the Western Port Segment as the surface waters bounded by high water of Western Port shores and the western and eastern entrances to Bass Strait and comprising the following two sub-segments (but not including marine waters within the Aquatic Reserves segment):

- Entrances and North Arm – the surface waters of the section of the bay bounded by the western (West Head to Point Grant) and eastern (Cape Woolamai) entrances to Bass Strait and the boundaries of the East Arm
- East Arm – the surface waters of the section of the bay bounded in the west by Tooradin (Pelican Point and Palmer Point), and in the south east by Corinella (Stockyard Point to Settlement Point).

The Crib Point Jetty is located within the Entrances and North Arm with the following protected beneficial uses for surface waters:

- water dependent ecosystems and species that are largely unmodified
- human consumption of aquatic foods
- aquaculture
- industrial and commercial
- water-based recreation (primary contact)
- water-based recreation (secondary contact)
- water-based recreation (aesthetic enjoyment)
- Traditional Owner cultural values
- cultural and spiritual values
- navigation and shipping.

The relevant beneficial uses and environmental quality objectives for marine sediment is to protect water dependent ecosystems and species for a largely unmodified ecosystem.

### Previous marine sediments investigation report – Crib Point Jetty

*Baseline Environmental Contamination Investigation – Crib Point Jetty for Port of Hastings Development Authority (Jacobs, June 2017)*

Baseline environmental contamination investigation of the Crib Point Jetty was undertaken by Jacobs in 2017 for PoHDA. As part of the investigation, Jacobs reviewed the *Preliminary Assessment of Soil and Harbour Sediment Quality at the Port of Hastings, Stage 2 – Sampling and Analysis of Soils and Sediments* (Final Report No. J2078/2) (Energetics Environmental, 1997) report and undertook field investigations comprising collection and analysis of marine sediment from beneath the Crib Point Jetty.

A summary of marine sediment conditions at Crib Point Jetty, as gathered by Jacobs through review of Energetics Environmental (1997) report is presented below.

- Marine sediments at Crib Point Jetty were described as comprising silty sands. Particle size analysis indicated a high proportion of medium to coarse grained sand.
- Arsenic in marine sediment samples was detected at a concentration of 32 mg/kg, exceeding the ANZECC & ARMCANZ (2000) trigger levels.
- The laboratory testing of marine sediment samples was limited to the analysis of metals, TPHs and PAHs. TPHs & PAHs were reported below the LOR.

A summary of key findings from Jacobs (2017) contamination investigation on marine sediment conditions beneath the Crib Point Jetty are summarised below. Sampling locations are shown in Figure 15.

- Arsenic (39.4 mg/kg), Benz(a)anthracene (0.9 mg/kg) in marine sediment sample SED01 exceeded the ANZECC & ARMCANZ (2000) interim sediment quality guideline (ISQG) Low Trigger Values.
- Fluoranthene in marine sediment samples SED01 (3.6 mg/kg), SED02 (0.6 mg/kg) and SED03 (1.3 mg/kg) exceeded the ANZECC & ARMCANZ (2000) ISQG Low Trigger Value.
- Phenanthrene in marine sediment sample on SED01 (2.3 mg/kg) exceeded the ANZECC & ARMCANZ (2000) ISQG High Trigger Value.
- Pyrene in marine sediment samples SED01 (2.6 mg/kg) and SED03 (1 mg/kg) exceeded the ANZECC & ARMCANZ (2000) ISQG High and Low Trigger Values, respectively.
- Tributyltin (TBT) in marine sediment sample SED02 (17.1 µg/kg) exceeded the ANZECC & ARMCANZ (2000) ISQG Low Trigger Values.
- PFOS was detected in one of two marine sediment samples analysed for perfluorochemicals (SED03 at 0.0007mg/kg), however the concentration was below the 0.022 mg/kg (CRCCARE No.38 Part 4 Table 5 Health Based Screening Levels for Sediments) criteria adopted by Jacobs.
- Jacobs considered the exceedances were generally low and may be considered acceptable for current use of the Crib Point Jetty, subject to further assessment.

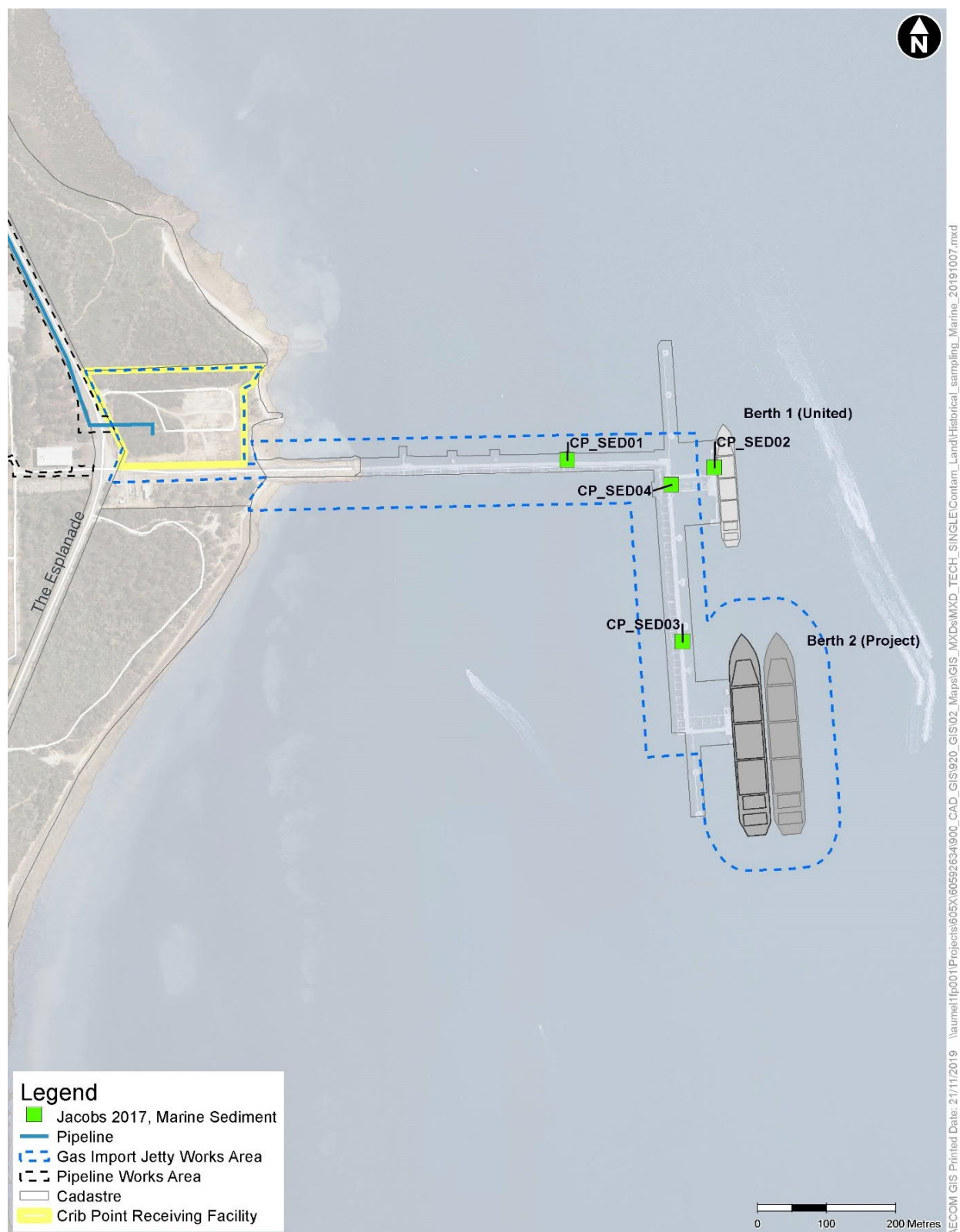


Figure 15 Marine sediment sampling locations for previous investigation undertaken at the Crib Point Jetty

### 5.3.2 Field investigation

Full details of the marine sediment investigation undertaken are detailed in Appendix A. Key components of the marine sediment field investigation program are summarised below.

A total of 20 marine sediment samples were collected during the two rounds of sampling undertaken by CEE on 1 March 2019 and 18 July 2019. Four samples were collected from reference sites located approximately 500m north of Berth 1 and South of Berth 2. The marine sediment sampling locations are shown in Figure A8, Appendix A-A.

Marine sediment at Berths 1 and 2 were described as silty fines through to medium sands with shell fragments. Sampling location NRA (reference site) located north of Berth 1 was described as clean medium/coarse sand and SRA (reference site) located south of Berth 2 was described as silty fine sand, black in colour with high organic content and worm tubes. No indicators of potential marine sediment contamination were observed.

Description of marine sediment at each sample location including photographs of collected samples are provided in *AGL Gas Import Jetty Project Crib Point, Western Port* (CEE, 2019) report included in Appendix A-I.

Reported results were either below the laboratory LOR or below the adopted sediment quality guidelines values (SQGVs) with the exception of two samples collected from Berth 1 which exceeded the SQG-High for tributyltin (TBT), and two samples from reference sites located north of Berth 1 which recorded arsenic at concentrations exceeding the SQGVs.

PFAS compounds were detected above the laboratory LOR at three locations within Berth 2, however, Australian guideline values for maintaining ecosystem health for PFAS in marine sediment are currently not available. Therefore, in the absence of guideline value for PFAS in marine sediment, it is considered that, based on low concentrations of PFAS (i.e. within the same magnitude of the laboratory LOR), the existing beneficial use of protecting water dependent ecosystems and species is protected.

Tabulated results are provided in Table B13, Appendix A-B and presented in Figure A8, Appendix A-A.

Field investigation undertaken as part of this assessment indicated that marine sediment contamination from historical and/or existing activities at the Crib Point Jetty is limited to Berth 1, where concentrations of TBT exceeded the SQGV.

It is concluded that the existing beneficial use of protecting water dependent ecosystems and species at Berth 2 is protected and therefore risk and impacts assessment associated with the disturbance of contaminated marine sediment is not addressed further in this report.

## 5.4 Conceptual site models (CSMs)

A Conceptual Site Model (CSM) is a representation of project-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. Potential human and ecological receptors and transport pathways are summarised in Table 5-12. Generic CSMs based on the existing conditions and proposed construction methodologies for the Project are shown in Figure 16 to Figure 18.

Table 5-12 Potential receptors and contaminant transport pathways

Source	Potential Transport Pathway	Receptors	Comment
Contaminated soil from historical industrial activity: fuel storage, landfill, farming	Direct contact with contaminated soil stockpiles	On-site workers	<p>Surface soils at the proposed Crib Point Receiving Facility are impacted by zinc and benzo(a)pyrene. S.</p> <p>Surface soils at location along the Esplanade and rail corridor in Hastings (KP5.9 – KP6.8) are impacted by benzo(a)pyrene.</p>
	Leaching of contaminants from soils and transport within groundwater	Terrestrial ecosystem if water is discharged to land, and aquatic ecosystem if water is discharged to surface waters	
	Runoff from contaminated stockpile flowing into receiving waters	Receiving waters leading to Western Port	
	Windblown dust from contaminated soil or stockpile	On-site workers via direct contact and inhalation	
Contaminated groundwater	Abstraction of groundwater, discharge to land or surface water body	Human health via direct or secondary contact	Groundwater near the former Tyabb landfill is contaminated with PFAS; and groundwater beneath the road easement between KP7.3 and KP7.9 in Hastings, adjacent to the metal recycling yard is potentially impacted by historical and existing land uses (subject to instructive investigation).
		Aquatic ecosystems	
		Stock (where suitable for reuse)	
Acid sulfate soils	Generation of acid leachate through oxidation of previously submerged soils	<p>Terrestrial ecosystem if water is discharged to land, and aquatic ecosystem if water is discharged to surface waters</p> <p>Human health via direct or secondary contact</p>	Existing acidic soils are present throughout the study area, and PASS was identified at MW09 (KP17.8), MW10 (KP19.4), BH207 (KP32.4), BH209 (KP32.6) and BH34 (KP35.4), and at Crib Point (assessed by Construction Sciences (2019), see Section 10.5.2).
	Runoff from ASS soil or stockpile flowing into receiving waters	<p>Terrestrial ecosystem if water is discharged to land, and aquatic ecosystem if water is discharged to surface waters</p> <p>Human health via direct or secondary contact</p>	

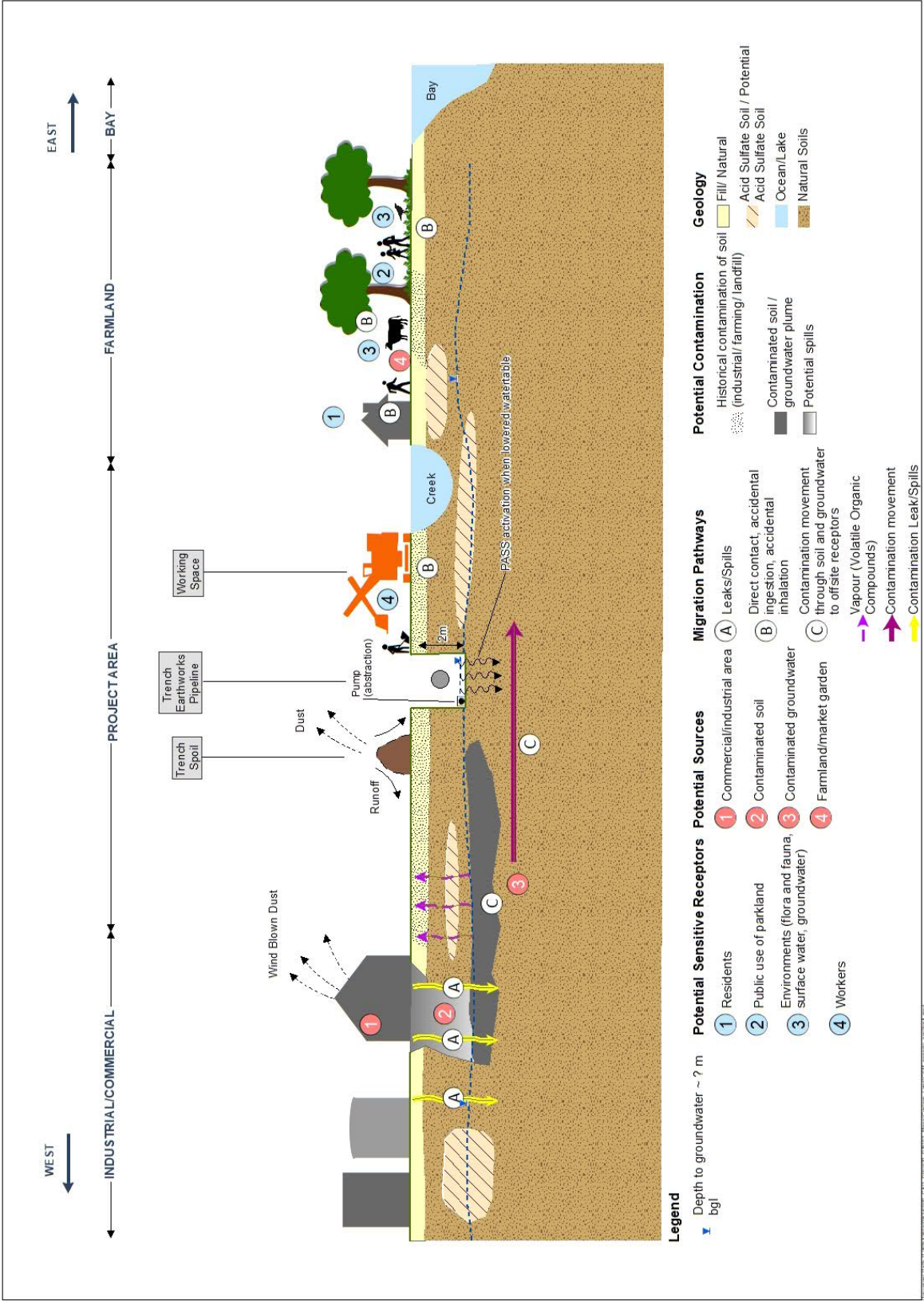


Figure 16 Conceptual site model – open trench



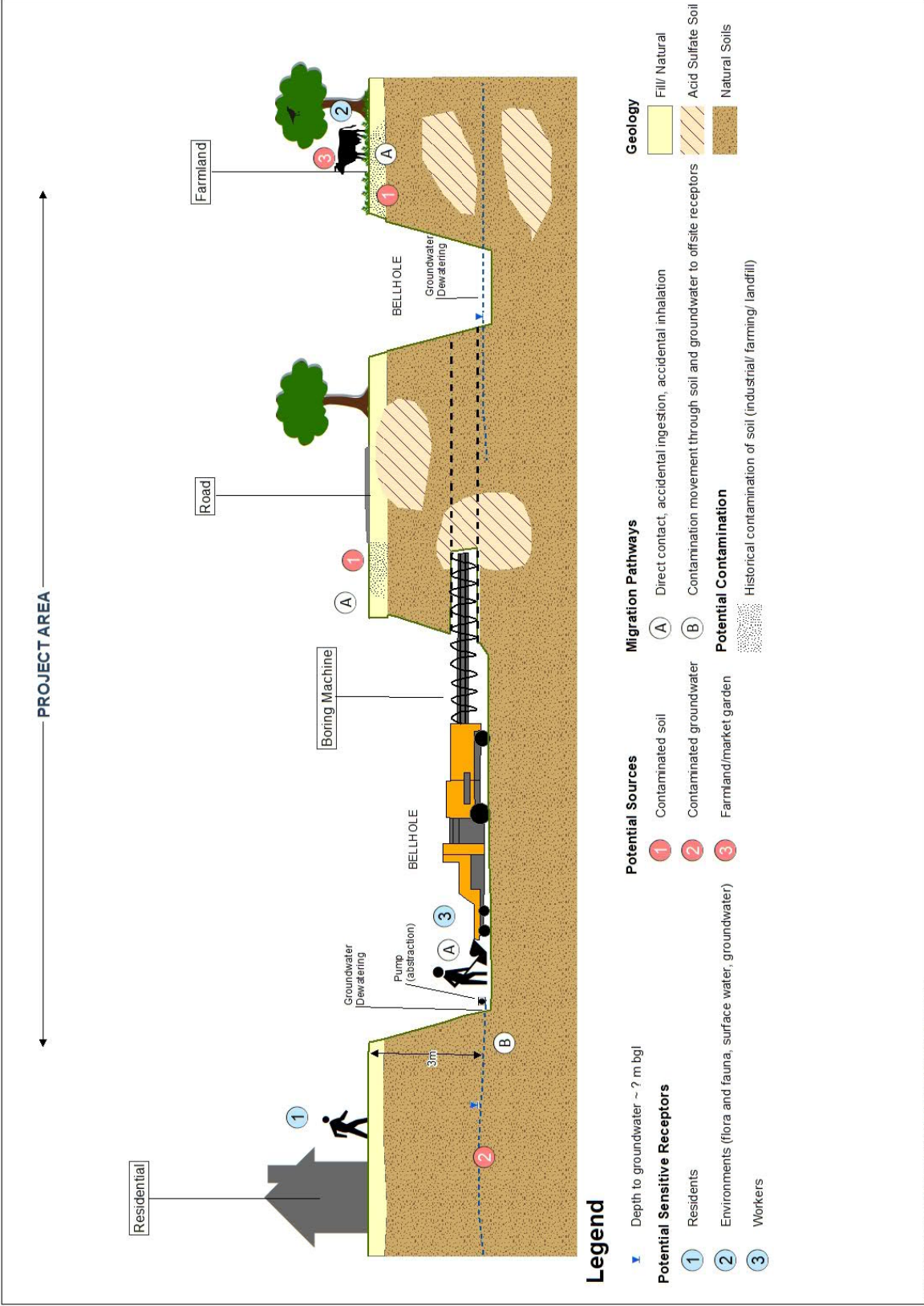


Figure 17 Conceptual site model – thrust bore





## 6.0 Risk assessment

An assessment of contamination and ASS risks posed by the Project was undertaken in accordance with the method described in Section 4.2. The initial and residual contamination and ASS risks associated with the Project are summarised in Table 6-1.

The initial risk ratings presented below consider an initial set of mitigation measures (where relevant), which are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of similar type, scale and complexity. Risk ratings were applied to each of the identified risk pathways assuming that these mitigation measures were in place. The proposed mitigation measures were reviewed in consultation with AGL and APA and other members of the team (designers, contractors and other specialists) to ensure the recommended mitigation measures would be achievable and compatible with those proposed by other specialists.

All the initial risk ratings relating to contamination and ASS were determined to be very low or low with initial mitigation measures in place. Therefore, additional mitigation measures were not required to lower the residual risk rating.

As discussed in Section 5.3.1, the marine sediment investigation concluded that no contamination exceeding the adopted guideline values has been identified at Berth 2 and the relevant beneficial use of water dependent ecosystems and species at Berth 2 is protected. Therefore, impacts from contaminated marine sediment is not addressed further, and no mitigation measures are proposed.

Table 6-1 Contamination and ASS risks

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk			
Construction										C	L	Risk
C1	Gas Import Jetty Works and Pipeline Works	Contaminated soil	Disturbance, handling, storage or disposal of contaminated soils that affects human health via direct contact; surface water quality due to contaminated runoff; and groundwater quality due to leaching of contaminants from soils.	<u>MM-C01 Contaminated soils</u> Environmental Management Plan with reference to the SEPP (PMCL), <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and EPA Victoria Publication <i>IWRG621 - Soil Hazard Categorisation and Management</i> , EPA Victoria interim Position Statement on PFAS.  Minimise the duration of stockpiling	Moderate	Unlikely	Low	No additional mitigation measures identified	Moderate	Unlikely	Low	

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
					C	L	Risk		C	L	Risk
C2	Gas Import Jetty Works and Pipeline Works	Acid Sulfate Soils	Disturbance, handling, storage, treatment or disposal of acid sulfate soils that results in generation of acidic waters that affects human health via direct or secondary contact, surface water and/or groundwater quality.	MM-C02, MM-C03 Acid Sulfate Soil Management Protocol for the Pipeline Works and Acid Sulphate Soils Management Plan (ASSMP) for the Gas Import Jetty Works with reference to the <i>Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999</i> and <i>EPA Victoria - Publication IWRG655.1 Acid Sulfate Soil and Rock, and the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (2010)</i> .  Minimise the duration of stockpiling of untreated ASS.  Watercourse trenching and discharge of trench water and as per EES Technical Report C: <i>Surface water impact assessment</i> .	Moderate	Unlikely	Low	No additional mitigation measures identified	Moderate	Unlikely	Low

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
					C	L	Risk		C	L	Risk
C3	Pipeline Works	PASS activation	Generation of acid leachate through oxidation of previously submerged soils (dewatering from trenches and bell holes) leads to generation of acidic waters that affects human health via direct and secondary contact, surface water and/or groundwater quality.	MM-C02 Pipeline Works Construction Environmental Management Plan with reference to <i>Industrial Waste Management Policy (Waste Acid Sulfate Soils)</i> 1999 and EPA Victoria - Publication <i>IWRG655.1 Acid Sulfate Soil and Rock</i> .  Minimise duration and extent of dewatering activities - dewater immediately prior to installation of pipe.  Minimise the time that trench sections and bell holes are open as per EES Technical Report D: <i>Groundwater impact assessment</i> .	Minor	Rare	Very low	No additional mitigation measures identified	Minor	Rare	Very low
C4	Pipeline Works	Contaminated groundwater	Contaminated groundwater encountered during pipeline construction that affects human health via direct and secondary contact and the environment, due to inappropriate handling, storage and disposal.	MM-C04 Pipeline Works Construction Environmental Management Plan with reference to the SEPP (Waters), <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and PFAS NEMP (2018).  Treat contaminated groundwater onsite, disposed offsite to an EPA Victoria licensed facility or adopt construction approach where contaminated groundwater may be left in-situ.	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
					C	L	Risk		C	L	Risk
C5	Pipeline Works	Dewatering of non-contaminated, acidic and/or brackish trench water	Dewatering activities affects soil, surface water and/or groundwater quality.	MM-C04 Pipeline Works Construction Environmental Management Plan with reference to SEPP (Waters) and <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> . Trench water that does not meet the relevant discharge criteria must be treated or disposed to an EPA Victoria licensed facility. Non-contaminated water should be discharged in accordance with mitigation measures in EES Technical Report: <i>Surface water impact assessment</i> .	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low
C6	Pipeline Works	Contaminant migration	Dewatering (during trenching and thrust-boring works) results in intersection of contaminated groundwater and/or mobilisation of contaminant plumes from outside the Project Area impacting on beneficial uses.	MM-C04 Pipeline Works Construction Environmental Management Plan with reference to SEPP (Waters) and <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and PFAS NEMP (2018). Treat contaminated groundwater prior to discharge, dispose to an EPA Victoria licensed facility or adopt construction approach where contaminated groundwater may be left in-situ.	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Residual risk		
					C	L	Risk	C	L	Risk
C7	Pipeline Works	Drilling Mud	Inappropriate management, handling and disposal of drilling mud that affects human health and the environment.	<p>MM-C05 Pipeline Works Construction Environmental Management Plan with reference to <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and <i>EPA Victoria Industrial Waste – Classification for Drilling Mud</i>.</p> <p>Prevent discharge from trenchless drilling sites as per EES Technical Report C: <i>Surface water impact assessment</i>.</p> <p>Use biodegradable and non-toxic drilling mud, where geotechnical conditions allow as per EES Technical Report D: <i>Groundwater impact assessment</i>.</p> <p>Drilling conducted by HDD specialist contractor as per EES Technical Report D: <i>Groundwater impact assessment</i>.</p>	Minor	Unlikely	Low	Minor	Unlikely	Low



Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
					C	L	Risk		C	L	Risk
C8	Pipeline Works	Contaminated hydrostatic test water	Inappropriate handling, storage and disposal of contaminated water from hydrostatic test affects human health via direct and secondary contact, soil surface water and/or groundwater quality.	MM-C06 Pipeline Works Construction Environmental Management Plan with reference to SEPP (Waters). Oxygen scavengers and biocides added to hydrotesting water should be neutralised before discharged to land. Water quality criteria to be met for discharge to land as per EES Technical Report C: <i>Surface water impact assessment</i> .	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low
C9	Gas Import Jetty Works and Pipeline Works	Unknown contamination	Unknown contamination encountered and disturbed during construction results in an impact to human health and the environment.	MM-C07 Development and implementation of Environmental Management Plan(s). Cessation of ground disturbance at the unknown contamination location and within the immediate vicinity. Assessment of the discovered contamination and determination of appropriate remedial action.	Minor	Possible	Low	No additional mitigation measures identified	Minor	Possible	Low
C10	Gas Import Jetty Works and Pipeline Works	Dust from contaminated stockpile	Dust from contaminated soil/stockpile blown by wind affects human health via direct contact, soil and/or surface water quality.	Dust suppression (e.g. water sprays, stockpiles sprays) and covering vehicle loads as per EES Technical Report G: <i>Air quality impact assessment</i> . Odorous soils to be managed as per EES Technical Report G: <i>Air quality impact assessment</i> .	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
					C	L	Risk		C	L	Risk
C11	Gas Import Jetty Works and Pipeline Works	Spill (construction)	Leaks or spillages during construction from machinery/plant, fuel and chemical storage impact human health via direct and secondary contact, and the environment.	<u>MM-C08</u> Development and implementation of Environmental Management Plan(s). Development and implementation of fuel/chemicals management and maintenance procedures. Spills management and refuelling of vehicles and mobile machinery as per EES Technical Report C: <i>Surface water impact assessment</i> .	Minor	Possible	Low	No additional mitigation measures identified	Minor	Possible	Low
C12	Gas Import Jetty Works and Pipeline Works	Waste streams (construction)	Mismanagement of waste streams (solid inert, liquid, organic, packaging etc.) generated during Project construction affects human health, aesthetics and the environment.	<u>MM-C09</u> Development and implementation of Environmental Management Plan. Development and implementation of waste management procedures.	Negligible	Possible	Low	No additional mitigation measures identified	Negligible	Possible	Low
<b>Operation</b>											
C13	Gas Import Jetty Works and Pipeline Works	Spill (operation)	Leaks or spillages during operation from machinery/plant, fuel and chemical storage impact human health via direct and secondary contact, and the environment.	<u>MM-C08</u> Development and implementation of Operational Environmental Management Plans. Development and implementation of fuel/chemicals management and maintenance procedures. Spills management and refuelling of vehicles and mobile machinery as per EES Technical Report C: <i>Surface water impact assessment</i> .	Moderate	Unlikely	Low	No additional mitigation measures identified	Moderate	Unlikely	Low

Risk ID	Works area	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Residual risk		
					C	L	Risk	C	L	Risk
C14	Gas Import Jetty Works and Pipeline Works	Waste streams (operation)	Mismanagement of waste streams (solid inert, liquid, organic, packaging etc.) generated during Project operation affects human health, aesthetics and the environment.	MM-C10 Development and implementation of Operational Environmental Management Plans. Development and implementation of waste management procedures.	Negligible	Possible	Low	Negligible	Possible	Low
					No additional mitigation measures identified					

## 7.0 Impact assessment

This section of the report provides detail on the potential contamination and ASS impacts that were identified in the risk assessment outlined in Section 6.0. The potential impacts draw on the 'existing conditions' data presented in Section 5.0. Impacts associated with groundwater are also discussed in EES Technical Report D: *Groundwater impact assessment*.

### 7.1 Project construction

The construction of the Gas Import Jetty Works and the Pipeline Work both have the potential to cause the following impacts:

- Disturbance, handling, storage or disposal of contaminated soils and/or ASS that affects human health and the environment.
- Generation of acid leachate through oxidation of previously submerged soils, that affects soil, vegetation, surface water and/or groundwater quality.
- Unknown contamination encountered and disturbed during construction results in impact to human health, and/or the environment.
- Leaks or spillages during construction from machinery/plant, fuel and chemical storage that affects human health and/or the environment.
- Mismanagement of other waste streams (solid inert, liquid, organic, packaging and food scraps) that affects human health, aesthetics and the environment.
- Generation of dust from contaminated soil or stockpile blown by wind affects human health and the environment.

The following are potential impacts associated with the construction of the Pipeline Works only:

- Disturbance, handling, storage and disposal of contaminated groundwater that affects human health and/or the environment.
- Discharge or dewatering of non-contaminated, acidic and/or brackish trench water that affects soil, surface water and/or groundwater quality.
- Mobilisation of unknown contaminant plumes from outside the Project Area that affects beneficial uses.
- Inappropriate handling, storage and disposal of drilling mud affects human health and/or the environment.
- Inappropriate handling, storage and disposal of contaminated water from hydrostatic test that affects human health and/or the environment.

The following sections describe these potential impacts in further detail, grouped according to the identified risk source (see Section 5.4):

- Impacts from disturbance of contaminated soils (Risk IDs C1 and C10)
- Impacts from disturbance of ASS (Risk IDs C2 and C3)
- Impacts from acidic, brackish and/or contaminated groundwater (Risk IDs C4, C5 and C6)
- Impacts from drilling mud (Risk ID C7)
- Impacts from contaminated hydrostatic test water (Risk ID C8)
- Impacts from unknown contamination, spills and waste streams (Risk IDs C9, C11 and C12).

### 7.1.1 Impacts from disturbance of contaminated soils (Risk IDs C1 and C10)

#### Contaminated soils (Risk ID C1)

Due to existing and historical land uses within the Project Area, it is expected that a minor quantity of contaminated soil would be encountered during the construction of the Project. The field investigation has identified that contaminated soils are likely to be very limited in extent. The majority of contaminated soils are expected to be encountered near or at the Crib Point Receiving Facility, adjacent to the former BP refinery (The Esplanade) and the rail corridor in Hastings, via excavation and/or trenching.

Potential pathways include direct contact with contaminated soil and contaminants entering waterways, via surface water runoff from contaminated stockpile materials, and leaching of contaminants from soils to groundwater.

The disturbance of contaminated soils during construction of the Project is considered to have low risk of impacts to human health and the environment, including the Western Port Ramsar Site, due to identified contamination being limited in extent, of low concentration and non-leachable. Erosion and sediment control measures would be implemented during construction, to prevent sediments from the construction area entering the Western Port Ramsar Site. Public access to the construction sites would also be restricted.

It is noted that due to dense vegetation restricting access to Project Area between KP7.3 and KP7.9, the Pipeline Works must undertake intrusive soil and groundwater investigation, prior to pipeline construction, to confirm presence or absence of contaminated soils and groundwater within the area, resulting from historical and existing land uses.

The Project would manage contaminated soils in accordance with the EPA Victoria waste management hierarchy as defined in the *Environment Protection Act 1970*, which prioritises management of waste in the following order of preference:

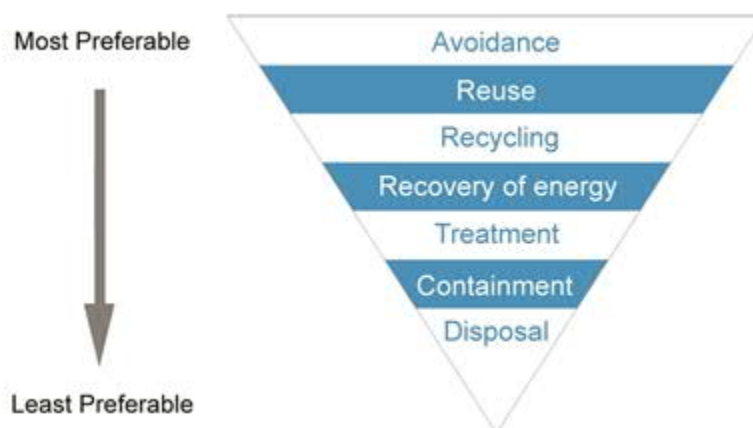


Figure 19 EPA Victoria waste management hierarchy

The Project aims to reuse excavated soil to backfill the trench, which would be managed in accordance with the SEPP (PCML). Depending on construction methodology and based on samples collected, contaminated soils encountered within the Crib Point Receiving Facility and The Esplanade may be reused onsite. However, it is noted that, geotechnical investigation undertaken to date at the Crib Point Receiving Facility indicated that the spoil would be geotechnically unsuitable for reuse at the site, and would therefore potentially be disposed of off-site. The Project would minimise the duration of stockpiling spoil onsite prior to disposal.

Where contaminated soils (including HDD screened cuttings) are to be disposed off-site, soil sampling and categorisation in accordance with EPA Victoria Publication IWRG702 and IWRG621 would be undertaken. Handling and transport of contaminated soils for off-site treatment/disposal would be in accordance with *Environment Protection (Industrial Waste Resource) Regulations 2009*.

Soil samples collected from the proposed Crib Point Receiving Facility, the former BP refinery and adjacent to the former BP refinery (The Esplanade), reported detectable concentrations of PFAS,

although the concentrations are below the PFAS NEMP (2018) human health and ecological guideline values for all land uses. Based on the Project description, no mitigation measures are required to address on-site soil reuse. If soils are to be disposed offsite, disposal must be completed in accordance with the *Environment Protection (Industrial Waste Resource) Regulations 2009* and EPA Victoria Publication IWRG621; and approval from EPA Victoria for offsite disposal, through request for classification.

Any material imported onto the Project Area for use as backfill will comply with the EPA Victoria Publication IWRG621 for 'Fill Material', and will be accompanied by relevant documentation confirming its compliance to the 'Fill Material' criteria.

To ensure compliance with applicable regulatory requirements and guidelines, an EMP would be developed for the Gas Import Jetty Works and a CEMP for the Pipeline Works. These management plans would include the mitigation measures described above and in Section 8.0, to minimise risk of contaminated soils impacting on human health and the environment.

### **Dust from contaminated stockpile (Risk ID C10)**

Inappropriate management of contaminated soil/stockpiles has the potential to cause dust from the stockpile to be blown by wind affecting human health and the environment. Wind-borne dust from contaminated stockpiles may contain contaminants such as PFAS, heavy metals and PAHs (particle phase) attached to the dust particles. These contaminants can be absorbed through the lining of the alveoli into the blood stream, when very fine particles are inhaled deep into the lungs. For larger particles, exposure may result through ingestion. Further deposition of contaminated dust may also result in contamination of surface water (DEC, 2011).

The risk to human health and the environment is considered to be low as soil contamination has been shown to be very limited in extent and is located away from sensitive receptors (e.g. residential land use). Management of dust is a general environmental duty required by EPA Victoria and must form part of the Gas Import Jetty Works EMP and Pipeline Works CEMP. These management plans would include mitigation measures specified in the EES Technical Report G: *Air quality impact assessment*, reproduced in Section 8.0, such as utilising dust suppression techniques and ensuring construction vehicles transporting material with the potential for loss of loads (such as dust or litter) would be covered when using public roads.

### **7.1.2 Impacts from disturbance of acid sulfate soils (Risk IDs C2 and C3)**

The presence of actual or potential acid sulfate conditions, does not relate to contamination, rather the underlying geology. When exposed to air (either by excavation or lowering of groundwater table), ASS can produce sulfuric acid, which can liberate substances such as nutrients and metals, which can affect:

- Human health – physical contact with groundwater and surface water containing toxic concentrations of acid and metal contaminants can cause skin irritation and dermatitis.
- The environment – the release of acid and metal contaminants into the environment can have significant adverse effects on the ecology of wetlands and shallow freshwater and brackish aquifer systems by degrading water quality, habitat and dependent ecosystems.
- Engineered structures – the leachate can corrode concrete and steel infrastructure, such as culverts, pipes and bridges, reducing their functional lifespan (Queensland Government, 2002).

The primary concern with ASS is the possibility of acidic water impacting soil quality and vegetation, entering waterways (via surface water runoff from ASS stockpile materials) and leaching to groundwater.

### **Acid sulfate soils (Risk ID C2)**

The ASS investigation undertaken as part of this Project has identified the presence of ASS throughout the study area. Therefore, any soil disturbance activities such as excavation, trenching, HDD and thrust boring would have the potential to encounter ASS (potentially resulting in a decrease in pH of soil, leachate and groundwater and potentially mobilisation of metals - either naturally present or as a result of historic land use). Low pH or metals mobilised may directly impact upon human health



(via direct contact, ingestion, or recreation) or the environment (via direct contact or leaching to receiving water bodies).

The distribution of AASS and PASS throughout the study area would suggest that all soils will be managed as ASS in accordance with CASS BPMG (2010).

The Pipeline Works crosses 64 watercourses and surface drains. The waterways characteristics and the proposed construction methodology for each of the waterways are described in EES Technical Report C: *Surface water impact assessment*. The assessment indicated that the waterways are ephemeral with the exception of Watson Creek and Cardinia Creek. The ASS investigations identified the presence of ASS adjacent to the 44 watercourse crossings with trenchless construction method proposed for 17 of the watercourse crossings and open trench method for the remaining 27 watercourses.

The open trench sections for the Pipeline Works and the Gas Import Jetty Works would disturb approximately 91,500 m<sup>3</sup> and 2,500 m<sup>3</sup> of soil (in-situ), respectively. Based on the volume of soil disturbance, both set of Works are classified as a 'High Hazard' under the CASS BPMG (2010) and may only proceed with an approved environmental management plan.

The following are ASS management strategies numbered in order of priority, as prescribed by the CASS BPMG (2010). Strategies 2 to 5 would be adopted as part of the ASSMP(s), as avoiding disturbance of ASS is not possible based on the current Project description (actual mitigation measures would vary depend upon contractor approach):

1. Avoid disturbance.
2. Minimise disturbance – Excavate the smallest quantity of soil possible, avoid dewatering where possible or reduce extent and timeframe of dewatering, creation of small stockpiles etc.
3. Prevent oxidation – Stage Project activities to reduce stockpile duration, consider covering stockpiles with high density polyethylene (HDPE) if extended exposure required.
4. Treat to reduce or neutralise acidity – Treat stockpiles with lime or use guard layers in conjunction with prevention techniques. Treatment may not be required depending on minimisation and prevention approaches adopted.
5. Offsite reuse or disposal - Dispose offsite at an EPA Victoria approved facility.

The preferred management option for the pipeline construction is to prevent oxidation of ASS and minimise exposure upon excavation. Due to limited space within the ROW, treatment of a large volume of material on a constructed treatment or liming pad is not feasible. Management strategies that may prevent or limit oxidation of sulfides and generation of potential acidity are described in the CASS BPMG (2010). The pipeline construction would adopt staging of soil excavations such that ASS are exposed to oxygen and surface waters for the minimum amount of time possible. The recommended time period over which soils may be temporarily stockpiled before treatment commences, as recommended by the CASS BPMG (2010), is presented in Table 7-1.

**Table 7-1 Suggested short-term stockpiling durations based on soil texture (after Dear et al., 2002)**

Type of material (McDonald et al., 1990)	Approx. clay content %	Duration of stockpile
Coarse (sands to loamy sands)	≤ 5	Overnight (18 hours)
Medium (sandy loams to light clays)	5–40	2.5 days (70 hours)
Fine (medium to heavy clays and silty clays)	≥ 40	5 days (140 hours)

The Project construction schedule/strategy must incorporate constraints on stockpile exposure or indicate where alternative management approaches (such as liming, stockpile covering, etc) would be required. The strategy should identify the location, timing and volume of soil to be excavated. The schedule/strategy should be flexible to manage potential risks associated with wet weather and plans for other contingencies.

It is noted that soils or soil layers with existing acidity (AASS indicated by field pHF < 4.5) can be difficult to manage once disturbed and some treatment may be required if the proposed short-term excavation approach cannot be achieved. Usually, addition of neutralising agent would be required for long-term stockpiles (greater than 2-5 days). Where in-situ mixing is carried out, detailed material location records must be kept using maps and GPS coordinates to enable appropriate verification of liming.

As described in Section 1.2.6, the construction of the Pakenham Delivery Facility and EOLSS would potentially require stockpile of excavated materials for an extended period of time. These stockpiles would require treatment to reduce or neutralise acidity, and management to reduce infiltration of surface water and leachate discharge. Treatment of disturbed ASS with alkaline materials such as lime is commonly used to manage acidity. Sufficient neutralising agent(s) is mixed into the soil to neutralise existing acidity and to neutralise acidity as it is generated. The amount of neutralising agent(s) required is calculated based on the analytical results of existing acidity and potential acidity. Careful calculation of the amount of neutralising agent(s) is needed to ensure that all existing acidity that is present and all potential acidity that may be generated from complete oxidation of the sulfides can be treated (CASS BPMG, 2010).

It is noted that spoil generated from the construction of the Crib Point Receiving facility would potentially be disposed off-site as geotechnical investigation undertaken to date indicated that the spoil would be geotechnically unsuitable for reuse at the site. The Project would minimise duration of stockpiling spoil onsite prior to disposal.

The construction methodology has been designed to minimise the potential for generation of acidic leachate and therefore the quantity of leachate is expected to be low. Any leachate that is captured within the trench will only be discharged in accordance with mitigation measure MM-SW01 (refer to the EES Technical Report C: *Surface water impact assessment*) to prevent loss to watercourses.

Acid leachate generation during the construction of waterways crossing using the open trenching method is considered unlikely due to the ephemeral nature of the waterways; and the likelihood is further reduced with the construction to be undertaken during no flow conditions only as prescribed in mitigation measures MM-SW03 and MM-SW04 (refer to the EES Technical Report C: *Surface water impact assessment*).

When employed, the procedures outlined above are considered sufficient to restrict the oxidation of ASS and / or its migration into surface water and groundwaters in the vicinity of the Project Area. As such, the pathway between the source (natural ASS) and receptors, including human health and the environment (in particular the Western Port Ramsar site) will not be realised. Therefore, the disturbance of ASS during construction of the Project is considered to have low risk of impact to human health and the environment including the Western Port Ramsar Site, as the impacts would be confined within the Project Area and would be managed in accordance with the Industrial Waste Management Policy (Waste Acid Sulfate Soils), EPA Victoria Publication IWRG655.1, and the CASS BPMG (2010).

The risk would be further reduced through implementation of mitigation measures outlined in Section 8.0.

If ASS cannot be managed on-site it would be disposed offsite to premises that are either:

- licenced to accept waste acid sulfate soils in accordance with the *Environment Protection Act 1970*, or
- has an Environment Management Plan (EMP) approved by EPA Victoria (EPA Victoria Publication IWRG655.1).

### **Potential ASS activation (Risk ID C3)**

The potential for dewatering to result in activation of PASS may occur where PASS is present in shallow soil and dewatering is necessary to install the pipe.

PASS was identified at five locations at depths ranging between 0.05 mbgl and 3.0 mbgl at MW09 (KP17.8), MW10 (KP19.4), BH207 (KP32.4), BH209 (KP32.6) and BH34 (KP35.4). However, dewatering is only required at locations MW09 and MW10, based on groundwater gauging data

measured in January 2019. The groundwater table was detected at 1.62 mbgl and 1.99 mbgl in MW09 and MW10, respectively, shallower than the depth for trenching and HDD entry/exit pits.

The water table drawdown was estimated within the EES Technical Report D: *Groundwater impact assessment* for the following scenarios:

- open trench intersecting two metres of groundwater
- thrust bore bell hole intersecting 2.5 metres of groundwater.

A summary of the estimates of drawdown on the water table are reproduced in Table 7-2 .

**Table 7-2 Summary of water table drawdown estimate, reproduced from EES Technical Report D: *Groundwater impact assessment***

Scenario	Maximum Drawdown (m)	
	10 m distance from excavation	25 m distance from excavation
Open trench intersecting two metres of groundwater	0.79	0.09
Thrust bore bell hole intersecting 2.5 metres of groundwater	0.76	0.11

Based on the drawdown estimates, the potential for oxidation of PASS surrounding MW09 and MW10 is expected to be confined within the pipeline ROW (typically within a 30-metre-wide) and have very limited effect upon the surrounding area.

PASS detected between KP32.4 and KP32.6 was identified in shallow soils only, by a combination of SPOCAS and CRS analytical techniques. Soils excavated at the southern boundary of CPT084 should be managed as PASS, and avoid activities that result in large scale or long-term fluctuation in groundwater levels. The majority of soils in the vicinity of CPT091 have been identified as exceeding the action criteria and as such should be managed as ASS, in accordance with measures outlined in Risk ID C2.

PASS activation during construction of the pipeline is considered to have very low risk of impacts to human health and the environment including the Western Port Ramsar Site, due to the limited extent of PASS that could interact with Project activities, and the short construction timeframe during which this interaction could occur.

Further investigation should be undertaken to refine the management area surrounding MW09 and MW10 as sample density does not comply with the recommendation made in Table 1 of the EPA Victoria Publication IWRG655.1 (sampling at a density of one soil bore per 100 metres for a pipeline), or the Pipeline Works should conservatively assume that PASS management strategy applies for areas between KP17.4 and KP20.0.

### **7.1.3 Impacts from acidic, brackish and/or contaminated groundwater (Risk IDs C4, C5 and C6)**

#### **Contaminated groundwater (Risk ID C4)**

Groundwater from beneath the study area has been shown to exceed the adopted investigation levels; although the majority of the exceedances including TDS, ions (such as calcium and sulfate as SO<sub>4</sub>) and metals are attributed to background concentrations, with the exception of the area adjacent to a metal recycling yard in Hastings (KP7.3 – KP7.5) and south of the former Tyabb landfill (KP13.3 – KP13.7), where further investigation is required to confirm whether nickel is naturally elevated. PFAS has also been detected in groundwater east of the former Tyabb landfill (KP14.0 – KP14.3).

Based on the HDD construction method proposed for the area south of the Tyabb landfill, and nickel concentrations detected below the adopted criteria at the other two groundwater monitoring wells (0.002 mg/L at MW07 and 0.003 mg/L at GW05), it is considered unlikely that management of groundwater would be required at this location, and therefore it is unlikely to present a risk to ecology at the site and to off-site receptors. However, contaminated groundwater is likely to be encountered during construction of the Pipeline Works adjacent to a metal recycling yard in Hastings and east of

the former Tyabb landfill as the existing groundwater table (measured in January 2019) is shallower than the proposed depth for trenching.

As noted in Section 5.1.2, due to dense vegetation restricting access to the study area between KP7.3 and KP7.9, the Project must undertake intrusive soil and groundwater investigation, prior to pipeline construction, to confirm presence or absence of contaminated soils and groundwater within the area, resulting from historical and existing land uses.

Based on the limited extent of groundwater impact and low concentrations of potential contaminants, management of contaminated groundwater during construction of the Project is generally considered to have a low risk of impact to water dependant ecosystems. However, groundwater adjacent to the former Tyabb landfill, between KP14.0 and KP14.3, must not be discharged to surface or stormwater or otherwise permitted to enter aquatic ecosystems. Management options for PFAS impacted groundwater near the former Tyabb landfill include:

- Dewatering and treatment of PFAS impacted groundwater off-site at a licenced facility. The volume of dewatered water can be minimised by dewatering immediately prior to pipe installation.
- Adopting an approach where pipe can be laid down without dewatering the trench, while preventing discharge of PFAS impacted groundwater to surface soils.

Additional mitigation measures are outlined in Section 8.0, and if groundwater contamination is encountered in between KP7.3 and KP7.9 during required sampling works (prior to construction) further management measures may be required.

When employed, the procedures outlined above are considered sufficient to restrict the movement of contaminated groundwater into surface water in the vicinity of the Project Area. As such, the pathway between the source (discrete plumes of groundwater contamination) and receptors, including human health and the environment (in particular the Western Port Ramsar site) will not be realised.

#### **Dewatering of non-contaminated, acidic and/or brackish water (Risk ID C5)**

Groundwater from beneath the study area has been shown to exceed the adopted investigation levels (TDS, copper, iron, nickel, zinc, PFAS, ammonia, total phosphorous, calcium, sulfate as SO<sub>4</sub> and pH), although the majority of the exceedances are attributed to background concentrations, with the exception of area adjacent to the former Tyabb landfill (PFAS and nickel) and adjacent to a metal recycling yard in Hastings (potentially nickel) (see Risk ID C4).

Groundwater salinity was measured in 15 monitoring wells along the pipeline alignment and TDS concentrations were calculated to be between 884 mg/L (MW07) and 18,700 (MW11), with an average of 6,217 mg/L, which classify groundwater as brackish. Although the TDS is naturally elevated and is not related to contamination, it may preclude the use of the groundwater for beneficial uses including agriculture and irrigation (stock watering), agriculture and irrigation (irrigation), industrial and commercial and water-based recreation, therefore would restrict discharge to land and potentially receiving waters.

The pH of groundwater sampled from along the pipeline alignment ranged between 5.96 and 7.34 and did not exceed adopted investigation levels. However, due to presence of ASS across the study area, potential for Pipeline Works to encounter acidic groundwater during construction exists (see Risk IDs C2 and C3).

Inappropriate management and disposal of non-contaminated but acidic and/or brackish groundwater/trench water has the potential to impact soil and/or surface water. Release of acidic and/or brackish water into the environment can result in changes to soil and surface water chemistry, which could preclude protected beneficial uses.

To ensure that pipeline construction meets applicable standards, the trench may need to be dewatered to remove any water which has collected during the time it has been open. The Pipeline Works would discharge dewatered water from the open trenches and bell holes to adjacent land (with permission/approval from relevant landholder (where appropriate)). Based on the quality of groundwater in samples collected (the source/s, which are largely uncontaminated) and the proposed water discharge areas (which must be distant from surface water bodies or other pathways, as specified in mitigation measure MM-SW01 described in EES Technical Report C: *Surface water impact assessment*) dewatering or discharge of non-contaminated acid and/or brackish

groundwater/trench water to land during construction of the pipeline is generally considered to have a low risk of impact to soils and receiving waters (receptors).

Dewatering activities would be managed in accordance with SEPP (Waters) and the Pipeline Works CEMP. The Pipeline Works CEMP would include mitigation measures specified in Section 8.0, such as treatment of water to meet relevant discharge criteria prior to discharge (with permission/approval from relevant landholder (where appropriate), and disposal of water that cannot be treated to meet the relevant discharge criteria to an EPA Victoria licensed disposal facility.

### **Contaminant migration (Risk ID C6)**

Dewatering (during trenching and thrust-boring works) has the potential to mobilise groundwater contaminant plumes from outside the Project Area that affects beneficial uses.

EES Technical Report D: *Groundwater impact assessment* concluded that drawdown of the water table would only extend up to 30 metres from the pipeline alignment, even under the 'worst case'<sup>3</sup> scenario. Therefore, increased contamination migration, as a result of the Pipeline Works, is considered to have low risk of impact to beneficial users and does not require further assessment. The risk of abstracting contaminated groundwater from the immediate vicinity of the Pipeline Works is addressed in Risk ID C4.

#### **7.1.4 Impacts from drilling mud (Risk ID C7)**

Drilling muds (source), consisting predominantly of natural bentonite clay, are used in HDD pipe installation to act as a coolant, to wash in-situ material (cuttings) from the drilled hole and to seal and line the hole to facilitate insertion of the pipe. Cuttings are screened, removed at the HDD rig and the drilling mud is recycled.

Drilling muds are classified by the Victorian EPA as a non-prescribed industrial waste, so long as drilling did not encounter contaminated soils and does not contain synthetic additives.

The primary potential pathway with HDD is the migration of drilling muds away from the HDD drill path. While the path of least resistance is typically the borehole itself, drilling muds can enter the groundwater table or 'frac-out' to surface via an existing fracture, fissure, or formation opening in the soil or rock substrate (pathways) results in impact to human health, terrestrial ecosystems, surface water quality and groundwater quality (receptors). Potential impacts can also occur through inappropriate disposal of drilling muds.

The uncontrolled loss of large quantities of drilling muds is considered unlikely, and any impacts would be managed and localised, when a suitably qualified and experienced HDD contractor is used. The potential effects could be further reduced if non-toxic and biodegradable drilling muds (potentially not including synthetic additives) are used where possible. The primary clay used for drilling mud is bentonite (sodium montmorillonite), a non-toxic, naturally occurring mineral clay, which is added to fresh water to produce a 'mud'. The risk associated with uncontrolled loss of drilling muds is discussed in EES Technical Report: D *Groundwater impact assessment* and has been assessed to be very low.

Inappropriate management, handling and disposal of drilling mud during Pipeline Works is considered to have a low risk of impact to human health and the environment as the impact from drilling muds would be mitigated by developing and implementing the HDD Management Plan, which would be prepared by the appointed HDD contractor and submitted to the Pipeline Regulator for endorsement. The HDD Management Plan would specify suitable drilling mud and additives, and include contingency procedures if a release was to occur, to minimise the impacts to the environment. The risk would be further reduced by implementing additional mitigation measures specified in Section 8.0 such as disposal of drilling muds in accordance with *Environment Protection (Industrial Waste Resource) Regulations 2009* and EPA Victoria *Industrial Waste – Classification for Drilling Mud*, Victoria Government Gazette G37.

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<sup>3</sup> Assuming the highest hydraulic conductivity value measured (0.3 metres per day), and two days of dewatering to the base of the trench (2 metres deep) or two days of dewatering to the base of thrust bore pits (3 metres deep). See (EES Technical Report D: *Groundwater impact assessment*) for further details.

It is considered that the risk to surface water bodies including the Western Port Ramsar site is very low, given the low toxicity of the primary constituent and the absence of a pathway (when satisfactorily managed).

#### **7.1.5 Impacts from contaminated hydrostatic test water (Risk ID C8)**

As described in Section 1.2.6, hydrostatic testing would require approximately 10 megalitres of water in total and reuse is assumed between adjacent test sections. Water for hydrostatic testing would be obtained from dams, groundwater bores, irrigation channels or watercourses near the pipeline alignment under agreements and/or licences/permits with relevant landholders and authorities.

Depending on the final configuration of hydrostatic test sections and the availability of water, biocides and oxygen scavengers (potential sources) may be added as required to hydrostatic test water to minimise the risk of corrosion and bacterial growth in the pipeline. The proposed biocide is Backtron AUK550 (active ingredients: sodium hydroxide and tetrakis(hydroxymethyl)phosphonium sulfate), which would be neutralised by Hydrosure DA-4070 (active ingredient: hydrogen peroxide).

Degradation can also occur with temperature and sunlight. The proposed oxygen scavengers is Nalco OS2 (active ingredient: Ammonium Bisulfite) which would be neutralised by aeration and exposure to sunlight.

Inappropriate handling, storage and disposal of contaminated water from hydrostatic test is considered to have low risk of impacts to human health and the environment as the hydrostatic test water would be neutralised and aerated in accordance with manufacturer guidelines to ensure that the post hydrostatic test water is free from any remaining active biocide and oxygen scavengers. Any discharge of water would be undertaken in accordance with permission/approval from relevant landholder (where appropriate). The risk would be further reduced by implementing additional mitigation measures specified in Section 8.0.

The potential for impact to receptors is considered to be low as pathways to receptors, including surface water bodies can be readily managed and the source itself will be neutralised before discharge.

#### **7.1.6 Impacts from unknown contamination, spills and waste streams (Risk IDs C9, C11 and C12)**

##### **Unknown contamination (Risk ID C9)**

Encountering unknown contamination (including asbestos) during Project construction is possible, although the risk of impacts to human health and the environment is considered to be low. The risk is mitigated by managing visible signs of potential contamination and/or odours in accordance with the Gas Import Jetty Works EMP and Pipeline Works CEMP.

In the event that unknown contamination is uncovered during Project construction, the following measures would be undertaken:

- Cessation of ground disturbance at the unknown contamination location and within the immediate vicinity.
- Assessment of the site contamination and determination of appropriate remedial action (if required).

While it is possible that unknown contamination will be encountered during excavation activities, large scale impacts are considered likely to have been identified as part of the Preliminary Site Assessment and Detailed Site Assessment completed. The potential impact to receptors, including surface water bodies, from unknown contamination is low, noting that mitigation measures, should reduce the likelihood that pathways are realised during the project construction.

##### **Spills (Risk ID C11)**

During the Project construction, fuel/chemicals would be stored, and vehicles, plant and machinery would be operating within the construction laydown area, additional work areas (as defined in the Project description) and throughout the Project Area.

There is a possibility that leaks or spills may occur during Project construction from machinery/plant, fuel and chemicals storage impacting human health and the environment. The risk, however, is



considered to be low with application of industry standard mitigation measures during Project construction. In addition to good practice such as minimal storage of chemicals at the work site, bunding of areas where storage is required and storing chemicals away from waterways, a potential spill would be localised and contained at the active work site rather than being widespread.

The Gas Import Jetty Works EMP and Pipeline Works CEMP would include measures specified in Section 8.0.

The potential for impacts to groundwater and surface water (including the West Port Ramsar site) associated with loss of sources including fuel, oils or other construction related chemicals is low on the basis that only small quantities of chemicals will be kept on site, all chemicals will be stored in secure bunded systems and loss of chemicals from equipment can be easily managed and maintained in a small lateral extent. As such, the pathway from sources to receptors is unlikely to be completed.

### **Waste streams (Risk ID C12)**

The Project would generate a range of wastes during construction. Wastes other than soil, groundwater and drilling muds would be generated by the Project including:

- wastes from transportation and storage of construction materials
- wastes from survey, clearing the Project Area
- pipeline coating waste
- welding/grinding waste (for example, spent welding rods)
- machinery waste
- other solid inert, liquid, organic, packaging and food scraps.

If these wastes are not appropriately managed, they could be released to the environment resulting in impacts to human health, aesthetics and the environment.

Inappropriate management and disposal of waste streams are considered to have low risk of impacts to human health, the environment and aesthetics. The impacts are mitigated by suitable storage, reusing and recycling construction wastes where practicable, or disposal at appropriately licenced facilities; and incorporating additional mitigation measures specified in Section 8.0 in the Gas Import Jetty Works EMP and Pipeline Works CEMP such as managing prescribed waste in accordance with *Environment Protection (Industrial Waste Resource) Regulations 2009* and identification of suitable waste disposal locations prior to construction commencing in consultation with local waste sub-contractors and local government(s). As such, the pathway from sources to receptors is unlikely to be completed.

## **7.2 Project operation**

On-going operation of the Gas Import Jetty Works and Pipeline Works has the potential to cause the following impacts:

- Leaks or spillages from machinery/plant/pipeline, fuel and chemicals storage that affects human health and the environment (Risk ID C13).
- Mismanagement of waste streams (solid inert, liquid, organic, packaging etc.) affects human health, aesthetics and the environment (Risk ID C14).

### **7.2.1 Spills (Risk ID C13)**

Planned maintenance activities for the Gas Import Jetty Works include:

- lubrication of the marine loading arm (MLA) joints and seals
- checking valve operation
- pipeline paint inspections
- firefighting system testing
- fire pump testing and operation

- receipt and addition of odorant and nitrogen
- equipment inspection and maintenance at the Crib Point Receiving Facility.

No PFAS containing firefighting foam would be stored and used for the Project. The firefighting system to be installed at for the Gas Import Jetty Works is described in EES Chapter 4 *Project Description*. Regular testing would be undertaken in accordance with relevant standards and Safety Management Systems requirements.

Planned maintenance activities for the Pipeline Works include:

- Equipment maintenance at the Pakenham Delivery Facility.
- Corridor inspections to address issues such as land stability (e.g. subsidence, erosion), revegetation, weed invasion, cover at watercourse crossings and third-party (such as asset owners) and landowner activities.
- Pigging activities, including minor excavation to access the EOLSS, to be undertaken 10 years post-construction, then at a frequency determined by the result of each inspection, most likely greater than 10 years.

There is a possibility that leaks or spills may occur from machinery/plant/pipeline, fuel and chemicals storage or usage, and maintenance activities impacting human health and the environment. In particular, a member of the community raised concern over the effect of an odorant spill/leak on soil and water. The Project proposes to use Spotleak 1005 with tetrahydrothiophene (also known as thiophane or THT) and 2-methyl-2-propanethiol (also known as tert-Butyl mercaptan or TBM) as the main chemical ingredients. Both of these chemicals are volatile and do not persist for long periods in the environment or accumulate in living organisms.

THT is not soluble in water and if released to the environment in a spill, it will remain as a separate phase with little tendency to sorb to soil. It is a volatile organic compound which would be expected to be present as a gas in association with a spill of the liquid. In the atmosphere it would be expected to rapidly break down due to oxidation by hydroxyl radicals in the atmosphere. It may be degraded biologically in the environment and due to its low boiling point and low octanol water partition coefficient it is not expected to bioconcentrate in living organisms.

TBM is a VOC which if released to the environment will exist mainly as a gas. In the ambient atmosphere, TBM will be rapidly degraded by reaction with hydroxyl radicals. If released to soil, TBM is expected to volatilise and unlikely to sorb to soil. If released into water, it is only slightly soluble in water and is expected to volatilise and not to sorb to sediment. The potential for bioconcentration in aquatic organisms is low.

The potential for impacts to groundwater and surface water (including the West Port Ramsar site) associated with loss of sources including fuel, oils or other maintenance related chemicals is considered to be low with the application of industry standard and mitigation measures during operation, and on the basis that only small quantities of chemicals would generally be kept on site, all chemicals would be stored in secure bunded systems and loss of chemicals from equipment can be easily managed and maintained in a small lateral extent. As such, the pathway from sources to receptors is unlikely to be completed. The Project operations would also be undertaken in accordance with regulatory requirements and guidelines and Operational Environmental Management Plans (OEMPs) that would include mitigation measures specified in Section 8.0.

Potential spills associated with the FSRU moored at Crib Point is addressed in the EES Technical Report A: *Marine biodiversity impact assessment*.

#### 7.2.2 Waste streams (Risk ID C14)

On-going operation of the Project is not likely to generate large amount of wastes associated with the ongoing operation and maintenance activities except discharges from the FSRU which would include:

- Approximately 300 – 400 m<sup>3</sup> of grey water per month that would be stored in holding tank prior to off-site disposal by a licenced contractor.

- Approximately 30 m<sup>3</sup> per month of black water/sewage generated from FSRU operation that is treated in the sewage treatment plant in accordance with relevant commonwealth and state regulations, and the International Maritime Organization (IMO) regulations.
- Approximately 15 – 25 m<sup>3</sup> per month of sludge from marine diesel oil and lube oil purifiers, as well as oil residue from drain, drip trays, oil separators and sludge unit produced from ongoing operation of FSRU.
- Approximately 70 – 100 m<sup>3</sup> of bilge water collected in a holding tank which would either be pumped to deck for discharge to shore/barge, or sent to the Oily Bilge Separator where the bilge water would be treated to an oil content of less than 15 ppm and sent to the Clean Bilge Tank. The bilge from this tank may be pumped to deck for off-site disposal by a licensed contractor.
- Mixed solid waste such as food scraps, paper, glass, packaging and recyclables.

Treated water from FSRU operation would be pumped to deck for off-site disposal. Sludge produced from ongoing operation of FSRU would be collected and sent off-site for disposal by a licensed contractor.

In addition, the Gas Import Jetty Works is also expected to generate wastewater from firefighting training exercises, testing and maintenance activities. Firefighting water generated at the Crib Point Receiving Facility would be captured in the onsite sump prior to off-site disposal by a licenced contractor; while foam-free water from firefighting system tests and flushing at the jetty, would be discharged to the ocean. It is noted that no PFAS containing firefighting foam would be stored or used for the Project.

Wastes that may be generated from the Pipeline Works operation and maintenance activities includes:

- Oils and grease from pipeline maintenance activities
- Dust and millscale (steel flakes) from infrequent maintenance or pigging activities.

Waste volume generated from pigging is expected to be less than one cubic metre for the entire pipeline. This waste would be collected at scraper station locations approximately every 10 years as part of maintenance activities. Pigging waste would be tested for waste classification prior to disposal at a licensed waste management facility. Activities associated with the management and disposal of waste are considered to have low impacts to human health and the environment. The impacts are mitigated through mitigation measures specified in Section 8.0 such as managing prescribed waste in accordance with *Environment Protection (Industrial Waste Resource) Regulations 2009* and reusing and recycling wastes where practicable, or disposal at appropriately licenced facilities.

The potential for impacts to land and surface water (including the Western Port Ramsar site) associated with loss from operational waste streams is low on the basis that products generated on site are commonly / routinely managed (i.e. grey water, sewage, oil residues, paper, plastics, packaging etc.) and in many cases are already being managed in the immediate area, would be stored in secure facilities and loss of products can be easily managed and maintained in a small lateral extent. As such, the pathway from sources to receptors is unlikely to be complete.

## 8.0 Recommended mitigation measures

This section outlines the recommended mitigation measures for contamination and ASS identified as a result of the risk and impact assessments.

The recommended mitigation measures listed in Table 8-1 combine the initial and additional mitigation measures applied during the risk assessment to arrive at recommended mitigation measures for the design, construction and operation of the Gas Import Jetty Works and the Pipeline Works.

In the course of finalising this technical report, consultation was undertaken with AGL and APA and other members of the team (designers, contractors and other specialists) so that recommended mitigation measures would be achievable and compatible with those proposed by other specialists.

The recommended mitigation measures have been refined as a result of these discussions and should be incorporated into the EMF, which would be implemented as described in Chapter 25 *Environmental Management Framework* through the Project approvals to effectively manage the environmental performance of the Project.

In addition to the contamination mitigation measures recommended in Table 8-1, mitigation measures are also recommended as per:

- EES Technical Report C: *Surface water impact assessment* on discharge of non-contaminated water and from trenchless drill sites, and management of spills
- EES Technical Report D: *Groundwater impact assessment* regarding drilling mud type and the use of suitable drilling contractors
- EES Technical Report G: *Air quality impact assessment* on measures to manage potentially contaminated dust
- EES Technical Report K: *Safety, hazard and risk assessments* regarding storage and handling of dangerous goods.

**Table 8-1 Recommended mitigation measures**

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
MM-C01	<p><b>Contaminated Soils</b></p> <p>a. Contaminated soil should be managed in accordance with the SEPP (Prevention and Management of Contaminated Land) and EPA Victoria interim Position Statement on PFAS. All Project personnel should be made aware of the presence of contaminated soils at the following locations during the site(s) induction:</p> <ul style="list-style-type: none"> <li>– The Crib Point Receiving Facility</li> <li>– The Esplanade adjacent to the former BP refinery</li> <li>– The former BP refinery</li> <li>– Within the railway corridor between High Street and Cool Store Road in Hastings</li> <li>– Between KP7.3 and KP7.9 in Hastings (if intrusive investigation confirms presence of contaminated soils).</li> </ul> <p>b. An intrusive investigation should be undertaken in the area between KP7.3 and KP7.9 prior to commencing pipeline construction, to confirm the presence or absence of contaminated soils,</p>	Gas Import Jetty Works and Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p>due to historical and existing land uses. Should contamination of soil and/or groundwater be encountered, consider additional mitigation measures (if required).</p> <ul style="list-style-type: none"> <li>c. Construction works during wet weather should be avoided unless conditions are such that property damage, contaminated soils, and surface water issues can be managed.</li> <li>d. Stockpile of trench spoil should be managed in accordance with EPA Victoria Publication 480 – <i>Best Practice Environmental Management: Environmental Guidelines for Major Construction Sites</i>.</li> <li>e. Where excess soils, including HDD screened cuttings, are required to be disposed off-site, these should be sampled and categorised in accordance with EPA Victoria Publications IWRG702 – <i>Soil Sampling</i> and IWRG621 – <i>Soil Hazard Categorisation and Management</i>.</li> <li>f. Handling and transport of contaminated spoil for off-site treatment/disposal should be in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>.</li> <li>g. Any material imported for use as backfill should comply with the EPA Victoria Publication IWRG621 – <i>Soil Hazard Categorisation and Management</i> for 'Fill Material', and should be accompanied by relevant documentation confirming its compliance to the 'Fill Material' criteria.</li> </ul>		
MM-C02	<p><b>Acid Sulfate Soils Management Protocol</b></p> <p>An Acid Sulfate Soils Management Protocol should be developed in accordance with the <i>Industrial Waste Management Policy (Waste Acid Sulfate Soils)</i> 1999 and EPA Victoria Publication IWRG655.1 – <i>Acid Sulfate Soil and Rock</i>, and the <i>Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils</i> (CASS BPMG, 2010). As agreed with EPA Victoria, the Pipeline Works ASS Management Protocol should be developed and included in the Pipeline Works CEMP which should be approved in accordance with the <i>Pipelines Act 2005</i>, in consultation with EPA Victoria. The Pipeline Works ASS Management Protocol should include:</p> <ul style="list-style-type: none"> <li>a. All soils be managed as AASS or PASS in accordance with CASS BPMG (2010).</li> <li>b. A risk assessment together with proposed risk mitigation and management measures across the Project Area including justification of why certain areas may be excluded from treatment by liming.</li> </ul>	Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<ul style="list-style-type: none"> <li>c. Monitoring of the performance of mitigation and management measures, including potential remedial measures where/if required.</li> <li>d. All relevant site-based personnel should be made aware of the locations where PASS (MW09 at KP17.8, MW10 at KP19.4, BH207 at KP32.4, BH209 at KP32.6 and BH34 at KP35.4) has been identified.</li> <li>e. Relevant site-based personnel must be trained on the requirements of the acid sulfate materials management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010).</li> <li>f. Construction works should not occur during wet months unless conditions are such that land degradation and surface water management problems can be avoided or appropriate mitigation measures implemented.</li> <li>g. Minimise the duration of stockpiling of untreated ASS by staging soil excavations in a manner that takes in constraints on stockpile duration where treatment of ASS may not be required, as per the CASS BPMG (2010).</li> <li>h. Include a procedure for managing unexpected discovery of ASS/PASS in the ASS Management Protocol.</li> <li>i. If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile.</li> <li>j. Run-off that has the potential to be impacted by stockpile material should be directed into the open trench (where practicable).</li> <li>k. Minimise activation of PASS by minimising duration (less than 10 days) and extent of dewatering activities, such as dewatering immediately prior to installation of pipe and minimise the time that trench sections and bell holes are open.</li> <li>l. Implement a monitoring program in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils.</li> </ul>		
MM-C03	<b>Acid Sulfate Soil Management Plan</b> An Acid Sulfate Soil Management Plan (ASSMP) should be developed in accordance with the <i>Industrial Waste Management Policy (Waste Acid</i>	Gas Import Jetty Works	Construction



Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p><i>Sulfate Soils</i>) 1999 and EPA Victoria Publication IWRG655.1 – <i>Acid Sulfate Soil and Rock</i>, and the <i>Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils</i> (CASS BPMG, 2010). The ASSMP shall be approved by the Authority.</p> <ol style="list-style-type: none"> <li>Relevant site-based personnel must be trained on the requirements of the acid sulfate materials management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010).</li> <li>The duration of stockpiling of untreated ASS should be minimised by taking into consideration the constraints on stockpile duration where treatment of ASS may not be required, as per the CASS BPMG (2010).</li> <li>Include a procedure for managing unexpected discovery of ASS/PASS in the ASSMP.</li> <li>If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile.</li> <li>Run-off that has the potential to be impacted by stockpile material should be captured (where practicable) and managed in accordance with the CASS BPMG (2010).</li> <li>A monitoring program should be implemented in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils.</li> </ol>		
MM-C04	<p><b>Contaminated groundwater/trench water</b></p> <ol style="list-style-type: none"> <li>Contaminated groundwater/trench water should be managed in accordance with: <ul style="list-style-type: none"> <li>SEPP (Waters)</li> <li>PFAS National Environmental Management Plan.</li> </ul> </li> <li>All Project personnel should be made aware of the presence of contaminated groundwater containing PFAS east of the former Tyabb landfill.</li> <li>Disturbance of saturated soil and groundwater within the PFAS affected area should be minimised. The management plan should include measures to prevent migration of PFAS into the surrounding soil or surface water.</li> </ol>	Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<ul style="list-style-type: none"> <li>d. An intrusive groundwater investigation should be undertaken in the area between KP7.3 and KP7.9 prior to commencing pipeline construction, to confirm presence or absence of contaminated groundwater within the area, due to historical and existing land uses.</li> <li>e. Water from areas that have been identified as contaminated should not be discharged to the environment (land, waterways, sewer).</li> <li>f. Contaminated water should either be treated onsite, depending on contaminant encountered (this may require approval from the EPA Victoria) or disposed offsite to an EPA Victoria licensed facility. Alternatively, adopt a construction approach where contaminated groundwater may be left in-situ (i.e. not abstracted or disturbed).</li> </ul>		
MM-C05	<p><b>Drilling muds disposal</b></p> <p>Drilling muds/additives used in horizontal directional drilling should be selected to avoid impact to sensitive environments during drilling activities as per EES Technical Report D: <i>Groundwater impact assessment</i>.</p> <p>Place bunds and/or drainage channels around the upper edges of the drill site and work area, to divert natural runoff around and away from the drill site and avoid cross contamination of the drilling compound runoff as per EES Technical Report C: <i>Surface water impact assessment</i>.</p> <ul style="list-style-type: none"> <li>a. Monitor circulation of drilling muds throughout the HDD operation for indication of an inadvertent drilling mud release.</li> <li>b. Drilling muds should be disposed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i> and EPA Victoria <i>Industrial Waste – Classification for Drilling Mud</i>, Victoria Government Gazette G37.</li> <li>c. Records of HDD mud disposal should be maintained.</li> </ul>	Pipeline Works	Construction
MM-C06	<p><b>Hydrostatic test water</b></p> <ul style="list-style-type: none"> <li>a. Hydrostatic test water should be managed in accordance with SEPP (Waters).</li> <li>b. Water should be reused where practicable to conserve water and minimise the number of discharge locations.</li> <li>c. If oxygen scavengers and biocides are used during hydrostatic testing, they should be neutralised before disposal, in accordance with manufacturer guidelines, to ensure that the water is free from any remaining active biocide and oxygen scavengers before discharge land.</li> <li>d. Dams and hydrostatic test water may remain for land holders beneficial use with landholder</li> </ul>	Pipeline Works	Construction

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	and regulatory approval if water quality requirements are met.		
MM-C07	<b>Unknown contamination</b>  In the event that unknown contamination (including asbestos containing material) is encountered during construction: <ol style="list-style-type: none"> <li>Cease ground disturbance at the unknown contamination location and within the immediate vicinity.</li> <li>Assess site contamination and identify appropriate remedial action.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction
MM-C08	<b>Fuel and Chemical Leaks/Spills</b> <ol style="list-style-type: none"> <li>Diesel generators should be bunded.</li> <li>Routine and scheduled maintenance of vehicles and plant/machinery/equipment should be undertaken to minimise the potential for leaks/spills to occur.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction and operation
MM-C09	<b>Construction Waste Management</b> <ol style="list-style-type: none"> <li>Waste should be managed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>, including establishment of appropriate and secured waste storage locations on-site, as required.</li> <li>Waste management procedures should be developed and implemented.</li> <li>Identification of suitable waste disposal locations should occur prior to construction commencing in consultation with local waste sub-contractors.</li> <li>Waste materials should be reused or recycled where practicable, or collected and transported by licenced contractors for disposal at appropriately licenced facilities.</li> <li>Portable toilet facilities should be available for work construction crews on the construction footprint.</li> <li>Waste containers should be available for different types of waste generated onsite.</li> <li>Waste containers should be located at each worksite to enable collection of waste, with regular removal from worksites to designated areas.</li> <li>Refuse containers should be lidded to mitigate fauna access.</li> </ol>	Gas Import Jetty Works and Pipeline Works	Construction
MM-C10	<b>Operation Waste Management</b> <ol style="list-style-type: none"> <li>Prescribed waste should be managed in accordance with <i>Environment Protection (Industrial Waste Resource) Regulations 2009</i>, including establishment of appropriate and</li> </ol>	Gas Import Jetty Works and Pipeline Works	Operation

Mitigation measure ID	Recommended mitigation measures	Works area	Stage
	<p>secured waste storage locations on-site, as required.</p> <p>b. Waste management procedures should be developed and implemented.</p> <p>c. Waste materials should be stored appropriately, reused or recycled where practicable, or collected and transported by licenced contractors for disposal at appropriately licenced facilities.</p> <p>d. Waste containers should be available for different types of waste generated onsite.</p> <p>e. Waste containers should be lidded to mitigate fauna access.</p>		

## 9.0 Conclusion

An assessment of contamination and ASS has been undertaken to determine the potential impacts of the Project construction and operation, on human health and the environment, and to identify recommended mitigation options where appropriate in order to reduce potential risks of the Project.

### Contaminated soils and groundwater

The contaminated soils impact assessment found limited potential for impacts on human health and the environment with the exception of the proposed location for the Crib Point Receiving Facility, along The Esplanade (adjacent to the former BP refinery), the former BP refinery and within the rail corridor in Hastings. Potential construction impacts were related to disturbance, handling and storage or disposal of contaminated soils. The risk was identified as being low due to identified contaminants being non-leachable, discontinuous and generally low in concentrations.

The contaminated groundwater impact assessment found the extent of groundwater contamination within the study area to be limited in extent. Excluding compounds considered likely to be naturally sourced/ background (TDS, selected metals, sulfate, phosphorous, calcium, etc.), contamination including PFAS and nickel was only encountered adjacent to the former Tyabb landfill and adjacent to a metal recycling yard on Frankston-Flinders Rd, respectively. Potential pipeline construction impacts were related to discharge or disposal of dewatered groundwater/trench water (contaminated or non-contaminated but acidic and/brackish). The risk rating was identified as being low due to contaminants generally low in concentrations, shallow depth of trenching and horizontal boring, the short duration of dewatering activities (where groundwater is intersected) and clay and silt dominated nature of the materials likely to be encountered (restricting groundwater inflow).

It is noted that due to dense vegetation restricting access to study area between KP7.3 and KP7.9, the Pipeline Works must undertake intrusive soil and groundwater investigation prior to pipeline construction to confirm the presence or absence of contaminated soils and groundwater within the area, as a result of adjacent historical and existing industrial land uses.

### Acid sulfate soils (ASS)

The ASS impact assessment identified the presence of ASS throughout the study area; and PASS was identified at several locations between KP17.8 and KP35.4. Therefore, any soil disturbance activities such as excavation, trenching and thrust boring would have the potential to encounter ASS and oxidise PASS.

The investigation reported 43% of the soil samples exceeding the 'Action Criteria' of 0.03%S for disturbance exceeding 1,000 tonnes. Both Pipeline Works and Gas Import Jetty Works are classified as High hazard under the CASS BPMG (2010) based on the estimated volume of soil disturbance. Therefore, the proposed Works may only proceed with an approved environmental management plan. It is noted that EPA Victoria was consulted on 19 August 2019, and it was agreed that the Pipeline Works would not require an EPA Victoria approved ASSMP. Instead, an ASS Management Protocol would be developed and included in the Pipeline Works CEMP, which would be approved in accordance with the *Pipelines Act 2005*, in consultation with EPA Victoria. The Gas Import Jetty Works, however, would require an ASSMP that would need to be approved by EPA Victoria.

### Contaminated marine sediments

The marine sediment investigation concluded that the relevant beneficial use of water dependent ecosystems and species at Berth 2 is protected, and contamination from historical and/or existing activities at the Crib Point Jetty is limited to Berth 1 only. Therefore, no mitigation measures have been proposed.

### Other impacts

Several other construction and/or operational impacts were related to potential soil, groundwater and surface water impacts from HDD drilling muds, discharge or disposal of contaminated hydrostatic test water, unknown contamination encountered during construction, leaks/spills and waste generation. The risk ratings were identified as being low with application of industry standard and mitigation measures during Project construction and operation.

### Impact assessment summary

Overall, construction and operation of the Project is considered to present limited risk to soil, groundwater and receiving surface water due to the limited extent of contamination. The potential environmental risk associated with ASS is limited by the shallow depth of trenching and horizontal boring, and the short duration of stockpiling and dewatering activities (where groundwater is intersected). Where dewatering is required the reduction in groundwater levels are also estimated to be of limited magnitude and limited lateral extent (assessed in EES Technical Report D: *Groundwater impact assessment*). The proposed construction methodologies would confine potential impacts within the Project Area and thus have very limited effect upon the surrounding area.

The risk of potential impacts on human health via direct and secondary contact with soils, groundwater and surface were identified as being low or very low, and can be mitigated as outlined in Section 8. It was concluded that the Project is consistent with the scoping requirements and the draft evaluation objective with respect to potential impacts on environment or health from disturbance of contaminated soil or ASS, waste materials/streams generated by the Project works, and spills or other incidents during Project construction or operation, with mitigation measures that are commonly applied and have proven effective in major construction projects in place. As the risk assessment for potential contamination and ASS impacts did not identify any initial risks with a rating of medium or higher, no additional mitigation measures have been deemed necessary.



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# Appendix A

Contamination and acid  
sulfate soils field  
investigation

## Appendix A Contamination and acid sulfate soils field investigation

# Contamination and Acid Sulfate Soils Field Investigations

EES Technical Report E - Appendix A

## Contamination and Acid Sulfate Soils Field Investigations

EES Technical Report E - Appendix A

Client: AGL Wholesale Gas Limited and APA Transmission Pty Limited

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## Executive summary

This report has been prepared as an appendix to the Gas Import Jetty Pipeline Project (the Project) Environment Effects Statement (EES) Technical Report E: *Contamination and acid sulfate soils impact assessment*. It documents contaminated soils, groundwater, marine sediments, and acid sulfate soils (ASS) field investigations undertaken for the Project.

The study area for the purpose of the soil and groundwater contamination investigation, and ASS investigation, includes the pipeline right of way (ROW) including alignment alternatives and a buffer area of 50 metres either side of the ROW, the Pakenham Delivery Facility, the End of Line Scraper Station (EOLSS), and the landside component of the Gas Import Jetty Works which includes gas piping and the Crib Point Receiving Facility.

The study area for the purpose of the marine sediment contamination investigation, includes Berth 1 and 2, and a buffer area of approximately 200 metres east of the berths.

### Objectives

The purpose of this report is to support the EES by providing information relating to the environmental condition of soil, groundwater and marine sediments within the study area, likely to be encountered during construction of the Project.

The objectives are:

- to assess the soil, groundwater and marine sediment quality within the study area via a field investigation program
- to assess the potential risk to receptors (residents, the general public, ground intrusive workers and ecosystem) posed by potential presence of ASS and contaminated soil and groundwater across the study area, and contaminated marine sediment at the Crib Point Jetty.

### Scope and methodology

The assessment methodology included:

- Undertaking a field investigation program which includes:
  - Development of a Safety, Health and Environment Management Plan (SHEMP).
  - Underground service clearance of all soil bores and groundwater monitoring well locations by a professional service locator.
  - Advancement and logging of 99 soil bores to a maximum depth of 2.5 metres (m) below ground level (mbgl) or refusal by a combination of non-destructive drilling (NDD) and hand auger. The NDD method was used down to just where sample was to be collected, then sample was collected using hand auger from undisturbed portion of the lithology. Soil samples were generally collected at the surface of the site and depths of 0.5, 1.0, 1.5, 2.0 and 2.5 mbgl. No rock samples were collected. Each soil sample was assessed for head space vapour concentrations using a photo-ionisation detector (PID). Soil sampling consisted of grid and targeted sampling as outlined below:
    - Collection of samples on a grid basis from 58 soil bores, located along the pipeline alignment, at a density of approximately one soil bore per kilometre of pipeline, including samples collected during installation of 26 groundwater monitoring bores. The sampling density was adopted to assess the potential for widespread/regional contamination of soil, based on the largely rural setting. Assessment of ASS was also completed at a density of one soil bore per kilometre, except targeted ASS sampling locations. This approach is considered sufficient to assess the potential for soil contamination and the presence or absence of ASS within the study area.
    - Collection of samples from eleven soil bores, targeting areas that had been identified during desktop review to have higher potential for contamination (e.g. near industrial/commercial areas, existing pipeline easements and former landfill).

- Collection of samples from 27 soil bores targeting areas where the desktop review identified that ASS is more likely to be present (as per Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) soil database), at a density of one soil bore per 100 metres of pipeline, in accordance with guidance in the EPA Victoria Publication *Industry Waste Resource Guideline (IWRG) 655.1 – Acid Sulfate Soils and Rock*.
- Collection of samples from three soil bores, targeting the proposed pipe stringing area in the former Western Port BP Refinery site following its inclusion in the revised pipeline alignment.
- Soil samples were analysed for EPA Victoria Publication *IWRG621 – Soil Hazard Categorisation and Management* suite of analytes including the Australian Standard Leaching Procedure (ASLP) leach (selected samples only), Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS)/chromium reducible sulfur (CRS) suite, and at selected locations Per- and polyfluoroalkyl substances (PFAS).
- Inspection of soils in the field for general signs of contamination such as staining and odour, and presence of asbestos containing material (ACM).
- Installation of four groundwater monitoring wells in areas that have been identified, through desktop review, to have higher potential for contamination. Groundwater gauging and sampling of 26 groundwater monitoring wells (with 22 groundwater monitoring wells installed as part of Technical Report D: *Groundwater impact assessment*).
- Groundwater samples were analysed for dissolved metals (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), aluminium (Al), iron (Fe), selenium (Se), mercury(Hg)), major ions, total dissolved solids (TDS), nitrate, ammonia, chromium trivalent (Cr(III)), chromium hexavalent (Cr(VI)), total phosphorous, total recoverable hydrocarbons (TRH) C<sub>6</sub>-C<sub>40</sub> and VOC/semi-VOC (SVOC). The groundwater sample from GW05 was also analysed for PFAS suite of analytes.
- Collection of marine sediment samples by Consulting Environmental Engineers Pty Ltd (CEE) from 20 locations, including four from reference locations located north and south of the study area at the Crib Point Jetty, specifically surrounding Berth 1 and 2, for the purpose of establishing baseline characteristics.
- Marine sediment samples were analysed for metals (antimony (Sb), arsenic, cadmium, chromium, copper, iron, lead, manganese (Mn), mercury, nickel, silver (Ag) and zinc), organotins - Tributyltin (TBT), Polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyl (PCBs), TRH, PFAS full suite (28 analytes), moisture content, particle sizing and total organic carbon (TOC).
- Data validation.
- Assessment of soils, marine sediments and groundwater results against applicable beneficial uses and adopted screening criteria; and assessment of soils against the EPA Victoria Publication IWRG621.
- Preparation of this report.

### Summary of potentially contaminated areas

The findings of this investigation are summarised below. The summary, however, does not present all exceedances of the adopted screening criteria. Rather, it focuses on source areas.

#### Contaminated soils

Soil conditions encountered within the study area are summarised below:

- BH42, GW04, BH216 and BH219 recorded high PID readings; however, analytical results were either below the laboratory limit of reporting (LOR) or below the adopted beneficial use guideline values, suggesting that it is unlikely to present risk to human health or the environment. The cause or source that contributes to the high PID readings, however, has not been identified.

- Light green staining was observed at MW21 at 2.2 mbgl, however, laboratory results, the absence of a potential source/odour or other signs of contamination, indicated that it is unlikely to be related to contamination.
- Trace concentrations of xylene were detected in seven soil samples (BH214, BH216, BH219, BH37, BH42, BH44 and BH47) located within paddocks between kilometric point (KP) 33 and KP49.4. The concentrations are below sensitive land use criteria. The cause or source has not been identified.
- Concentrations of zinc and benzo(a)pyrene at the proposed Crib Point Receiving Facility exceeded the Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for Commercial/Industrial land use, respectively. However, the elevated zinc concentration is considered unlikely to impact on ecology at the Crib Point Receiving Facility as the sample was collected within imported crushed rock; and laboratory analysis results indicated that it has not leached into the underlying sample at 0.4 mbgl, thus it is considered unlikely to present a risk to off-site receptors. Based on the proposed use and location of the Crib Point Receiving Facility, benzo(a)pyrene is also considered unlikely to present a risk to ecology at the site; and as it is not a leachable compound, it will also not present risk to off-site receptors.
- Concentrations of benzo(a)pyrene in a sample collected adjacent to the former Western Port BP refinery (near the Esplanade) exceeded the ESL for Coarse Soil, Urban Residential/Public Open Space and Commercial/Industrial. The exceedance, however, was within gravelly sand fill soil only and is likely to be associated with asphalt and roadmaking materials. Based on the existing use and proposed Pipeline Works, it is considered unlikely to present risk to ecology at the site and as it is not a leachable compound, it will not present risk to off-site receptors.
- Concentrations of arsenic in samples from bores located adjacent to the former Tyabb landfill exceeded the EILs for areas of ecological significance. The exceedances however, were detected within natural soil at a depth of 0.5 – 1.0 mbgl, whereas surface samples reported concentrations of 6 mg/kg and less than the laboratory LOR, indicating that arsenic is likely to be naturally elevated within the area (not due to recent anthropogenic site use e.g. orchard). Additionally, leachability analysis returned result below the laboratory LOR. Therefore, it is considered unlikely to present risk to off-site receptors.
- Concentrations of TRH fraction >C<sub>16</sub>-C<sub>34</sub> in samples from bores located at KP36.4 (BH35), KP37.5 (BH36) and KP44.2 (MW19) exceeded the ESLs (Coarse Soil, Urban Residential/Public Open Space). It is noted that these bores are located within the middle of a paddock away from hydrocarbon sources. Silica Gel clean-up on soil sample from BH36 returned results below the laboratory LOR indicating the absence of petroleum hydrocarbons and that the TRH was likely to be NOM. As such, the soil would remain classified as Fill Material (in the absence of other contaminants).
- Laboratory analysis indicated soil samples collected from the proposed location for the Crib Point Receiving Facility, the former Western Port BP refinery, the area adjacent to the former Western Port BP refinery (The Esplanade) and the railway corridor between High St and Cool Store Road in Hastings exceeded the EPA Victoria Publication IWRG621 thresholds for Fill Material. Soil samples collected from these areas are classified under IWRG621 as Category C, except at the Crib Point Receiving Facility where it was classified as Category B. The contaminants of concern include arsenic, copper, lead, zinc, fluoride, PAHs and polychlorinated biphenyls (PCBs).

#### Acid sulfate soils

Targeted ASS investigation within the study area concluded that:

- There is presence of existing acidic soils throughout the study area. This is evident from the presence of low pH and general low sulfate concentrations (<0.03 per cent sulfur (%S)) in the soil samples, indicating that the soils have already been acidified.
- Potential acid sulfate soil (PASS) was identified at the following locations:
  - MW09 at depth of 3.0 mbgl
  - MW10 at depth of 3 mbgl

- BH207 at depth of 0.5 mbgl
- BH209 at depth of 0.5 mbgl
- BH34 at depth of 2.0 mbgl.
- Net acidity exceeding the 'Action Criteria' of 0.03 %S for disturbance exceeding 1,000 tonnes (BPMG, 2010) was exceeded in 78 samples of a total 180 samples. Therefore, soils must be managed in accordance with the EPA Victoria Publication IWRG655.1.

#### Contaminated groundwater

Groundwater conditions encountered along the proposed pipeline alignment are summarised below:

- Depth to groundwater ranged between 0.995 metres below top of casing (mBTOC) (MW22) and 4.834 mBTOC (MW18). Four locations, MW04, MW23, MW17 and MW19 were noted to be dry during the gauging round. Groundwater elevations ranged between -0.909 mAHD (MW18) and 22.907 mAHD (MW22), consistent with the general topography and ground elevations along the pipeline alignment.
- No non-aqueous phase liquid (NAPL) (either dense (D) or light (L)) was encountered in any of the groundwater monitoring wells during gauging and groundwater sampling.
- Concentrations of total dissolved solids (TDS) exceeded the adopted Australian and New Zealand Guidelines for Fresh Water and Marine Water Quality (ANZECC & ARMCANZ 2000) – Livestock Watering (Beef Cattle, Poultry or Sheep) criteria except at MW07, suggesting that the groundwater along the pipeline alignment is naturally saline. MW07 is located adjacent to the McKirdys Road Drain and therefore the salinity may be influenced by surface water. It is noted that TDS concentrations at MW9 (13,800 milligrams per litre (mg/L)) and MW11 (18,700 mg/L) are higher than the rest of the locations. This is likely due to tidal interaction associated with the adjacent Watson Creek and Creek rivers that discharge to Western Port.
- Concentrations of copper exceeded the ANZECC & ARMCANZ 2000 – Maintenance of Ecosystems Marine Water 99% protection level criteria at eight out of 15 locations with detected concentrations ranging between 0.001 and 0.009 mg/kg. The distribution of copper along the pipeline length would indicate that it is naturally present or elevated within the aquifer and does not represent contamination.
- Concentrations of iron exceeded the ANZECC & ARMCANZ 2000 – Irrigation LTV criteria at eight out of 15 locations with detected concentrations ranging between 0.05 to 3.59 mg/kg. Iron is naturally encountered in groundwater in the region. It is noted that concentrations of iron in groundwater from MW09 (3.59 mg/L) and MW10 (3.02 mg/L) are higher than other wells. Based on the location of MW09 and MW10 it is considered likely that Watson Creek is influencing results. It is considered that the iron naturally fluctuates along the pipeline alignment and does not represent contamination.
- Concentrations of nickel exceeded the ANZECC & ARMCANZ 2000 – Maintenance of Ecosystems Marine Water 99% protection level criteria at five out of 15 locations with detected concentrations ranging between 0.002 and 0.019 mg/L. The distribution of nickel along the pipeline length would indicate that it is naturally present or elevated within the aquifer and generally does not represent contamination. However, it is noted that groundwater from GW04 (0.019 mg/L located adjacent to the former Tyabb landfill) and MW05 (0.012 mg/L) located adjacent to a metal recycling yard, recorded highest concentrations of nickel, indicating potential impact from the adjacent land uses.
- Concentrations of zinc exceeded the ANZECC & ARMCANZ 2000 – Maintenance of Ecosystems Marine Water 99% protection level criteria at all locations with detected concentrations ranging between 0.014 and 0.179 mg/L. The distribution of elevated zinc along the pipeline length would indicate that it is naturally present or elevated within the aquifer and does not represent contamination.
- Concentration of Perfluorooctane sulfonate (PFOS) exceeded the NEMP 2018 – PFAS Guidelines Freshwater Marine 99% criteria at MW05 located adjacent and down gradient from the former Tyabb landfill. It is noted that the laboratory LOR is higher than the criteria and PFOS was

only detected in the triplicate sample at LOR. However, other PFAS compounds were detected in the primary sample at trace concentrations and therefore it is considered likely that PFOS is present and exceeds the Maintenance of Ecosystems criteria. It is noted that the criteria only applies upon discharge to surface water body.

- Concentration of ammonia exceeded the ANZECC & ARMCANZ 2000 – Maintenance of Ecosystems Marine Water 99 % protection level criteria at MW09 (0.5 mg/L). It is noted that the concentration of ammonia fluctuates along the pipeline alignment generally within an order of magnitude and only meets the criteria and doesn't exceed it. It is considered likely that ammonia detected is associated with broad acre fertiliser use or stock grazing, based on the predominant land use throughout the proposed pipeline alignment.
- Concentrations of total phosphorus exceed the ANZECC & ARMCANZ 2000 – Irrigation LTV criteria in groundwater sampled from all wells along the pipeline alignment. The phosphorous concentration ranges between 0.07 and 0.048 mg/kg and similar to ammonia may be present regionally as a result of stock grazing or fertiliser use. The concentration of phosphorous in groundwater from all wells sampled is below the short-term irrigation criteria by an order of magnitude. Based on the Project lifespan it is considered that short-term irrigation criteria can reasonably be applied to assessing risk.
- Concentrations of calcium exceeded the ANZECC & ARMCANZ 2000 – Livestock Watering (Beef cattle) criteria at MW11 (1,270 mg/L). The increase in calcium in groundwater from well MW11 is consistent with an increase in general TDS in this area, which is considered likely to be associated with the topography and hydrology of the area and does not represent contamination.
- Concentrations of Sulfate as  $\text{SO}_4$  – Turbidimetric (Filtered) exceeded the ANZECC & ARMCANZ 2000 – Livestock Watering (Beef cattle) criteria at MW09 (1,220 mg/L) and MW11 (1,170 mg/L). The increase in sulfate in groundwater from wells MW09 and MW11 is consistent with an increase in general TDS in these areas, which is considered likely to be associated with the topography and hydrology of the area and does not represent contamination.
- Field measured pH exceeded the NHMRC 2008 – Guidelines for Managing Risks in Recreational Waters criteria at eight out of 13 locations, ranging between 5.96 and 7.34. MW14 (pH 5.96) also exceeded the ANZECC & ARMCANZ 2000 – Irrigation LTV criteria. Acidic groundwater is consistent with the presence of Actual ASS (AASS) as detected throughout the proposed pipeline alignment and is therefore considered to be naturally occurring and does not represent contamination.

#### Marine sediment

Marine sediment conditions encountered within the marine sediment study area (at the Crib Point Jetty) are summarised below:

- Sediment samples collected from Berth 1 exceeded adopted sediment quality guidelines values (SQGVs) for arsenic and tributyltin (TBT) (normalised to 1% TOC).
- Concentrations of PFAS compounds were detected in the marine sediment samples collected from Berth 2; however, Australian guideline values for maintaining ecosystem health in marine sediment are currently not available for PFAS to allow for an assessment of whether the relevant beneficial uses are protected. It is noted that the reported concentrations were low i.e. within the same order of magnitude as the LOR (0.0002 mg/kg), suggesting that the relevant beneficial uses are protected.

### **Conclusion**

#### Contaminated soils and groundwater

Based on broadly spaced intrusive investigations undertaken as part of the field assessment, soil contamination is considered to be limited in extent. Contaminated soils were identified at the Crib Point Receiving Facility proposed location, along The Esplanade adjacent to the former Western Port BP refinery, the former Western Port BP refinery and within the railway corridor between High Street and Cool Store Road in Hastings. It should be noted that localised impacts may be present and may be encountered during Project construction works.



The extent of groundwater contamination is also limited, based on available data. Excluding compounds considered likely to be naturally sourced/background (TDS, selected metals, sulfate, phosphorous, calcium, etc.), contamination was only encountered adjacent to the former Tyabb landfill (PFAS and nickel) and metal recycling yard in Hastings (potentially nickel). It is noted that, while likely areas of concern were assessed as part of this investigation, localised groundwater contamination may be encountered within the Project Area during construction of the Project.

#### Acid sulfate soils (ASS)

Analysis of soils within the study area confirmed the presence of AASS throughout the study area, and PASS at the following locations:

- MW09 at depth of 3.0 mbgl
- MW10 at depth of 3 mbgl
- BH207 at depth of 0.5 mbgl
- BH209 at depth of 0.5 mbgl
- BH34 at depth of 2.0 mbgl.

The net acidity in soil in 78 of 180 samples exceeded the 'Action Criteria' of 0.03%S for disturbance exceeding 1,000 tonnes (CASS BPMG, 2010). Therefore, this must be managed in accordance with EPA Victoria Publication IWRG655.1.

Further ASS assessment may be undertaken to comply with IWRG655.1 sampling frequency; however, the distribution of ASS would suggest that this is not required and that all soils be managed as AASS or PASS in accordance with CASS BPMG (2010). It is recommended that the Project adopt management strategies that prevent or limit oxidation of sulfides and generation of potential acidity such as adopting staging of soil excavations such that ASS are exposed to oxygen for the minimum amount of time possible. Should treatment of ASS be required, further assessment to refine liming rates may be undertaken.

It is noted that although the Pipeline Works and the Gas Import Jetty Works are assessed as a full Project under the EES, the construction works will be undertaken separately under separate approvals and management plans. Therefore, for the purpose of ASS classification under the CASS BPMG (2010), specifically the requirement for an Acid Sulfate Soil Management Plan (ASSMP), the classification will need to be completed for both sets of works independently. The action criteria for each Works would be determined by the volume of soils to be disturbed during construction. It is noted that EPA Victoria was consulted on 19 August 2019, and it was agreed that the Pipeline Works would not require an EPA Victoria approved ASSMP, instead ASS Management Protocol will be developed and included in the Pipeline Works Environment Management Plan (EMP) which will be approved in accordance with the *Pipeline Act 2005*, in consultation with EPA Victoria. This is discussed in the EES Technical Report E: *Contamination and acid sulfate soils impact assessment*.

#### Marine sediment

The marine sediment quality investigation undertaken at the Crib Point Jetty identified that contamination from historical and/or existing activities is limited to Berth 1. The marine sediment quality in the Berth 2 area is below the adopted criteria for the assessment of potential ecological risk; therefore, relevant beneficial uses are considered to be protected.

Overall, this investigation concluded that the risk to receptors including human health and the environment from the construction and operation of the Project can be minimised with appropriate mitigation measures in accordance with applicable regulations, guidelines and standards.

## Abbreviations

Abbreviation	Definition
AASS	Actual acid sulfate soils
ABC	Ambient background concentration
ACL	Added Contaminant Limits
ACM	Asbestos containing material
AECOM	AECOM Australia Pty Ltd
AGL	AGL Wholesale Gas Limited
AHD	Australian Height Datum
AMG	Australian Mapping Grid
ANC	Acid Neutralising Capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
APA	APA Transmission Pty Limited
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
ASC	Assessment of Site Contamination
ASLP	Australian Standard Leaching Procedure
ASRIS	Australian Soil Resource Information System
ASS	Acid sulfate soils
ASSMP	Acid Sulfate Soils Management Plan
BaP	benzo(a)pyrene
BPMG CASS	Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils
BTEX	Benzene, toluene, ethylbenzene & xylene
CASS	Coastal acid sulfate soils
CEC	Cation Exchange Capacity
COPC	Contaminants of Potential Concern
CRS	Chromium reducible sulfur
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CUN	Clean up Notice
DBYD	Dial Before You Dig
DDT	Dichlorodiphenyltrichloroethane
DQI	Data Quality Indicators
EES	Environment Effects Statement
EILs	Ecological Investigation Levels
ERS	Environment Reference Standard
ESLs	Ecological Screening Levels
FSRU	Floating storage and regasification unit

Abbreviation	Definition
GPS	Global Positioning System
GQRUZ	Groundwater Quality Restricted Use Zones
GW	Groundwater well
HILs	Health Investigation Levels
ILs	Investigation Levels
IWRG	Industrial Waste Resource Guidelines
KP	Kilometre point
LNG	Liquefied natural gas
LOR	Limit of reporting
LTV	Long-term trigger value
m	Metre
MAH	Monocyclic aromatic hydrocarbons
mbgl	Metres below ground level
m btoc	Metres below top of casing
meq/100g	milliequivalents per 100 gram
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
MLs	Management Limits
MLV	Mainline valve
MW	Monitoring well
NA	Net Acidity
NAGD	National Assessment Guidelines for Dredging
NAPL	Non-aqueous phase liquid
NATA	National Association of Testing Authorities
NDD	Non-destructive digging
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NOM	Natural organic matter
OCP	Organochlorine pollutants
PAHs	Polycyclic aromatic hydrocarbons
PAN	Pollution Abatement Notice
PASS	Potential acid sulfate soils
PCBs	Polychlorinated biphenyls
PFAS	Per- and polyfluoroalkyl substances
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexane sulphonic acid
PFOA	Perfluorooctanoic acid

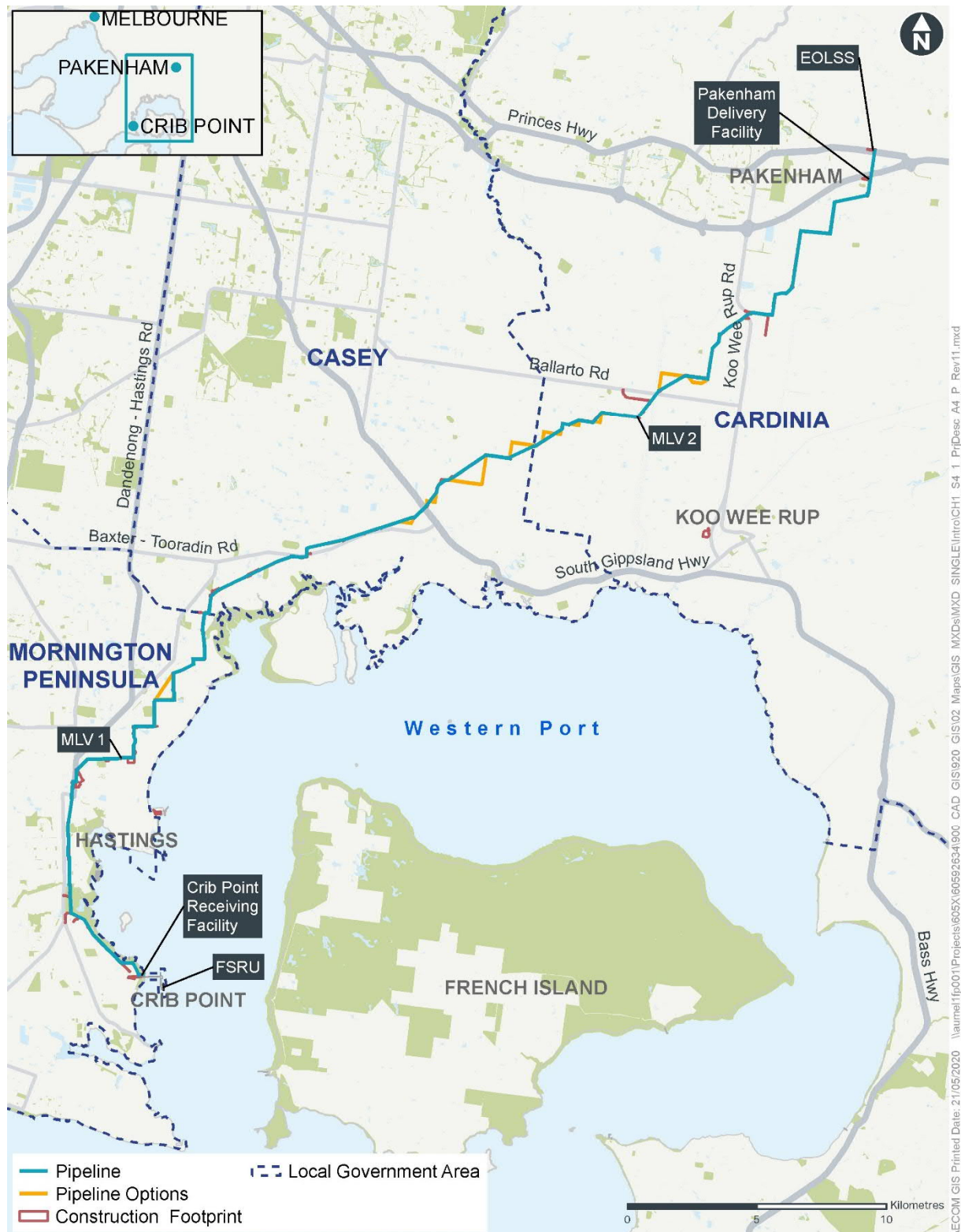
Abbreviation	Definition
PFOS	Perfluorooctane sulfonate
pH <sub>f</sub>	Field pH
pH <sub>fox</sub>	Field peroxide pH
PID	Photo-Ionisation Detector
PIW	Prescribed Industrial Wastes
PMCL	Prevention and Management of Contaminated Land
PoHDA	Port of Hastings Development Authority
ppm	Parts per million
PVC	Polyvinyl chloride
QA/QC	quality assurance/quality control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SEPP	State Environment Protection Policy
SHEMP	Safety, Health and Environment Management Plan
SPOCAS	Suspension Peroxide Oxidation – Combined Acidity and Sulfate
SPOS	Potential acidity
SQGVs	Sediment quality guidelines values
SQO	Soil quality objective
SVOC	Semi-volatile organic compounds
SWD	South Western Drilling Pty Ltd
TAA	Titratable Actual Acidity
TBT	Tributyltin
TDS	Total dissolved solids
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
VOCs	Volatile organic compounds
VTs	Victorian Transmission System
WOE	Weight of evidence

## 1.0 Introduction

### 1.1 Background

This report has been prepared as an appendix to the Gas Import Jetty and Pipeline Project (the Project) Environment Effects Statement (EES) Technical Report E: *Contamination and acid sulfate soils impact assessment*. It documents contaminated soils, groundwater and marine sediment, and acid sulfate soils (ASS) field investigations undertaken for the Project. This document should be read in conjunction with the EES Technical Report E.

The Project and its key components are shown in Figure 1.



The Project is made up of two sets of works: the Gas Import Jetty Works and the Pipeline Works.

The Gas Import Jetty Works and the Pipeline Works will be undertaken by AGL Wholesale Gas Limited (AGL) and APA Transmission Pty Limited (APA) respectively and are described in the following sections.

## Gas Import Jetty Works

The Gas Import Jetty Works would consist of a liquefied natural gas (LNG) import facility, which comprises:

- Continuous mooring of a floating storage and regasification unit (FSRU) at Berth 2 of the existing Crib Point Jetty. The FSRU would regasify LNG into natural gas.
- Infrastructure on the Crib Point Jetty including marine loading arms (MLAs) and gas piping to transfer the gas from the FSRU.
- Crib Point Receiving Facility, which would be located on land adjacent to the Crib Point Jetty and will process the natural gas.

The Crib Point Jetty is owned and managed by the Port of Hastings Development Authority (PoHDA).

The FSRU is a vessel approximately 300 metres in length and 50 metres in breadth. Visiting vessels carrying LNG (LNG carriers) would berth alongside the FSRU for 32 to 36 hours and transfer LNG to the FSRU. The FSRU would return LNG back into a gaseous state by heating the LNG using a heat source (a process known as regasification).

Following regasification, the natural gas would be transferred from the FSRU to the Crib Point Receiving Facility. The Crib Point Receiving Facility would include processing facilities to inject mercaptan (odorant) and nitrogen (as required) into the natural gas to meet Victorian Transmission System (VTS) gas quality specifications.

## Pipeline Works

The Pipeline Works would comprise of a bi-directional gas transmission pipeline to transport gas from the Crib Point Receiving Facility to the VTS, east of Pakenham. The pipeline would be approximately 57 kilometres long with a nominal diameter of 600 millimetres. The pipeline would be buried at a depth of generally 1.2 metres below ground (to the top of the pipe).

The Pipeline Works also comprises the following facilities:

- the above ground Pakenham Delivery Facility situated adjacent to the Pakenham East rail depot to monitor and regulate the gas
- the below ground End of Line Scraper Station (EOLSS) located at the connection point to the VTS, north of the Princes Highway in Pakenham
- two above ground mainline valves (MLVs) that will be situated along the pipeline alignment, which will allow for isolation of the pipeline in an emergency.

The proposed pipeline alignment and facilities, as well as the reference points, identified as the Kilometre Points (KPs), from the Crib Point Receiving Facility to the EOLSS, are shown in the EES Attachment VII: *Map book* and Figure A3 in Appendix A-A.

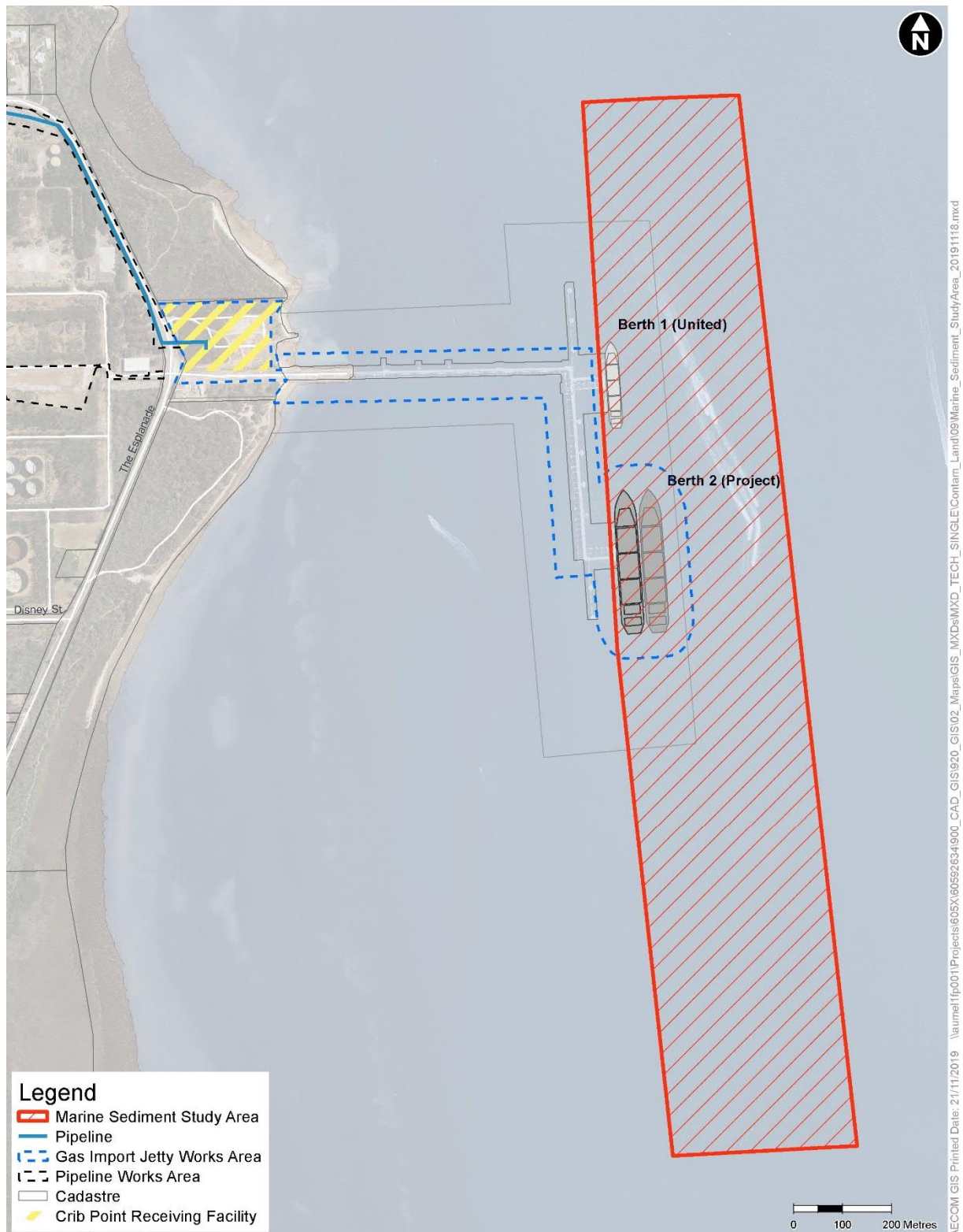
## Study area

The study area for the purpose of soil and groundwater contamination investigation, and ASS investigation, includes the pipeline right of way (ROW) and alignment alternative and a buffer area of 50 metres either side of the ROW, the Pakenham Delivery Facility, the EOLSS, and the landside component of the Gas Import Jetty Works which includes the gas piping and the Crib Point Receiving Facility.

The study area for the purpose of marine sediment contamination investigation includes Berth 1 and 2 and a buffer area of approximately 200 metres east of the berths.

The marine sediment study area is shown in Figure 2 below.





**Figure 2 Marine sediment study area**

## 1.2 Objectives

The purpose of this report is to support the EES by providing information relating to environmental condition of soil, groundwater and marine sediment within the study area, likely to be encountered during construction and operation of the Project.

The objectives are to:

- assess the soil, groundwater and marine sediment quality within the study area, via a field investigation program.
- assess the potential risk to receptors (e.g. residents, the general public, ground intrusive workers and ecosystem) posed by potential presence of ASS, contaminated soils and groundwater, and contaminated marine sediment, across the study area.

## 2.0 Methodology

This section describes the methodology that was used to assess the potential impacts of contaminated soil, groundwater and marine sediment, and ASS on the Project.

### 2.1 Soil investigation program

Soil investigations undertaken for the landside component of the Gas Import Jetty Works and the Pipeline Works are summarised below:

- A site visit was undertaken by AECOM staff on 3 December 2018 to assist in identifying suitable locations for the soil bores.
- Underground service clearance of all soil bores and groundwater well locations was undertaken prior to excavation between 29 November 2018 and 27 February 2019 by QEST Environments and JULS Projects, using electronic scanning equipment and service plans.
- Advancement and logging of 96 soil bores between 14 January 2019 and 26 April 2019, to a maximum depth of 2.5 metres below ground level (mbgl) or refusal. An additional three soil bores were advanced in the proposed pipe stringing area within the former Western Port BP Refinery on 31 March 2020. This was done using a combination of non-destructive drilling (NDD)/hand auger depending on site access and ground conditions. Where combination of NDD/hand auger was used, the NDD method was used down to just where sample was to be collected, then sample was collected using hand auger from undisturbed portion of the lithology. The soil bores were drilled and reinstated by QEST Environments, under the supervision of qualified AECOM environmental staff. The locations of all soil bores installed across the study area are shown in Figure A3, Appendix A-A and bore logs are presented in Appendix A-C. Unique location identifier names for individual land parcels were used to easily identify bore locations and are summarised in Table B2, Appendix A-B. The simplified bore identification is referred to in this report. Soil sampling consisted of grid and targeted sampling as outlined below:
  - Collection of samples on a grid basis from 58 soil bores along the pipeline alignment at a density of approximately one soil bore per kilometre of pipeline, including samples collected during installation of 26 groundwater monitoring bores. The sampling density was adopted to assess the potential for widespread/regional contamination of soil, based on the largely rural setting. Assessment of ASS was also completed at a density of one soil bore per kilometre, except targeted ASS sampling locations, described below. This approach is considered sufficient to assess the potential for the presence or absence of soil contamination and ASS within the study area.
  - Collection of samples from 11 soil bores, targeting areas that had been identified during desktop review to have higher potential for contamination, e.g. near industrial/commercial areas, shared pipeline corridor and former landfill (refer to EES Technical Report E: *Contamination and acid sulfate soils impact assessment* for details).
  - Collection of samples from 27 soil bores targeting areas where the desktop review identified that ASS is more likely to be present (as per CSIRO's Australian Soil Resource Information System (ASRIS) soil database), at a density of one soil bore per 100 metres of pipeline, in accordance with in the EPA Victoria Publication *Industry Waste Resource Guideline (IWRG) 655.1 – Acid Sulfate Soils and Rock* (refer to EES Technical Report E: *Contamination and acid sulfate soils impact assessment* for details).
  - Collection of samples from three soil bores, targeting the proposed pipe stringing area in the former Western Port BP Refinery site following its inclusion in the Project.
- Inspection of soils in the field for general signs of contamination such as staining and odour, and presence of asbestos containing material (ACM).
- Soil samples were collected in glass jars provided by the laboratory, or plastic jars provided by the laboratory when Per- and polyfluoroalkyl substances (PFAS) screening was required, and plastic zip-lock bags for ASS analysis.
- Samples were generally collected at the surface of the site and depths of 0.5 m, 1.0 m, 1.5 m, 2.0 m and 2.5 mbgl. Note that no rock samples were collected. Each soil sample was assessed for

head space vapour concentrations using a Photo-Ionisation Detector (PID). A list of soil samples collected is provided in Table B2, Appendix A-B.

- Samples were stored on ice in an esky whilst on site and in transit to the laboratory for analysis at the completion of each sampling day. ASS bags were frozen within 24 hours of collection by the laboratory to ensure holding time compliance. All soil and Quality Control and Quality Assurance (QA/QC) samples were submitted under chain of custody procedures to ALS (primary laboratory) and Eurofins (secondary laboratory). Both laboratories are National Association of Testing Authorities (NATA) accredited for analysis selected.
- Soil samples were analysed for a combination of:
  - EPA Victoria Publication *IWRG621 – Soil Hazard Categorisation and Management* suite of analytes including the and Australian Standard Leaching Procedure (ASLP) (selected samples only), and PFAS compounds at selected locations within the landside component of the Gas Import Jetty Works and adjacent to the former Western Port BP refinery (The Esplanade), to assess for contamination.
  - Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS) and chromium reducible sulfur (CRS) suite of analytes, to assess for the presence of ASS.
- The sampling equipment (hand auger) was decontaminated prior to use and between sample locations by being washed in Liquinox solution and rinsed with potable water and laboratory supplied deionised water. Disposable nitrile gloves were changed between sampling locations.
- Soil cuttings were returned to the soil bores and backfilled using washed sand. At locations where NDD was used soil/water slurry was transported off-site by QEST Environments and disposed of in accordance with EPA Victoria Guidelines. QEST Environments waste transport records are provided in Appendix A-F.
- Sampling equipment calibration certificates from the supplier are provided in Appendix A-G.

## 2.2 Groundwater investigation program

### 2.2.1 Groundwater monitoring wells

A total of 22 groundwater wells were installed as part of EES Technical Report D: *Groundwater impact assessment*, and four groundwater monitoring wells (GW02 to GW05) were installed as part of this investigation to target areas of potential environmental concern identified through desktop review.

The locations of groundwater monitoring wells are shown in Figure A3 (Appendix A-A). GW01 was not installed during the site investigation program, due to observations made in GW03 and MW04 (installed as part of EES Technical Report D: *Groundwater impact assessment*) that indicated the groundwater level along the Frankton-Flinders Road in Hastings is greater than three mbgl, which is deeper than the proposed excavation depth for the area and therefore groundwater is unlikely to be encountered.

Groundwater monitoring well installation undertaken along the pipeline alignment and alternative alignments, is summarised below:

- Acquisition of a bore construction licence from the appropriate Water Authority (Southern Rural Water) prior to boring activities. Licences were obtained by APA following approval from land owners.
- Location and/or clearance of underground cables/utilities by underground service location specialists QEST Environments and JULS Projects at all locations.
- Drilling of groundwater monitoring wells over the period of 3 December 2018 and 11 January 2019. The wells were constructed by South Western Drilling Pty Ltd (SWD) under the supervision of qualified AECOM geo-environmental staff.
- Installation of four groundwater monitoring wells, to a maximum depth of 4.1 mbgl. Wells were cleared to 1.5 mbgl by a combination of NDD/hand auger and drilling was then advanced by solid stem auger to target depth. Groundwater bore logs are presented in Appendix A-C and details of the bore construction are summarised in Table B3, Appendix A-B.

- Groundwater monitoring wells were constructed using nominal 50 millimetre diameter Class 18 polyvinyl chloride (PVC) casing. All bores were screened across the water table with three metre long machine-slotted (0.5 millimetre slots) PVC screen. A sand filter pack (8/16" washed quartz sand) was installed in the bore annulus across the screen and at least 0.1 metres above the top of the screen. Above this, a bentonite seal (at least 0.5 metre thick) was installed and hydrated. The annulus was then grouted to surface level and either a flush gatic or stick-up monument were installed. Details of the groundwater wells are presented in the EES Technical Report D: *Groundwater impact assessment*.
- Groundwater monitoring wells were developed in general accordance with EPA Victoria Publication 669 – *Groundwater Sampling Guidelines* by agitating the water column and removing of fines using a dedicated disposable bailer. The well development records are presented in Table B3, Appendix A-B.
- Surveying of the top of the well casing and location of newly installed groundwater monitoring wells to Australian Height Datum (AHD) and Australian Mapping Grid (AMG) was done on 30 January 2019. Survey data is provided in Table B3, Appendix A-B.

### 2.2.2 Groundwater gauging

One round of groundwater gauging was undertaken on all groundwater monitoring wells installed along the proposed pipeline alignment on 30 January 2019. All groundwater wells (26 locations) were gauged using an oil-water interface meter for depth to groundwater and total depth. Groundwater gauging records are provided in Table B4, Appendix A-B.

### 2.2.3 Groundwater sampling

A total of 15 groundwater monitoring wells were sampled between 23 January 2019 and 30 January 2019. The groundwater monitoring event was completed as follows:

- Groundwater gauging of all monitoring wells using an oil-water interface meter to detect groundwater depth and potential presence of non-aqueous phase liquid (NAPL).
- Field measurement of well headspace Volatile Organic Compounds (VOCs) concentrations using a portable PID.
- Groundwater sampling was conducted in wells GW03, GW04, GW05, MW01-MW03, MW05, MW07, MW09-MW11, MW14, MW15, MW21, and MW22. The remaining 11 wells did not have sufficient water column to collect a sample (noting that wells were installed to approximately four mbgl, one metre below the maximum depth of excavation for the trench and horizontal thrust boring sections).
- Low flow sampling of MW10 was completed in general accordance with EPA Victoria Publication 669. At wells MW02, MW03, MW05, MW07, GW04, GW05, MW09, MW11, MW14, MW15, MW21 and MW22 recharge was too slow for low flow sampling, so 50% of the well volume was purged with the low flow pump and samples were collected the following day (within 24 hours) using a low flow pump (operating with minimal drawdown). The water column was insufficient in wells MW01 and GW03 to effectively operate low flow pump, so a grab sample was collected using a dedicated disposable bailer.
- Collection of ex-situ measurements of groundwater field chemistry (pH, electrical conductivity, dissolved oxygen, oxidation reduction potential, and temperature) was undertaken during low-flow purging. Where samples were collected the following day, in-situ measurements of groundwater field chemistry were collected prior to sampling. Stabilised field parameters and groundwater sampling observations are summarised in Table B5, Appendix A-B.
- Submission of all groundwater and QA/QC samples to ALS and Eurofins, both NATA accredited laboratories, for analysis of a selected suite of contaminants of potential concern (COPC) (refer to Appendix A-D). Samples for dissolved metals were field filtered with a single-use Stericup 0.45 micrometre filter to remove suspended solids and colloids and collected in laboratory-provided sample collection bottles containing acid for stabilisation/preservation.
- Groundwater samples were analysed for dissolved metals (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), aluminium (Al), iron (Fe), selenium

(Se), mercury(Hg)), major ions, Total dissolved solids (TDS), nitrate, ammonia, chromium trivalent (Cr(III)), chromium hexavalent (Cr(VI)), total phosphorous, total recoverable hydrocarbons (TRH) C<sub>6</sub>-C<sub>40</sub> and VOC/semi-VOC (SVOC). The groundwater sample from GW05 was also analysed for PFAS suite of analytes.

- Decontamination procedures included washing the interface probe and low flow pump in Liquinox solution, followed by a rinse with potable water and deionised water between wells. Low flow bladders, low flow tubing and bailers were dedicated for each well.
- The water quality meter used to collect groundwater field parameters was calibrated daily prior to sampling.

## 2.3 Marine sediment investigation program

Marine sediment sampling was undertaken by Consulting Environmental Engineers Pty Ltd (CEE) on 1 March 2019 and 18 July 2019. A total of 20 marine sediment samples were collected from the following four locations:

- Berth 1
- Berth 2
- reference site 500 metres north of Berth 1
- reference site 500 metres south of Beth 2.

The locations of all marine sediment samples are shown in Figure A8, Appendix A-A.

The methodology employed to collect marine sediment samples is summarised below:

- Samples were retrieved using a stainless Ponar grab deployed from a vessel by experienced and qualified marine scientists, following the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Handbook for Sediment Quality Assessment (Simpson et al., 2005), Revision of the Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Sediment Quality Guidelines (Simpson et al., 2013), and the National Assessment Guidelines for Dredging (NAGD) (2009).
- Each sampling location was located using a handheld Global Positioning System (GPS).
- Samples were logged and processed on board the vessel.
- Samples were stored on ice in an esky whilst on site and in transit to the laboratory for analysis at the completion of each sampling day. All primary and QA/QC samples were submitted under chain of custody procedures to ALS (primary laboratory) and Eurofins (secondary laboratory). Both laboratories are NATA accredited for the analysis selected.
- Marine sediment samples were analysed for metals (antimony (Sb), arsenic, cadmium, chromium, copper, iron, lead, manganese (Mn), mercury, nickel, silver (Ag) and zinc), organotins - Tributyltin (TBT), polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyl (PCBs), TRHs, PFAS full suite (28 analytes), moisture content, particle sizing and total organic carbon (TOC). It is noted that only initial samples collected on 1 March 2019 were analysed for pesticides, PCBs and TRH. As the concentration of these compounds was below the limit of reporting (LOR) during initial sampling, it was considered that this analysis was not required for subsequent monitoring.
- Quality control samples consist of:
  - Collection of field triplicates (three separate samples taken at the same location) to determine the variability of the marine sediment physical and chemical characteristics
  - Collection of split triplicates (one thoroughly mixed sample split into three containers) to assess laboratory variation, with one of the three samples sent to a second (reference) laboratory for analysis.

Sediment sampling and analysis were undertaken in general accordance with the Simpson et al. (2005), Simpson et al. (2013), NAGD (2009) and ANZECC & ARMCANZ Water Quality Guidelines (ANZECC & ARMCANZ 2000).

It is noted that, although the NAGD (2009) was referenced for guidance in developing the scope of work and undertaking the marine sediment assessment, complete adherence to the NAGD (2009) was not applicable as the purpose of this investigation is not to inform a dredging application.

Detailed descriptions of methodology used by CEE to undertake marine sediment sampling at the marine sediment study area is described in the report *AGL Gas Import Jetty Project Crib Point, Western Port* (CEE, 2019) provided in Appendix A-J.

## 2.4 Assumptions and limitations

Assumptions and limitations relating to the field investigations for the Project are provided below:

- Interpretation of subsurface conditions and the nature and extent of contamination is based on field observations and laboratory analytical data from widely spaced locations.
- Information contained in this report should only be used as a guide. The assessment was undertaken on preliminary basis to provide a contamination (soils, groundwater and marine sediment) and ASS impact assessment for the EES and to develop mitigation measures for potential impacts. Further detailed investigation may be necessary for selected areas (e.g. where stain or odorous soils are encountered).
- AECOM has tested only for those chemicals specifically referred to in this report. AECOM makes no statement or representation as to the existence (or otherwise) of any other chemicals.
- Where this report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information except as expressly stated in the report. AECOM assumes no liability for any inaccuracies in or omissions to that information.
- Except as otherwise specifically stated in this report, AECOM makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials (ACM) on the site. If fill has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or materials from such buildings disposed of on the site, the site may contain asbestos or ACM. At each sampling location visual inspection was made for the presence of ACM.
- No investigations have been undertaken on any adjoining sites, which may be impacted by potential contamination originating from the Project Area; and no investigation have been undertaken on adjoining sites that may be impacting the Project Area.
- Investigations undertaken in respect of this report are constrained by the particular locations selected for investigation. As a result, not all relevant site features and contamination may have been identified in this report.
- The conclusions presented are based solely on the information and findings contained in this report.



## 3.0 Beneficial uses and adopted screening criteria

### 3.1 Introduction

This report focuses on the potential impacts of contaminated soils, contaminated groundwater, contaminated marine sediments and ASS on human health (with respect to nearby residents and the general public) and the environment from the Project construction and operational activities. The protected beneficial uses and adopted screening criteria applicable to the study area for the contaminated soil, groundwater, marine sediment and ASS assessment are summarised in the following sections.

### 3.2 Beneficial use assessment

#### 3.2.1 Contaminated land

The *State Environment Protection Policy (SEPP) Prevention and Management of Contaminated Land (PMCL)* provides a statutory framework for protecting people and the environment from the effects of contamination. Table 1 of the SEPP (PMCL) (reproduced below as Table 1) outlines the beneficial uses to be protected by land use.

**Table 1 Protected beneficial uses of land (SEPP (PMCL), 2002)**

Beneficial Use	Land Use						
	Park & Reserves	Agricultural	Sensitive Use		Recreation/ Open Space	Commercial	Industrial
			High Density	Other			
Maintenance of ecosystems							
<i>Natural Ecosystems</i>	✓						
<i>Modified Ecosystems</i>	✓	✓		✓	✓		
<i>Highly Modified Ecosystems</i>		✓	✓	✓	✓	✓	✓
Human Health	✓	✓	✓	✓	✓	✓	✓
Buildings and Structures	✓	✓	✓	✓	✓	✓	✓
Aesthetics	✓		✓	✓	✓	✓	
Production of food, flora and fibre	✓	✓		✓			

The existing land uses within the study area, include all those listed in Table 1, except high density residential. Therefore, all beneficial uses, for land uses listed in Table 1 were considered in assessing the potential impacts from the Project construction and operational activities, such that mitigation measures could be put in place to ensure current and future uses are not precluded. The key receptors of interest for the Project are considered to be:

- People residing, working and utilising the land within the study area, reserves and recreational areas.
- Construction workers undertaking ground intrusive works.
- Natural ecosystems that exist along the study area, including the Western Port Ramsar site.

Soil indicators and objectives for the beneficial uses of land are outlined in Table 2 of the SEPP (PMCL). The adopted investigation levels (ILs) for comparison of the soil analytical results with those

identified as potential beneficial uses relevant for the Project, are discussed below and summarised in Table B10, Appendix A-B.

### Maintenance of Ecosystems – natural ecosystems

For the assessment of Maintenance of Ecosystems the following screening criteria have been adopted:

- The Amended *National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) 2013* Ecological Investigation Levels (EILs)

The EILs apply to zinc (Zn), copper (Cu), chromium III (Cr III), nickel (Ni), lead (Pb), arsenic (As), naphthalene and Dichlorodiphenyltrichloroethane (DDT); and principally apply to samples from the top two metres of soil (this is considered the limit of the plant root zone and habitation of many species).

The derivation of EILs considers the physicochemical properties of soil and contaminants and the capacity of the soil to accommodate increases in contaminant levels above natural background, while maintaining ecosystem protection for identified land uses. Site specific EILs are derived by summing the Added Contaminant Limits (ACLs) and Ambient Background Concentration (ABC). The ACLs, however, is only applicable to Zn, Cu, Cr(III) and Ni for site-specific EIL determination, and the EILs for As, DDT and naphthalene are generic to all soils and are presented as a total soil contaminant concentration.

The methodology used to derive the adopted EILs screening criteria was:

- The ACLs for Cu, Ni and Zn were determined using the soil Cation Exchange Capacity (CEC). In the absence of measured CEC values, the CEC value was estimated based on lithology encountered within the study area and the indicative CEC values recommended by Hoyle (2013).
- The lithology encountered within the study area was observed to be predominantly clay; and Hoyle (2013) reported indicative CEC for clay soil textures between 25 milliequivalents per 100 grams (meq/100g) to 150 meq/100g.
- Instead of interpolating the data presented in Table 1B(1-3) of the Amended ASC NEPM 2013, a CEC value of 20 meq/100g was conservatively adopted, along with the average pH (field investigation data by CaCl<sub>2</sub> method) of 5.5.

It is noted that site specific ABC was not calculated, and the ACLs were adopted as the screening criteria. The results were conservatively screened against the screening criteria for Areas of Ecological Significance. Where concentrations exceeded the screening criteria for Areas of Ecological Significance, the results were then compared to the ACLs relevant to the existing land use such as Commercial/Industrial for the Crib Point Receiving Facility.

The adopted EILs are presented in Table 2.

**Table 2 Ecological Investigation Levels (EILs) adopted screening criteria**

Chemical	Screening Criteria (mg/kg)		
	Areas of Ecological Significance	Urban Residential/Public Open Space	Commercial/Industrial
Zinc	60	270	420
Copper	45	130	190
Chromium (III)	130	400	660
Nickel	45	270	460
Lead	470	1,100	1,800
Arsenic	40	100	160
DDT	3	180	640
Naphthalene	10	170	370

- The Amended ASC NEPM 2013 Ecological Screening Levels (ESLs)

The ESLs relate to various land uses and soil types for protection of soil processes, plant species and organisms that inhabit or contact soil; and therefore, only apply to samples from top three metres of soil (due to mobility and volatility of petroleum hydrocarbon contamination in the sub-surface). The ESLs apply to the petroleum hydrocarbon fractions F1-F4, benzene, toluene, ethylbenzene and xylene (BTEX) and benzo(a)pyrene (BaP) and are applicable to assessing risk to terrestrial ecosystems.

The ESLs criteria for Areas of Ecological Significance were initially adopted for screening purposes. Where concentrations exceeded the screening criteria for Areas of Ecological Significance, the results were then compared to the ESLs criteria relevant to the existing land use such as Commercial/Industrial for the Crib Point Receiving Facility.

- The Amended ASC NEPM 2013 Management Levels (MLs)

The MLs relate to various land uses and soil for TPH fractions F1-F4 to assess the potential risk associated with petroleum compounds, fire/explosion and damage to underground utilities. MLs are applicable after consideration of relevant ESLs and HSLs.

The MLs criteria for Residential, Parkland and Public Open Space were conservatively adopted for screening purposes. Where concentrations exceeded the screening criteria for Residential, Parkland and Public Open Space, the results were then compared to the MLs criteria relevant to the existing land use such as Commercial/Industrial for the Crib Point Receiving Facility.

## Human health

For the protection of human health the following screening criteria have been adopted:

- The Amended ASC NEPM 2013 Health Investigation Levels (HILs)

The HILs are scientifically based, generic assessment criteria designed to be used in the first stage of an assessment of potential risks to human health from chronic<sup>1</sup> exposure.

The HILs for Residential A (low density residential) have been conservatively adopted for screening purposes. Where concentrations exceeded the screening criteria for Residential A, the results were then compared to the HILs criteria relevant to the existing land use, such as Commercial/Industrial for the Crib Point Receiving Facility.

- The Amended ASC NEPM 2013 Health Screening Levels (HSLs)

The HSLs apply to petroleum hydrocarbon compounds that present human health concern predominantly through exposure to vapours from contaminant sources and by direct contact with affected soils. It is noted that the HSLs were developed for the standard service station site and their broader use needs to consider a range of limitations (as outlined in the ASC NEPM).

The HSL-A & HSL-B (low – high density residential) criteria has been conservatively adopted for screening purposes. Where concentrations exceeded the screening criteria for HSL-A & HSL-B, the results were then compared to the HSLs relevant to the existing land use, such as HSL-D (Commercial/Industrial) for the Crib Point Receiving Facility.

## Buildings and structures

According to the SEPP (PMCL), contamination must not cause the land to be corrosive to, or to adversely affect the integrity of structures or building materials. The exposure classifications for concrete piles and steel piles have not been considered as part of this environmental assessment. Assessment of risks to buildings and structures was undertaken as part of the geotechnical investigations for the Project.

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<sup>1</sup> Chronic health effects occur as a result of prolonged or repeated exposures over many days, months or years and symptoms may not be readily apparent (Amended ASC NEPM 2013)

## Aesthetics

The SEPP (PMCL) describes the objective of the beneficial use of aesthetics as: 'Contamination must not cause the land to be offensive to the senses of human beings'. Field observation of waste materials, soil odours and staining were used to assess the protection of this beneficial use.

## Production of food, flora and fibre

For the protection of the beneficial use Production of food flora and fibre, the same criteria as for the protection of the 'Maintenance of ecosystems – natural ecosystems' beneficial use have been adopted.

### 3.2.2 Groundwater

The SEPP (Waters) provides a statutory framework for protecting and improving the quality of Victoria's waters having regard to the principles of environment protection set out in the *Environment Protection Act 1970*. Table 2 of Schedule 2 of the SEPP (Waters) (reproduced below as Table 3) outlines the beneficial uses for groundwater.

**Table 3 Beneficial uses for groundwater (SEPP (Waters), 2018)**

Beneficial Use	Segment (TDS mg/L)						
	A1 (1-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,001)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Cultural spiritual values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties.	✓	✓	✓	✓	✓	✓	✓

Groundwater salinity was measured in 14 monitoring wells along the pipeline alignment, as described in Section 6.2.1. The salinity, measured as total dissolved solids (TDS), ranged from 1,253 mg/L (Segment B) at MW07 to 16,414 mg/L (Segment F) at MW11 with an average of 6,334 mg/L. Consistent with EES Technical Report D: *Groundwater impact assessment*, Segment B has been

conservatively adopted as the groundwater segment for the Pipeline Works. A map showing groundwater salinity along the study area and field measurements is provided in Figure A4, Appendix A-A.

Groundwater sampling at the landside component of the Gas Import Jetty Works was not undertaken as part of this investigation as groundwater levels measured and reported by following investigation reports for the Crib Point Jetty indicated that the Project is unlikely to encounter groundwater beneath the area:

- *Acid Sulfate Soil Investigation – Crib Point Receiving Facility* (Construction Science, January 2019)
- *Baseline Environmental Contamination Investigation – Crib Point Jetty for Port of Hastings Development Authority* (Jacobs, June 2017)
- *Environmental Site Assessment Works Port of Hastings* (No. VP7753.001:Rev0, 14-2273), CMPS&F Pty Ltd, 1997 (as an Appendix to the Statements of Environmental Audit, Port of Hastings Sites (No. 78J155A-pr29999d M7314), PPK Environment & Infrastructure Pty Ltd, 1998).

Groundwater levels at the Crib Point Jetty as reported within the above investigation reports are presented in Table 4 and in Figure 3.

**Table 4** Depths to groundwater measured in previous site investigation reports for the Crib Point Jetty

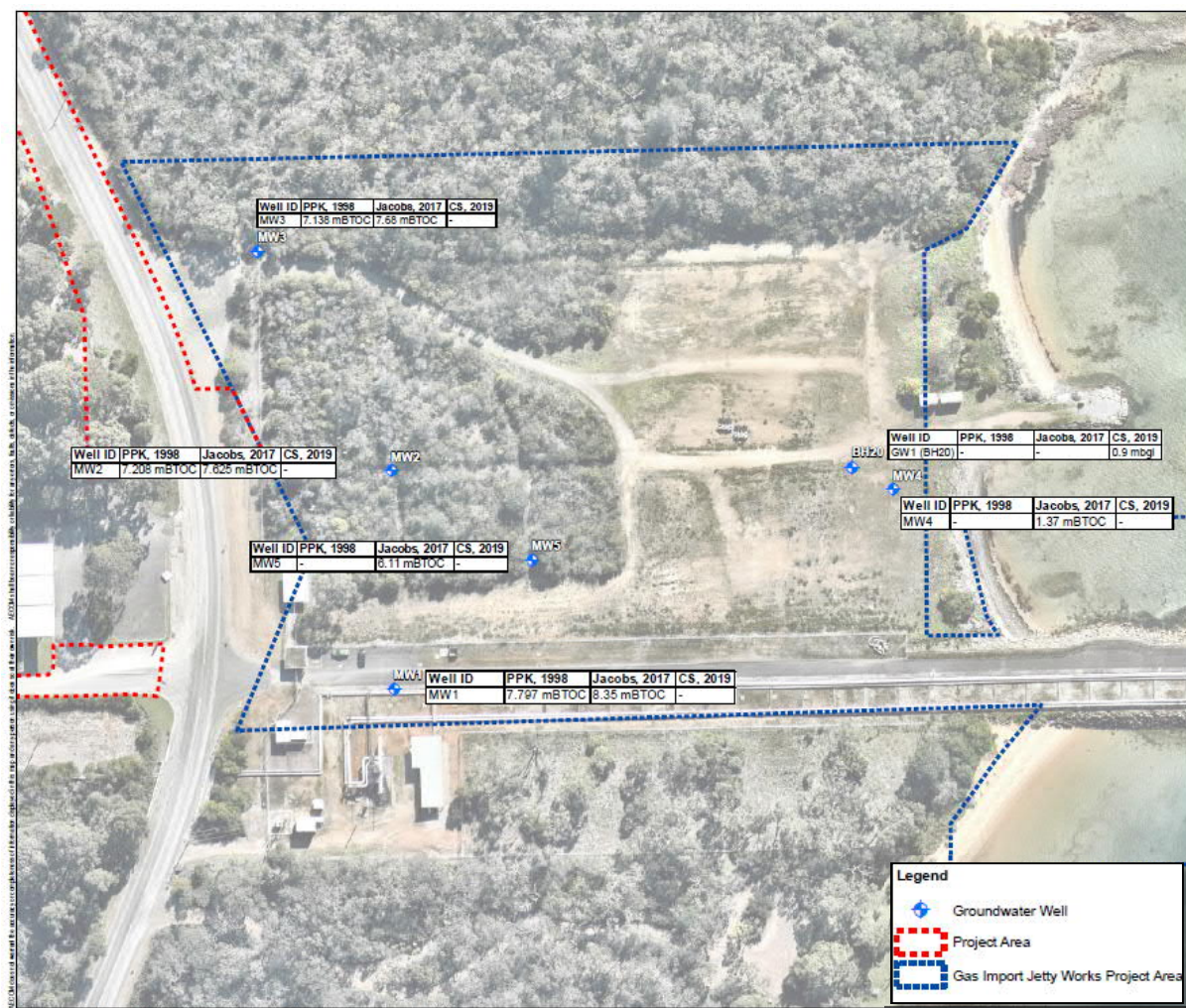
Groundwater Well	PPK Environment & Infrastructure Pty Ltd, 1998	Jacobs, 2017	Construction Science, January 2019
1	7.797 mBTOC	8.35 mBTOC	-
2	7.208 mBTOC	7.625 mBTOC	-
3	7.138 mBTOC	7.68 mBTOC	-
4	-	1.37 mBTOC	-
5	-	6.11 mBTOC	-
WSP-MW01	-	-	-
WSP-MW02	-	-	-
WSP-MW03	-	-	-
WSP-MW04	-	-	-
BH20 (GW1)	-	-	0.9 mbgl

Note:

Metre below top of casing (mBTOC): the depth from top of well casing to the groundwater table

Metre below ground level (mbgl): the depth from the ground surface level to the groundwater table





**Figure 3 Groundwater monitoring well locations installed and sampled during previous site investigations**

Groundwater quality indicators and objectives for the beneficial uses of groundwater are outlined in Schedule 3 of the SEPP (Waters) (2018). The beneficial uses of groundwater to be protected for the Project and the adopted ILs are summarised in Table 5 and Table B12, Appendix A-B.

**Table 5 Protected beneficial uses of groundwater and the adopted investigation levels (SEPP (Waters), 2018)**

Beneficial Use	Adopted Investigation Levels
Water dependent ecosystem and species (Western Port Segment- Entrance and North Arm)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMICANZ 2000), 99 % level of protection for marine water. PFAS NEPM (2018), Aquatic ecosystems: freshwater and marine water guideline values, 99 % species protection – high conservation value systems.
Agriculture and irrigation (irrigation)	ANZECC & ARMICANZ 2000, Agricultural irrigation water long-term trigger value (LTV).
Agriculture and irrigation (stock watering)	ANZECC & ARMICANZ 2000, Livestock Watering (Beef Cattle, Poultry and Sheep).
Industrial and commercial	In accordance with ANZECC & ARMICANZ 2000, no criteria have been adopted to be protective of this beneficial use. Due to the varied requirements for

Beneficial Use	Adopted Investigation Levels
	industrial use, it is considered that other coincidental environmental values will drive management of the resource.
Water-based recreation (primary contact recreation)	National Health and Medical Research Council (NHMRC) 2008, Guidelines for Managing Risks in Recreational Water.
Traditional Owner cultural values	In accordance with the SEPP (Waters), environmental quality objective for 'water dependent ecosystems' beneficial use have been adopted to be protective of this beneficial use.
Cultural and spiritual values	In accordance with the SEPP (Waters) environmental quality objective for 'water dependent ecosystems' beneficial use have been adopted to be protective of this beneficial use.
Buildings and structures	Not considered as part of this assessment.
Geothermal properties	Not applicable.

### 3.2.3 Marine sediment

The SEPP (Waters) provides a statutory framework for protecting and improving the quality of Victoria's waters having regard to the principles of environment protection set out in the *Environment Protection Act 1970*. Table 4 of Schedule 2 of the SEPP (Waters) outlines the beneficial uses for marine and estuarine waters. The beneficial uses for Western Port – Entrances and North Arm segment are reproduced below in Table 6.

**Table 6 Beneficial uses for Marine Waters – Western Port Entrances and North Arm Segment (SEPP (Waters), 2018)**

Beneficial Uses		Western Port – Entrances and North Arm
Water dependent ecosystems and species that are:	Largely unmodified	✓
	Slightly to moderately modified	
	Highly modified	
Human consumption after appropriate treatment		
Agriculture and irrigation		
Human consumption of aquatic foods		✓
Aquaculture		✓ where the environmental quality is suitable and an aquaculture licence has been issued under the <i>Fisheries Act 1995</i>
Industrial and commercial		✓
Water-based recreation (primary contact)		✓
Water-based recreation (secondary contact)		✓
Water-based recreation (aesthetic enjoyment)		✓
Traditional Owner cultural values		✓
Cultural and spiritual values		✓
Navigation and shipping		✓



For this Project, the relevant beneficial use and environmental quality objectives for marine sediment is to protect water dependent ecosystems and species for a largely unmodified ecosystem. The Revision of the ANZECC & ARMCANZ Sediment Quality Guidelines (Simpson et al., 2013) have been adopted as the screening criteria, and the sediment quality guideline values (SQGVs) are presented in Table B13, Appendix A-B.

### 3.3 IWRG soil hazard categorisation

In Victoria, the discharge or emission of waste to water, land or air, and controls on the disposal and transportation of waste is regulated under the *Environmental Protection Act 1970*, administered by the EPA Victoria. EPA Victoria regulates the storage, transport and disposal of waste in Victoria. Wastes taken off-site for treatment and disposal must be classified in order to determine EPA Victoria requirements and to choose an appropriate management option.

The Victorian EPA has produced Industrial Waste Resource Guidelines (IWRGs) under the *Environment Protection (Industrial Waste Resource) Regulations 2009* which set the framework for the categorisation of wastes and define criteria used for the categorisation of waste soil in Victoria. The following EPA Victoria publications provide guidance in relation to the sampling and categorisation of contaminated soil:

- *IWRG600.2 Waste Categorisation (2010)*
- *IWRG621 Soil Hazard Categorisation and Management (2009)*
- *IWRG702 Soil Sampling (2009)*.

Soils collected during this site investigation were classified in accordance with the EPA Victoria publication IWRG621. However, it is noted that the sampling density does not comply with the EPA Victoria Publication IWRG702, as this site investigation was intended to provide an indication of the potential for soil contamination within the study area only, and not for the purpose of off-site soil reuse, treatment or disposal. The Soil Hazard Categories in accordance with EPA Victoria Publication IWRG621 are:

- **Fill** - soil, gravel and rock of naturally occurring matters, often referred to as 'clean fill' by industry, with concentrations less than the upper limits specified for 'fill'. EPA Victoria does not regulate the use of fill material and re-use of this soil does not require EPA Victoria approval, however other authorities such as local councils, may have individual requirements. Use of fill material on any site must take into account general obligations (under the EP Act) to prevent adverse impacts on the environment and human health.
- **Category C** - contaminated soil with concentrations exceeding the limits for 'fill' but not exceeding the limits for 'Category C'. This is the lower level of contaminated soil classification for disposal and is accepted at a number of licensed landfills in Victoria, once the landfill has reviewed analytical results and agreed to accept the soil. Category C waste soils must be transported by an appropriately licensed EPA Victoria vehicle (unless exception issued) and accompanied by Waste Transport Certificates.
- **Category B** - Contaminated soil with concentrations exceeding the limits set out for 'Category C' but not exceeding the limits for 'Category B'. This is the higher level of contaminated soil classification for disposal, and is accepted at only one licensed landfill and/or a limited number of treatment facilities in Victoria. Category B waste soils is regulated by EPA Victoria and is subject to the same landfill acceptance, transport and certificate requirements as Category C waste soils.
- **Category A** - Contaminated soil with concentrations exceeding the limits set out for 'Category B'. Category A waste soils are regulated by EPA Victoria are subject to the same transport regulations as Category B or C waste soils, however soils with this higher level of contamination cannot be disposed to landfill. These soils must be treated either on- or off-site, or stored pending availability of an appropriate treatment technology. Once treated (or partially treated) the soils may be reclassified and, if appropriate, retained on site or disposed of to a licensed facility.

It is noted that The Victorian Environment Protection Act will take effect from 1 July 2021. Under the proposed Regulations, contaminated soils must be categorised as either Category A, B, C, D, 'Soil containing asbestos only' or 'Fill material', described in the EPA Victoria Publication *Waste Disposal Categories - Characteristics and Thresholds*, summarised below:

- **Category A, B, and C** – Considered as *reportable priority wastes* and are based on the existing categories in the current Environment Protection (*Industrial Waste Resource*) Regulations 2009 framework.
- **Category D** – Considered as *reportable priority waste* with lower levels of contamination than Category C which can be safely contained at the same project site where the soil was unearthed. Containment of the Category D soils on the unearthing site will be subject to a 5-year permit and site management orders. Alternatively, Category D soil may go to lower grade landfills, subject to standing statutory planning requirements.
- **Soil containing asbestos only** – Considered as *reportable priority waste* and the only contaminant is asbestos.
- **Fill Material** – Considered as *industrial waste* with contamination levels below the minimum Category D thresholds specified in EPA Victoria guidance; and would be subject to the Declaration of Use (DoU)<sup>2</sup> tool.

### 3.4 PFAS National Environment Management Plan (PFAS NEMP)

#### Soil

The *PFAS National Management Plan* (PFAS NEMP) (January 2018) presents nationally agreed guideline values that should be used to inform site investigations. The PFAS NEMP (2018) lists perfluorooctane sulfonate (PFOS)/perfluorohexane sulphonic acid (PFHxS) and perfluorooctanoic acid (PFOA) guideline values for the assessment of potential human exposure through direct soil contact. The guideline values have been applied in conjunction with other lines of investigation to account for potential leaching, off-site transport, bioaccumulation and secondary exposure.

The PFAS NEMP (2018) lists PFOS and PFOA guideline values for the assessment of ecological protection, which consider both direct and indirect exposure. Direct exposure applies specifically to protection of organisms that live within, or are closely associated with, the soil, such as earthworms and plants. Other factors important for assessing exposure, for example bioaccumulation and leaching/off-site transport, must be accounted for by including other lines of investigation. The indirect exposure guideline values are intended to account for the various pathways other organisms can be exposed to due to bioaccumulation and/or off-site transport.

The following guidelines from the PFAS NEMP (2018) have been adopted for both soil on-site and for any soil requiring off-site disposal to landfill:

- **Table 2: Soil criteria for investigation** – Human health - Public open space and Industrial/commercial.
- **Table 3: Soil criteria for investigation** – Ecological guideline values - Public open space and Industrial/commercial.
- **Table 6: Landfill acceptance criteria** – Unlined.

Note that the hierarchy of treatment and remediation options outlined in the PFAS NEMP should be followed when considering options for the management of PFAS impacted solid waste. The EPA Victoria Publication 1669.3 – *interim position statement on PFAS* should also be referred to for reuse of soil which may contain PFAS. If there are no other possible management options available, soils containing PFAS may be disposed off-site through a classification application to the EPA Victoria.

#### Aquatic ecosystem

The PFAS NEMP (2018) presents guideline values for freshwater and marine water (interim) aquatic ecosystems. The following guidelines have been adopted as screening criteria for groundwater:

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<sup>2</sup> Declaration of Use (DoU) is a proposed tool to support safe storage, reuse and recovery of material derived from different types of lower risk wastes. It will involve a self-assessment for the duty holder to complete, which will describe the waste, assess its risks and identify legitimate use. Proposed regulation 64 sets out the circumstances in which a DoU will be able to be used.

- **Table 5: Aquatic ecosystems: freshwater and marine water guideline values** – 99% species protection – high conservation value systems.

### Marine sediment

It is noted that Australian guideline values for maintaining ecosystem health are currently not available for PFAS in marine sediment.

## 3.5 Acid sulfate soil

The *Environment Protection (Industrial Waste Resource) Regulations 2009* sets out the requirements for management of industrial waste and prescribed industrial waste for the purpose of the *Environment Protection Act 1970*, which include the *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999*.

The *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999* provides a framework for management, disposal or reuse of waste ASS. It defines ASS as “any soil, sediment unconsolidated geological material or disturbed consolidated rock mass containing metal sulfides which exceeds criteria for acid sulfate soils specified in Publication 655 entitled ‘Acid Sulfate Soil and Rock’”. In addition, the Policy also sets out the requirement for management of waste ASS in accordance with current best practice or any best practice environmental guidelines approved by the Authority (i.e. EPA Victoria).

Criteria for ASS and rock classification as extracted from the EPA Victoria Publication 655.1 (2009) is provided in Table 7. The criteria is based upon three broad soil textures (coarse, medium and fine), the amount of ASS disturbed, and the sum of existing and potential acidity (not net acidity). The highest laboratory result is used to assess if the relevant action criterion level has been met or exceeded (Dear et al. 2014).

**Table 7 Texture-based action criteria for classification of acid sulfate soil (EPA Victoria Publication 655.1)**

Type of Material		Sum of Existing and Potential Acidity			
Soil or sediment texture	Approx. clay content (%)	1–1000 tonnes material disturbed		>1000 tonnes material disturbed	
		%S-equiv. (oven-dried basis)	Mol H <sup>+</sup> /t (oven-dried basis)	%S-equiv. (oven-dried basis)	Mol H <sup>+</sup> /t (oven-dried basis)
Fine: Medium to heavy clays and silty clays	>40	0.1	62	0.03	18
Medium: Sandy loams to light clays	5–40	0.06	36		
Coarse: Sands to loamy sands	<5	0.03	18		

Note: Soils with existing plus potential acidity below the action criteria may still be ASS, but may not require management.

Soils that meets or exceeds the action criteria are deemed to be soils that require treatment and management. In accordance with the requirement under the *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999*, further risk identification and assessment in accordance with the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010) should be undertaken to identify appropriate management options.

The CASS BPMG (2010) risk identification process is designed to guide any person through a decision-making process for any development or activity proposed on land that has been identified as having the potential to contain CASS. The following are four stages of risk identification and assessment as recommended by the CASS BPMG (2010):

- Stage A: Preliminary CASS hazard assessment
- Stage B: Detailed site soil sampling program and assessment
- Stage C: Surface/groundwater sampling program and assessment

- Stage D: CASS hazard assessment.

After the risk identification and assessment process, a CASS Management Plan (CASSMP) may need to be developed for the ongoing management and monitoring of impacts from CASS. This covers construction and operational phases of an activity or project.

It is noted that although the Pipeline Works and the Gas Import Jetty works are assessed as a full Project under the EES, the construction works will be undertaken separately under separate approvals and management plans. Therefore, for the purpose of ASS classification, specifically the requirement for an Acid Sulfate Soil Management Plan (ASSMP), the classification will need to be completed for both sets of works independently. The action criteria for each project would be determined by the volume of soils to be disturbed during construction. This is discussed in the EES Technical Report E: *Contamination and acid sulfate soils impact assessment*.

## 4.0 Findings of soil investigation

The following description of local geology is based on observations made during fieldwork. The bore logs (refer to Appendix A-C) provide details of the stratigraphy encountered, observations of foreign materials or potential contaminants (e.g. staining and/or odour), PID readings and sample depths.

Table B2, Appendix A-B summarises the information from soil bores including geology encountered, sample depths, analysis suite and KPs.

### 4.1 Soil

#### 4.1.1 Local geology

A generalised description of the local geology encountered is provided in Table 8 and the outcropping units in the study area are shown in Figure A1, Appendix A-A. The geology encountered was consistent with the *Geological Survey of Victoria Queenscliffe SJ 55-9 1:250,000* map (VandenBerg, A.H.M., 1997).

**Table 8 Generalised local geology**

Approximate Depth (mbgl)	Lithology / Formation	General Lithology Encountered
0.0 – 0.2	FILL and/or Sandy CLAY	Brown, FILL – minor reworked soils
0.0 – 1.0	Northern half: alluvial sediments, swamp lake deposit  Southern half: primarily Brighton Group	Clayey SAND to CLAY, brown becoming grey, high to low plasticity
0.1 – 2.5		Sandy CLAY to CLAY; brown to grey, high to low plasticity

#### 4.1.2 Field observations

The following field observations are based on observations made during borehole and well advancement:

**Table 9 Summary of field observations**

Field observation	PID Readings	Observations in Fill	Observation in Natural
PID measurement	LOW (0.0-5.0 parts per million (ppm))	Majority of samples	Majority of samples
	MEDIUM (5.0-20.0 ppm)	GW03, MW08	BH03, BH05, BH07, BH08, BH11, BH15, BH19, BH22, GW02, GW03, MW08, MW17
	HIGH (20.0-100.0 ppm)	Not observed in any samples	BH216, BH42
	VERY HIGH (>100.0 ppm)	Not observed in any samples	BH219, GW04
Staining	-	Not observed in any samples	MW21
Olfactory evidence	-	Not observed in any samples	Not observed in any samples
NAPL (non-aqueous phase liquid)	-	Not observed in any samples	Not observed in any samples

Field observation	PID Readings	Observations in Fill	Observation in Natural
Sheen		Not observed in any samples	Not observed in any samples
Ironstone band		BH12	BH12, BH15, BH22, BH24, GW03, GW04, MW01, MW07, MW12, MW22, MW23
Solid inert materials	Brick, Timber, Concrete	Concrete fragments observed in MW08 only	Not observed in any samples

BH42, GW04, BH216 and BH219 recorded high PID readings; however, analytical results were either below the laboratory LOR or below the adopted beneficial use guideline values, suggesting that it is unlikely to present risk to human health or the environment. The cause or source that contributes to the high PID readings has not been identified.

Staining was observed at MW21 at 2.2 mbgl, however, laboratory results, the absence of a potential source/odour or other signs of contamination, indicate that it is unlikely to be related to contamination.

## 4.2 Soil analytical data

### 4.2.1 Results

Soils analytical results are presented in Tables B6 to B10, Appendix A-B; and NATA certified laboratory reports are included with chain of custody documentation in Appendix A-D.

#### Beneficial uses

Soil analytical results for all samples were either below the laboratory LOR or below the adopted conservative beneficial uses guidelines values with exceptions presented in Table 10, and in Figure A5, Appendix A-A. No ACM were observed in soils within the study area.

**Table 10 Summary of soil screening criteria exceedances – study area (conservative criteria)**

Analyte	Sample ID	Location	Screening Criteria	Adopted Criteria (mg/kg)	Conc. (mg/kg)
Zinc	BH108_0.0	Crib Point Receiving Facility	NEPM 2013 Table 1B(1) EIL for Areas of ecological significance	60	507
	BH109_0.0				140
	BH110_0.0				97
	BH06_0.2	Rail Corridor KP6.0			288
	BH104_0.2	Rail Corridor KP6.3			172
	BH55_0.1	Former Western Port BP Refinery			146
Arsenic	BH108_0.4	Crib Point Receiving Facility	NEPM 2013 Table 1B(5) EIL for Areas of ecological significance	40	49
	GW04_0.5	Adjacent to Tyabb Landfill			89
	GW05_1.0	Adjacent to Tyabb Landfill			60

Analyte	Sample ID	Location	Screening Criteria	Adopted Criteria (mg/kg)	Conc. (mg/kg)
Copper	BH104_0.2	Rail Corridor KP6.3	NEPM 2013 Table 1B(2) EIL for Areas of ecological significance	45	115
Lead	BH06_0.2	Rail Corridor KP6.0	NEPM 2013 Table 1A(1) HILs Res A Soil	300	572
			NEPM 2013 Table 1B(4) EIL for Areas of ecological significance	470	
Nickel	BH54_0.5	End of Line Scraper Station (EOLSS)	NEPM 2013 Table 1B(4) EIL for Areas of ecological significance	45	46
TRH >C <sub>16</sub> -C <sub>34</sub> fraction	BH36_0.0	Agricultural Land KP37.5	NEPM 2013 Table 1B(6) ESLs for Urban Residential/Public Open Space (coarse soil)	300	1,520
	BH35_0.0	Agricultural Land KP36.4			400
	MW19_0.2	Agricultural Land KP44.2			310
	BH101_0.0	Crib Point Receiving Facility			670
	140119_0.0	Crib Point Receiving Facility			340
Benzo(a)pyrene (BaP)	BH101_0.0	The Esplanade between KP0.2 and KP0.3	NEPM 2013 Table 1B(6) ESLs for Areas of Ecological Significance, Urban Residential/Public Open Space and Commercial/Industrial (coarse soil)	0.7	2.0
	BH108_0.0	Crib Point Receiving Facility			9.2
	BH06_0.2	Rail Corridor KP6.0			0.9
Benzo(a)pyrene (BaP) Toxic Equivalence Quotient (TEQ)	BH101_0.0	The Esplanade between KP0.2 and KP0.3	NEPM 2013 Table 1A(1) HILs for Residential A	3	3.2
	BH108_0.0	Crib Point Receiving Facility			13.5
Polychlorinated Biphenyls (PCBs)	BH55_0.1	Former Western Port BP Refinery	NEPM 2013 Table 1A(1) HILs for Residential A	1	5.9



As shown in Table 10, the following soil sampling locations exceeded the most conservative land use criteria - Areas of Ecological Significance land use, and Urban residential and public open space - adopted for the study area:

- Samples collected from the proposed Crib Point Receiving Facility reported arsenic, zinc and TRH >C<sub>16</sub>-C<sub>34</sub> fraction; benzo(a)pyrene and benzo(a)pyrene Toxic Equivalence Quotient (TEQ)<sup>3</sup> exceeding the EIL, ESL and HIL criteria, respectively.
- Sample collected from The Esplanade (adjacent to the former Western Port BP refinery) reported benzo(a)pyrene and benzo(a)pyrene TEQ exceeding the ESL and HIL criteria, respectively.
- Samples collected from the railway corridor between High Street and Cool Store Road reported copper and lead exceeding the HIL and EIL criteria.
- Samples collected adjacent to the former Tyabb landfill reported arsenic exceeding the EIL criteria.
- Samples collected from the middle of a paddock reported TRH fraction >C<sub>16</sub>-C<sub>34</sub> exceeding the ESL criteria sample collected from the EOLSS reported nickel exceeding the EIL criteria.
- Sample collected from the former Western Port BP Refinery reported zinc and PCBs above the EIL and HIL criteria, respectively.

However,

- Concentrations of arsenic in soil samples collected from locations adjacent to the former Tyabb landfill were detected within natural soil at a depth of 0.5 – 1.0 mbgl, whereas surface samples reported concentrations of 6 mg/kg, and less than the laboratory LOR, indicating that arsenic is likely to be naturally elevated within the area (not due to recent anthropogenic site use e.g. orchard). Arsenic is commonly encountered in natural soils and the concentrations typically fluctuate across an area, due to depositional influences (such as groundwater migration, redox conditions, etc.). Leachability analysis returned results below the laboratory LOR, therefore it is considered unlikely that arsenic presents a risk to off-site receptors.
- Concentrations of TRH fraction >C<sub>16</sub>-C<sub>34</sub> exceeding the ELS criteria were detected from soil samples collected within the middle of paddocks (KP36.4, KP37.5 and KP44.2), away from hydrocarbon sources. Silica Gel clean-up on sample from BH36 returned results below the laboratory LOR indicating the absence of petroleum hydrocarbons and that the TRH was likely to be natural organic matter (NOM).
- Comparison against the criteria for Commercial/Industrial land use (Table 11) appropriate for the proposed Crib Point Receiving Facility, the roadside verge (The Esplanade), the railway corridor and the EOLSS, indicated that only zinc and benzo(a)pyrene exceeded guideline values; and exceedances were within fill soil only.

**Table 11 Summary of screening criteria exceedances – Commercial/industrial land use**

Analyte	Sample ID	Land Use	Screening Criteria	Adopted criteria (mg/kg)	Max. Con. (mg/kg)
Zinc	BH108_0.0	Crib Point Receiving Facility	NEPM 2013 Table 1B(1) EIL Commercial/Industrial	420	507
	BH109_0.0				140
	BH110_0.0				97
	BH06_0.2	Rail Corridor KP6.0			288
	BH104_0.2	Rail Corridor KP6.3			172

<sup>3</sup> The benzo(a)pyrene TEQ is calculated by multiplying the concentration of each carcinogenic PAH (benzo(a)anthracene, benzo(a)pyrene, benzo(b+j)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene and ndeno(1,2,3-c,d)pyrene) in the sample by its benzo(a)pyrene toxicity equivalence factor (TEF), and summing these products.

Analyte	Sample ID	Land Use	Screening Criteria	Adopted criteria (mg/kg)	Max. Con. (mg/kg)
	BH55_0.1	Former Western Port BP Refinery			146
Arsenic	BH108_0.4	Crib Point Receiving Facility	NEPM 2013 Table 1B(5) EIL for Commercial and Industrial	170	49
Copper	BH104_0.2	Rail Corridor KP6.3	NEPM 2013 Table 1B(2) EIL for Commercial/Industrial	190	115
Lead	BH06_0.2	Rail Corridor KP6.0	NEPM 2013 Table 1A(1) HILs Commercial/Industrial	1,500	572
			NEPM 2013 Table 1B(4) EIL for Commercial and Industrial	1,800	
Nickel	BH54_0.5	End of Line Scraper Station (EOLSS)	NEPM 2013 Table 1B(4) EIL for Commercial and Industrial	460	46
TRH >C <sub>16</sub> -C <sub>34</sub> fraction	BH101_0.0	Crib Point Receiving Facility	NEPM 2013 Table 1B(6) ESLs for Commercial/Industrial	1,700	670
	BH108_0.0	Crib Point Receiving Facility			340
Benzo(a)pyrene	BH101_0.0	The Esplanade between KP0.2 and KP0.3	NEPM 2013 Table 1B(6) ESLs for Areas of Ecological Significance, Urban Residential/Public Open Space and Commercial/Industrial (coarse soil)	0.7	2.0
	BH108_0.0	Crib Point Receiving Facility			9.2
	BH06_0.2	Rail Corridor KP6.0			0.9
Benzo(a)pyrene TEQ	BH101_0.0	The Esplanade between KP0.2 and KP0.3	NEPM 2013 Table 1A(1) HILs Commercial/Industrial	40	3.2
	BH108_0.0	Crib Point Receiving Facility			13.5
Polychlorinated Biphenyls (PCBs)	BH55_0.1	Former Western Port BP Refinery	NEPM 2013 Table 1A(1) HILs for Commercial/Industrial	7	5.9

The elevated zinc concentration is considered unlikely to impact upon the ecology at the Crib Point Receiving Facility, as the sample was collected within imported crushed rock; and laboratory analysis results indicated that it has not leached into the underlined sample at 0.4 mbgl, thus it is considered unlikely to present risk to off-site receptors.

Based on the proposed use of the Crib Point Receiving Facility and current use of the Esplanade (adjacent to the former BP refinery) and rail corridor in Hastings, benzo(a)pyrene is also considered unlikely to present a risk to ecology at the sites; and as it is not a leachable compound, it will also not present risk to off-site receptors.

### IWRG soil hazard categorisation results

All samples were analysed for the EPA Victoria Publication IWRG621 suite of analytes. Soil analytical results are presented in Tables B6 and B7, Appendix A-B. The laboratory results indicated presence of soils exceeding Fill Material criteria at the Crib Point Receiving Facility proposed location, the former Western Port BP refinery, an area located adjacent to the former Western Port BP refinery (the Esplanade) and an area located adjacent to the former Tyabb landfill.

The soil sample collected from the Crib Point Receiving Facility is classified as Category B, while soil samples collected from the former Western Port BP refinery, areas adjacent to the former Western Port BP refinery (the Esplanade), rail corridor between High St and Cool Store Road, and the former Tyabb landfill are classified as Category C. The contaminants of concern include arsenic, copper, lead, zinc, fluoride, PAHs and PCBs. Other locations within the study area also reported concentrations of arsenic exceeding the IWRG621 Fill Material upper limits; however, they are likely to be background concentrations and therefore not alter the disposal category (refer to Section 3.2 for further information).

Exceedances of the EPA Victoria Publication IWRG621 Fill Material criteria are summarised in Table 12.

**Table 12 Summary of IWRG621 exceedances for individual analytes**

Analyte	Fill Material Upper Limit (mg/kg)	Cat. C Upper limit (mg/kg)	Cat. B Upper Limit (mg/kg)	Result (mg/kg)	Sample ID	Location
TPH C <sub>10</sub> -C <sub>36</sub> fraction (sum)	1,000	10,000	40,000	1,620	BH36_0.0*	Agricultural land KP37.5
Benzo(a)pyrene	1	5	20	9.2	BH108_0.0	Crib Point Receiving Facility
				2	BH101_0.0	The Esplanade between KP0.2 and KP0.3
Sum of PAHs	20	100	400	114	BH108_0.0	Crib Point Receiving Facility
				25.6	BH101_0.0	The Esplanade between KP0.2 and KP0.3
Arsenic	20	500	2,000	49	BH108_0.4	Crib Point Receiving Facility
				20	BH109_0.5	
				39	BH06_0.2	Rail Corridor KP6.0
				20	BH09_0.0	Agricultural land KP8.8
				28	BH11_1.5	Bluescope Steel KP10.6
				89	GW04_0.5	Adjacent to Tyabb landfill

Analyte	Fill Material Upper Limit (mg/kg)	Cat. C Upper limit (mg/kg)	Cat. B Upper Limit (mg/kg)	Result (mg/kg)	Sample ID	Location
				60	GW05_1.0	
				25	BH22_1.5	Agricultural land KP23.0
				28	BH56_0.1	Former Western Port BP Refinery
Copper	100	5,000	20,000	115	BH104_0.2	Rail Corridor KP6.3
Lead	300	1,500	6,000	572	BH06_0.2	Rail Corridor KP6.0
Zinc	200	35,000	140,000	507	BH108_0.0	Crib Point Receiving Facility
				288	BH06_0.2	Rail Corridor KP6.0
Fluoride	450	10,000	40,000	500	BH13_0.9	Bluescope Steel KP12.6
				670	BH18_0.5	GPU Powernet KP18.4
Polychlorinated Biphenyls (PCBs)	2			5.9	BH55_0.1	Former Western Port BP Refinery
pH	A pH value of 4 or less or a pH value of 9 or more are considered to be Prescribed Industrial Wastes (PIWs). pH value of 2 or less or a pH value of 12.5 or more are classified as Category A PIW.			3.6	MW08_0.5	Agricultural land KP16.9
* See note for TPH below						

As aforementioned, the single elevated TPH C<sub>10</sub>-C<sub>36</sub> fraction was detected within the middle of a paddock away from hydrocarbon sources. Silica gel clean-up undertaken for sample BH36\_0.0 indicated the absence of petroleum hydrocarbons and that the TPH was likely to be NOM. As such the soil would remain classified as Fill Material (in the absence of other contaminants).

The pH of one sample, MW08\_0.5, was reported at a value of 3.6. This is outside of the adopted range (<4 or >9) of acceptable pH values for EPA Victoria Publication IWRG621 and therefore is classified as Prescribed Industrial Waste (PIW) Category B material.

#### Australian standard leaching procedure analysis

Based on the results of the primary laboratory analysis, leachability testing was conducted on 12 samples where concentrations exceeded the Fill Material upper limit requirements, listed in Table 2 of the EPA Victoria Publication IWRG621. All leachability results were reported either below the laboratory LOR or below the adopted guidelines values for leachability analysis (benzo(a)pyrene, arsenic, hexavalent chromium, zinc and fluoride). This is indicative of limited mobility in samples. Soil leachability analytical results are presented in Table B7, Appendix A-B.

#### PFAS

Concentrations of PFAS were analysed in 15 soil samples collected from six borehole locations identified as having a higher potential for PFAS contamination. Soil analytical results are presented in Tables B8 and B9, Appendix A-B.

The soil analytical results reported concentrations of PFAS below the adopted criteria in all soil samples. However, note that EPA Victoria (refer to EPA Victoria Publication 1669.3 for further details) has adopted an interim criterion for the reuse of soil which may contain PFAS based on a LOR of 0.004 mg/kg broken down as follows:

- PFOS <0.002 mg/kg
- PFHxS <0.001 mg/kg
- PFOA <0.001 mg/kg.

In addition, if soils containing PFAS are required to be disposed of off-site then a classification application is required to be submitted to EPA Victoria.

Samples with detectable PFAS compounds concentrations above the laboratory LOR are summarised in Table 13.

**Table 13 Summary of detectable PFAS compounds concentrations**

Analyte	Location	Location	Criteria Adopted(mg/kg)	Conc (mg/kg)
Perfluorooctanesulfonic acid (PFOS)	BH108_0.0	Crib Point Receiving Facility	Soil – Human health guideline value for Industrial/commercial: 20 mg/kg	0.0008
	BH109_0.0	Crib Point Receiving Facility		0.0005
	BH110_0.0	Crib Point Receiving Facility		0.0002
	BH101_0.0	The Esplanade between KP0.2 and KP0.3	Interim soil – ecological indirect exposure guideline value for Industrial/commercial: 0.14 mg/kg	0.0003
	BH102_0.0	The Esplanade Between KP0.6 and KP0.7		0.0008
	BH55_0.1	Former Western Port BP refinery		0.0002
Perfluorohexanoic acid (PFHxA)	BH110_0.0	Crib Point Receiving Facility	-	0.0002

### PFAS leachability analysis

PFAS leachability testing was conducted on 15 samples analysed for PFAS compounds, to assess whether concentrations were above the limits for waste acceptance, as outlined in the PFAS NEMP (2018) landfill acceptance criteria. However, leachability analysis was not conducted for the three soil bores in the former Western Port BP Refinery. All compounds were reported below the laboratory LORs. PFAS leachability testing analytical results are presented in Table B9, Appendix A-B.

### Other findings

It is noted that trace concentrations of xylene were detected in seven soil samples (BH214, BH216, BH219, BH37, BH42, BH44 and BH47) located within paddocks between KP33 and KP49.4; however, the cause or source has not been identified. At a number of these locations, slight hydrocarbon odours or PIDs above background were detected, indicating that the analytical data is unlikely to be a laboratory or sampling error. However, it is noted that concentrations detected were low, below sensitive land use criteria and unlikely to represent a risk to human health or the environment.

#### 4.2.2 Data Quality Indicators (DQI) for QA/QC data validation

The Data Quality Indicators (DQIs) adopted are based upon data validation guidance documents published by Standards Australia (SA) and National Environment Protection Council (NEPC). These include *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil* (AS 4482.1-2005), *Schedule B2 Site Characterisation* (NEPC 1999, amended 2013) and *Schedule B3 Laboratory Analysis of Potentially Contaminated Soils* (NEPC 1999, amended 2013). The process involves the checking of analytical procedure compliance and an assessment of the accuracy and precision of analytical data from a range of quality control measurements, generated from both the field sampling and analytical programs.

Specific elements that have been checked and assessed for this Project include:

- preservation and storage of samples upon collection and during transport to the laboratory
- sample holding times
- use of appropriate analytical and field sampling procedures
- required limits of reporting (LOR)
- frequency of conducting quality control measurements
- rinsate, field and trip blank results
- laboratory blank results
- field duplicate and triplicate results
- laboratory duplicate results
- matrix spike (MS) results
- surrogates spike results
- the occurrence of apparently unusual or anomalous results (e.g. laboratory results that appear to be inconsistent with field observations or measurements).

In summary, no QA/QC issues were identified in the field or laboratory datasets that could have a material implication to decision-making on the Project with the exception of:

- Concentration of zinc in rinsate sample QC357\_270219, which was reported at a concentration above the laboratory LOR. The primary laboratory confirmed that the result was not due to laboratory error by re-preparing and re-analysing the sample. Given the concentration of zinc in samples collected on 27 February 2019 was one order of magnitude greater than the result in the rinsate, and below the adopted criteria, the minor rinsate detection is not considered to affect the overall interpretation of the results. However, the interpretation for zinc results in samples taken on the 27 February 2019 should consider this result.
- Concentration of TRH, in trip blank sample QC500\_031218, was reported by the primary laboratory. This was checked with the laboratory and found to be due to trip blanks sent from the laboratory with 'in-house background levels'. Due to the absence of TRH in soil samples, it is not considered that this has affected interpretation of the results.

QA/QC sample data is presented in Appendix A-E. On the basis of the data validation, the overall quality of the analytical results is considered to be acceptable and suitable for assessment of the soil conditions of the study area.

### **4.3 Soil background concentration assessment**

The Victorian Background Soil Database provide a statistical summary of expected background metal/element concentrations in Victorian soils.

Statistical analysis of analytical laboratory results for metals/elements that exceeded the adopted screening criteria and/or EPA Victoria Publication IWRG621 Fill Material upper limits (i.e. arsenic, copper, lead, nickel, zinc and fluoride) were undertaken and compared against the reported background concentrations expected for soils of Brighton Group underlying the Greater Melbourne region.

The statistical analysis indicated that with the exception of soil samples from BH09 and BH13 and adjacent to the former Tyabb landfill (GW04 and GW05), the exceedances at the Crib Point Receiving Facility, the former Western Port BP refinery, along The Esplanade adjacent to the former Western Port BP refinery, and within railway corridor between High Street and Cool Store Road in Hastings were likely from anthropogenic impacts, as they lie outside of the range expected for background concentrations for soils of Brighton Group underlying the Greater Melbourne region; and observed to be present in higher concentrations compared to other samples collected within the study area.

Boxplots of laboratory analytical results showing variability for concentrations of arsenic, copper, lead, nickel, zinc and fluoride in soils within the study area are presented in Figure 4 (concentrations half of the LOR assumed for results reported less than the laboratory LOR), and copies of the statistical summary of expected background metal/element concentrations in Victorian soils obtained from the Victorian Background Soil Database are provided in Appendix A-H.

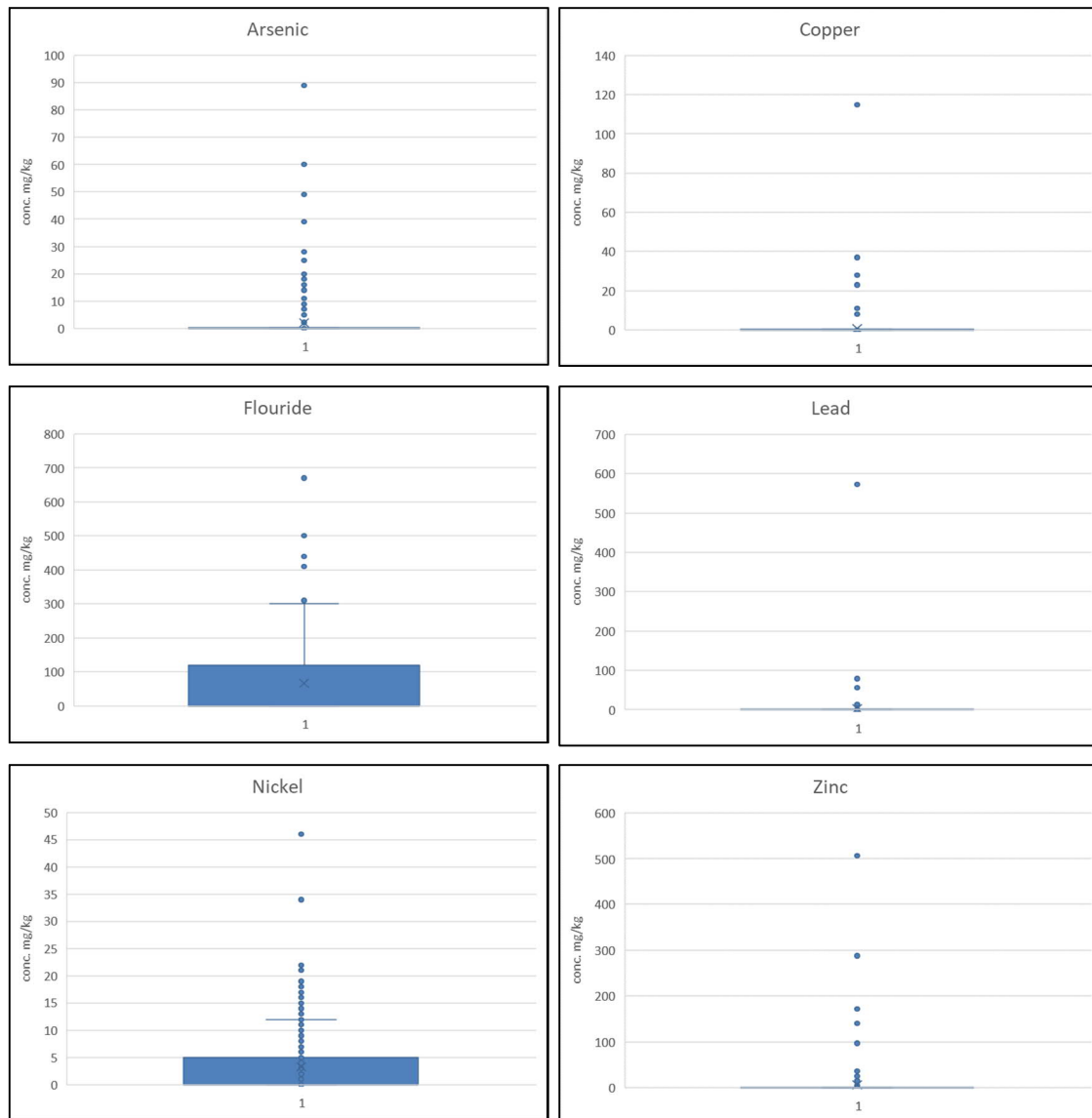


Figure 4 Boxplots of metals/elements where samples exceeded the adopted screening criteria



## 5.0 Findings of acid sulfate soil investigation

Results of ASS analysis are presented in Table B11, Appendix A-B, and summarised in Figure A6, Appendix A-A. The NATA certified laboratory reports are included with the chain of custody documentation in Appendix A-D.

### 5.1 Crib Point Receiving Facility

A total of four soil bores (BH108 to BH111) were drilled within the proposed Crib Point Receiving Facility. Field pH ( $pH_F$ ) and field peroxide pH ( $pH_{FOX}$ ) testing was not undertaken during this investigation. It should be noted that the field pH tests do not provide a quantitative measure of the amount of acid that has been or could be produced through oxidation. A total of eight samples were analysed using the Chromium Reducible Sulfur (CRS) suite method to verify the existence and nature of ASS. The results of the CRS suite testing at the Crib Point Receiving Facility are summarised in Table 14.

As shown in Table 14, actual acidity was identified in six samples ranging from 0.02 per cent sulfur (%S) to 0.04 %S indicating presence of existing acidity at these locations. Five samples also returned minor detectable potential acidity indicated by CRS concentrations ranging between 0.006 %S and 0.014 %S. Acid Neutralising Capacity (ANC) was reported in two samples however these two samples did not report any actual acidity or potential acidity.

The sum of actual and potential acidity ranged from 0.03 %S and 0.04 %S and exceeded the EPA Victoria Publication IWRG655.1 action criteria for management of ASS in six samples of total eight samples. The calculated liming rate to neutralise the calculated net acidity ranged between 1 Kg  $CaCO_3$ /tonne and 2 Kg  $CaCO_3$ /tonne. It is noted that this liming rate needs to be recalculated in the field based on the bulk density, aglime neutralising value (NV) and a safety factor of 1.5 (as per the calculation given in Dear et al., 2014).

**Table 14 Summary of Crib Point Receiving facility CRS suite testing, laboratory results (total eight samples)**

Analyte	No of Detections	Minimum Concentration	Maximum Concentration
Actual Acidity (%S)	6	0.020	0.04
Potential Acidity (%S)	5	0.006	0.014
Acid Neutralising Capacity (%S)	2	0.100	0.170
Sum of Actual Acidity and Potential Acidity (%S) *	6	0.030	0.040
Liming Rate (Kg $CaCO_3$ /tonne)	6	1	2
*All six samples reported net acidity <sup>4</sup> , exceeding the EPA Victoria Publication IWRG655.1 action criteria for ASS management >1,000 tonnes (0.03 %S)			

### 5.2 Pipeline alignment

#### 5.2.1 Crib Point to MLV1

A total of 26 soil bores (KP0 to 11.5) were drilled between the township of Crib Point to MLV1 in Tyabb. Within the township of Hastings, soil bores were drilled along the Frankton-Flinders Road and along the rail corridor to assess alternative alignments proposed for the area.  $pH_F$  and  $pH_{FOX}$  testing was not undertaken during this investigation. A total of 52 primary samples were analysed using CRS

<sup>4</sup> A calculation summing up the capacity of a given soil to generate acidity under favourable conditions. For ASS, the generalised formula for net acidity is potential acidity plus actual acidity plus retained acidity, minus the acid neutralising capacity, which is divided by the fineness factor.

Net acidity = potential acidity + existing acidity – acid neutralising capacity (ANC)

suite method to verify the existence and nature of ASS. The results of the CRS suite testing for Crib Point to MLV1 are summarised in Table 15.

As shown in Table 15, actual acidity was identified in 31 samples ranging from 0.02 %S to 0.08 %S (at BH08 at 0.5 metres) indicating the presence of existing acidity at these locations. 41 samples returned minor detectable potential acidity indicated by CRS concentrations ranging between 0.005 %S and 0.013 %S. ANC was reported in one sample (BH06\_0.5) with no actual or potential acidity.

The sum of actual and potential acidity ranged from 0.02 %S and 0.09 %S and exceeded the criteria for management of ASS in 31 samples of total 52 samples. The calculated liming rate to neutralise the calculated net acidity was reported ranging between 1 Kg CaCO<sub>3</sub>/tonne and 4 Kg CaCO<sub>3</sub>/tonne. It is noted that this liming rate needs to be recalculated in the field based on the bulk density, aglime NV and a safety factor of 1.5 (as per the calculation given in Dear et al, 2014).

**Table 15 Summary of Crib Point to MLV1 CRS suite testing, laboratory results (total 52 samples)**

Analyte	No of Detections	Minimum Concentration	Maximum Concentration
Actual Acidity (%S)	31	0.020	0.080
Potential Acidity (%S)	41	0.005	0.013
Acid Neutralising Capacity (%S)	1	0.19	0.19
Sum of Actual Acidity and Potential Acidity (%S) *	38	0.020	0.090
Liming Rate (Kg CaCO <sub>3</sub> /tonne)	37	1	4
*A total of 31 samples of 52 samples reported net acidity, exceeding the EPA Victoria Publication IWRG655.1 action criteria for ASS management >1,000 tonnes (0.03 %S)			

### 5.2.2 MLV1 to MLV2

A total of 50 soil bores (KP11.5 – KP40.0) were drilled between MLV1 in the township of Tyabb to MLV2 in Cardinia. pH<sub>F</sub> and pH<sub>FOX</sub> testing was not undertaken during this investigation. A total of 100 primary samples were analysed using CRS suite method to verify the existence and nature of ASS. The results of the CRS suite testing at MLV1 to MLV2 are summarised in Table 16.

As shown in Table 16, actual acidity was identified in 36 samples ranging from 0.02 %S to 0.11 %S indicating presence of existing acidity at these locations. 70 samples also returned detectable potential acidity indicated by CRS concentrations ranging between 0.005 %S and 0.168 %S (MW09 at 3.0 metres). Three samples reported CRS concentrations (>0.03 %S) indicating presence of PASS and absence of AASS as follows:

- MW09 at depth of 3.0 mbgl
- MW10 at depth of 3 mbgl
- BH207 at depth of 0.5 mbgl

Conservatively, the following locations are also classified as PASS, based on SPOCAS analysis (undertaken for QA/QC data validation purposes, refer to Section 5.3 for details).

- BH209 at depth of 0.5 mbgl
- BH34 at depth of 2.0 mbgl.

It is noted that MW09 and MW10 are located near the Watson Creek river mouth; and BH207, BH209 and BH34 are located within area classified in CSIRO's ASRIS soil database to have higher probability with high confidence for presence of acid sulfate soil (Ac(p1)) (refer to the EES Technical Report E: *Contamination and acid sulfate soils impact assessment* for details).

ANC was reported in five samples, with two samples not reporting any actual acidity or potential acidity. The sum of actual and potential acidity ranged from 0.02 %S and 0.18 %S and exceeded the criteria for management of ASS in 40 samples of total 100 samples. The calculated liming rate to neutralise the calculated net acidity was reported ranging between 1 Kg CaCO<sub>3</sub>/tonne and 8 Kg CaCO<sub>3</sub>/tonne. It is noted that this liming rate needs to be recalculated in the field based on the bulk density, aglime NV and a safety factor of 1.5 (as per the calculation given in Dear et al, 2014).

**Table 16 Summary of MLV1 to MLV2 CRS and SPOCAS suite testing, laboratory results (total 100 samples)**

Analyte	No of Detections	Minimum Concentration	Maximum Concentration
Actual Acidity (%S)	36	0.020	0.11
Potential Acidity (%S)	70	0.005	0.168
Acid Neutralising Capacity (%S)	5	0.290	0.930
Sum of Actual Acidity and Potential Acidity (%S) *	54	0.020	0.18
Liming Rate (Kg CaCO <sub>3</sub> /tonne)	48	1	8
*A total of 40 samples of 100 samples reported net acidity, exceeding the EPA Victoria Publication IWRG655.1 action criteria for ASS management >1,000 tonnes (0.03 %S)			

### 5.2.3 MLV2 to Pakenham Delivery Facility

A total of 10 soil bores (KP40.5 – KP56.7) were drilled between MLV2 in Cardinia to the Pakenham Delivery Facility. pH<sub>F</sub> and pH<sub>FOX</sub> testing was not undertaken during this investigation. A total of 20 primary samples were analysed using CRS suite method to verify the existence and nature of ASS. The results of the CRS suite testing between MLV2 and the Pakenham Delivery Facility are summarised in Table 17.

As shown in Table 17, actual acidity was identified in 11 samples ranging from 0.02 %S to 0.1 %S indicating presence of existing acidity at these locations. Eight samples also returned minor detectable potential acidity indicated by CRS concentrations ranging between 0.005 %S and 0.013 %S. ANC was not reported in any sample.

The sum of actual and potential acidity ranged from 0.02 %S and 0.12 %S and exceeded the criteria for management of ASS in 11 samples of total 20 samples. The calculated liming rate to neutralise the calculated net acidity was reported to range between 1 Kg CaCO<sub>3</sub>/tonne and 6 Kg CaCO<sub>3</sub>/tonne. It is noted that this liming rate needs to be recalculated in the field based on the bulk density, aglime NV and a safety factor of 1.5 (as per the calculation given in Dear et al, 2014).

**Table 17 Summary of MLV2 to Pakenham Delivery Facility CRS suite laboratory results (total 20 samples)**

Analyte	No of Detections	Minimum Concentration	Maximum Concentration
Actual Acidity (%S)	11	0.020	0.100
Potential Acidity (%S)	8	0.005	0.013
Acid Neutralising Capacity (%S)	0	0	0
Sum of Actual Acidity and Potential Acidity (%S) *	12	0.020	0.120
Liming Rate (Kg CaCO <sub>3</sub> /tonne)	12	1	6

Analyte	No of Detections	Minimum Concentration	Maximum Concentration
* A total of 11 samples of 12 samples reported net acidity, exceeding the EPA Victoria Publication IWRG655.1 action criteria for ASS management >1,000 tonnes (0.03 %S)			

### 5.3 Data Quality Indicators (DQI) for QA/QC data validation

The DQI adopted is based upon EPA Victoria Publication IWRG655.1 which recommended that a minimum of 10 per cent of samples are analysed using the other method. A total of 22 samples out of 180 samples (12 % samples exceeding the 10 % DQI) were analysed for both CRS and SPOCAS suite. The primary samples were analysed for CRS suite and the duplicate samples were analysed for SPOCAS. The net acidity with both methods was used to calculate the Relative Percentage Differences (RPDs).

The net acidity RPDs were calculated and ranged between four per cent and 129 percent. RPDs exceeding the acceptable range (50 percent) include CPT084\_BH209\_210119\_0.5 (RPD 74 percent) and CPT091\_BH34\_180119\_2.0 (RPD 129 percent). This may be attributed to soil heterogeneity and the difference in analysis for both the methods. However, both results reported net acidity exceeding the action criteria. The higher results have been used for data analysis. For purpose of this soil investigation, the data is deemed acceptable.

QA/QC sample data is presented in Appendix A-E. On the basis of the data validation, the overall quality of the analytical results is considered to be acceptable and suitable for assessment of the soil conditions of the study area.

## 6.0 Findings of groundwater investigation

### 6.1 Hydrogeology

The following description of the site-specific hydrogeology is based on observations made during the site inspection, drilling and installation of groundwater monitoring wells, and subsequent groundwater gauging, sampling, and analysis from 3 December 2018 to 30 January 2019.

Groundwater monitoring wells construction details, groundwater level measurements, and groundwater observations are provided in Table B3 – B5, Appendix A-B.

Historic assessment for the land adjacent to Crib Point Jetty indicated that the Project is unlikely to encounter groundwater beneath this area (refer to 3.2.2 for details). Therefore, no groundwater investigation work was undertaken at the landside component of the Gas Import Jetty Works.

#### 6.1.1 Groundwater occurrence and flow directions

Groundwater elevations were calculated from the well gauging data collected on 30 January 2019. The gauging results and groundwater elevations are summarised in Table B4, Appendix A-B.

During gauging, well head PID measurements were observed to be 0.0 ppm at all locations.

Depth to groundwater ranged between 0.995 metres below top of casing (m btoc) (MW22) and 4.834 m btoc (MW18). Four locations, MW04, MW23, MW17 and MW19, were noted to be dry during the gauging round. Groundwater elevations ranged between -0.909 mAHD (MW18) and 22.907 mAHD (MW22), which is consistent with the general topography and ground elevations along the pipeline alignment.

Groundwater elevation contours were not generated for the gauging round given the significant distance between locations along the pipeline alignment and the variable topography. However, it is reasonable to expect that groundwater is migrating towards the Western Port with location influences, due to natural or man-made features (e.g. pipelines etc.).

### 6.2 Groundwater purging and sampling

#### 6.2.1 Field observations

No NAPL (either dense (D) or light (L)) was encountered in any of the groundwater monitoring wells during gauging and groundwater sampling.

Stabilised groundwater field quality parameters are presented in Table B5, Appendix A-B and a summary of groundwater sampling parameters is presented in Table 18.

**Table 18 Groundwater Sampling: Field quality parameters**

Parameter	Minimum	Minimum Location	Maximum	Minimum Location
Temperature (°C)	16.8	MW03	19.3	MW22
Dissolved Oxygen (mg/L)	0.23	MW14	3.14	MW21
Electrical Conductivity (µS/cm)	1,927	MW07	25,252	MW11
pH	5.96	MW14	7.34	MW07
Redox Field (mV)	-10	MW10	170	GW05
Total Dissolved Solids	1,253	MW07	16,614	MW11
Redox Potential (Eh)	194	MW10	382	GW05
Note: - pH and Redox could not be measured due to inconsistencies in the measurement device at MW11 and MW15. - Total Dissolved Solids (TDS) approximated as Electrical Conductivity (EC) x 0.65 - Corrected Redox Potential = Field Redox Potential + (224.98 - 0.7443* Temperature) (Redox potential converted from Ag/AgCl electrode to standard hydrogen electrode)				

During well purging and groundwater sampling, no odours or sheens were observed, and water sample colour ranged from clear to light brown. Groundwater turbidity was observed to be low to no turbidity, with the exception of MW01, which was observed to have a high turbidity.

## 6.3 Groundwater analytical data

### 6.3.1 Results

Groundwater analytical results of groundwater collected from 15 of the 26 groundwater wells installed as part of this investigation (where there are sufficient water in the wells) are presented in Table B12, Appendix A-B, and exceedances of adopted beneficial uses criteria are summarised in Table 19 and Figure A7, Appendix A-A. The NATA certified laboratory reports are included with the chain of custody documentation in Appendix A-D. Groundwater analytical results are discussed further below.

**Table 19 Groundwater analytical results exceedances**

Analyte	Min Conc. (mg/L)	Max Conc. (mg/L)	Average Conc. (mg/L)	No. of Exceedances (sample)	Guideline Exceedance
Total Dissolved Solids (Laboratory Calculated)	884	18,700	6,217	8	ANZECC & ARMCANZ 2000 - Livestock Watering (Sheep) (5,000 mg/L)
				12	ANZECC & ARMCANZ 2000 - Livestock Watering (Beef cattle) (4,000 mg/L)
				14	ANZECC & ARMCANZ 2000 - Livestock Watering (poultry) (2,000 mg/L)
Copper (Filtered)	0.001	0.009	0.0025	8	ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% (0.003 mg/L)
Iron (Filtered)	0.05	3.59	0.93	8	ANZECC & ARMCANZ 2000 - Irrigation LTV (0.2 mg/L)
Nickel (Filtered)	0.002	0.019	0.0061	5	ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% (0.007 mg/L)
Zinc (Filtered)	0.014	0.179	0.062	15	ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% (0.007 mg/L)
pH (Lab)	6.31	7.9	6.9	3	NHMRC 2008 - Guidelines for Managing Risks in Recreational Waters (6.5 – 8.5)
pH (field)	5.96	7.34	6.4	1	ANZECC & ARMCANZ 2000 - Irrigation LTV (6 -8.5)
				8	NHMRC 2008 - Guidelines for Managing Risks in

Analyte	Min Conc. (mg/L)	Max Conc. (mg/L)	Average Conc. (mg/L)	No. of Exceedances (sample)	Guideline Exceedance
					Recreational Waters (6.5 - 8.5)
Ammonia (as N)	0.02	0.5	0.16	1	ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% (0.5 mg/L)
Total Phosphorus	0.07	0.48	0.23	15	ANZECC & ARMCANZ 2000 - Irrigation LTV (0.05 mg/L)
Calcium	11	1270	208	1	ANZECC & ARMCANZ 2000 - Livestock Watering (Sheep, Beef stock and Poultry) (1,000 mg/L)
Sulfate as SO <sub>4</sub> - Turbidimetric (Filtered)	88	1220	346	2	ANZECC & ARMCANZ 2000 - Livestock Watering (Sheep, Beef stock and Poultry) (1,000 mg/L)
PFOS	0.000002	0.000002	0.000002	1*	PFAS NEMP 2018 - PFAS Guidelines Freshwater Marine 99% (0.00023 µg/L)
* Laboratory LOR greater than guideline for three samples. The one triplicate sample total was calculated by addition by the laboratory.					

The results indicated that:

- Concentrations of TDS exceeded the adopted ANZECC & ARMCANZ 2000 - Livestock Watering (Beef Cattle, Poultry or Sheep) criteria at 14 out of 15 locations (exception was MW07), suggesting that the groundwater along the proposed pipeline alignment is naturally saline. MW07 is located adjacent to the McKirdys Road Drain and therefore the salinity may be influenced by surface water. It is noted that TDS concentrations at MW9 (13,800 mg/L) and MW11 (18,700 mg/L), located within the vicinity of Watson Creek, are higher than generally detected. This is likely due to tidal interaction associated with the adjacent Watson Creek and rivers that discharge to Western Port.
- Concentrations of copper exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at eight out of 15 locations with detected concentrations ranging between 0.001 and 0.009 mg/kg. The distribution of copper along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and does not represent pollution.
- Concentrations of iron exceeded the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria at eight out of 15 locations with detected concentrations ranging between 0.05 to 3.59 mg/kg. Iron is naturally encountered in groundwater in the region. It is noted that concentrations of iron in groundwater from MW09 (3.59 mg/L) and MW10 (3.02 mg/L) are higher than other wells. Based on the location of MW09 and MW10 it is considered likely that Watson Creek is influencing results. It is considered that the iron naturally fluctuates along the pipeline alignment and does not represent contamination.
- Concentrations of nickel exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at five out of 15 locations with detected concentrations ranging between 0.002 and 0.019 mg/L. The distribution of nickel along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and does



not represent pollution. However, it is noted that GW04 (0.019 mg/L located adjacent to the former Tyabb landfill) and MW05 (0.012 mg/L) located adjacent to a metal recycling yard in Hastings recorded highest concentrations of nickel, indicating potential impact from the adjacent land uses.

- Concentrations of zinc exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at all 15 locations with detected concentrations ranging between 0.014 and 0.179 mg/L. The distribution of elevated zinc along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and does not represent pollution.
- Concentration of PFOS exceeded the PFAS NEMP 2018 - PFAS Guidelines Freshwater Marine 99% criteria at GW05 located adjacent to the former Tyabb landfill. It is noted that the laboratory LOR is higher than the criteria, and PFOS was only detected in the triplicate sample at laboratory LOR. However, other PFAS compounds were detected in the primary sample at trace concentrations and therefore it is considered likely that PFOS is present and exceeds the Maintenance of Ecosystems criteria. It is noted that this criteria only applies upon discharge to surface water body.
- Concentration of ammonia exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at MW09 (0.5 mg/L). It is noted that the concentration of ammonia fluctuates along the pipeline alignment generally within an order of magnitude and only meets the criteria and doesn't exceed it. It is likely that the ammonia concentration detected is associated with broad acre fertiliser use or stock grazing, taking into consideration the predominant land use throughout the study area.
- Concentrations of total phosphorus exceed the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria in groundwater sampled from all 15 locations. The phosphorous concentration ranges between 0.07 and 0.048 mg/kg, and similar to ammonia, may be present regionally as a result of stock grazing or fertiliser use. The concentration of phosphorous in groundwater from all wells sampled is below the short-term irrigation criteria by an order of magnitude. Based on the proposed construction period for the Pipeline Works, it is considered that short-term irrigation criteria can reasonably be applied to assess risk.
- Concentrations of calcium exceeded the ANZECC & ARMCANZ 2000 - Livestock Watering (Beef cattle) criteria at MW11 (1,270 mg/L). The increase in calcium in groundwater from well MW11 is consistent with an increase in general TDS in this area, which is considered likely to be associated with the topography and hydrology of the area and does not represent pollution.
- Concentrations of Sulfate as SO<sub>4</sub> - Turbidimetric (Filtered) exceeded the ANZECC & ARMCANZ 2000 - Livestock Watering (Beef cattle) criteria at MW09 (1,220 mg/L) and MW11 (1,170 mg/L). The increase in sulfate in groundwater from wells MW09 and MW11 is consistent with an increase in general TDS in these areas, which is considered likely to be associated with the topography and hydrology of the area and does not represent pollution.
- Field measured pH exceeded the NHMRC 2008 - Guidelines for Managing Risks in Recreational Waters criteria at eight out of 13 locations, ranging between 5.96 and 7.34. MW14 (pH 5.96) also exceeded the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria. The slightly acidic pH of groundwater is consistent with the presence of acidic soils, as detected throughout the study area, and is therefore naturally occurring and does not represent pollution.

The adopted beneficial uses criteria for some compounds, listed below, were below the laboratory LORs values. Details of these beneficial uses criteria are summarised in Appendix A-B.

- Benzo(a)pyrene
- Aldrin
- Endrin
- Heptachlor
- Heptachlor epoxide

- Chlorpyrifos
- Dichlorvos
- Pirimphos-ethyl
- Dieldrin
- Aldrin + Dieldrin
- PFOS
- Chromium (hexavalent)
- Vinyl chloride
- Bromomethane
- Carbon Tetrachloride
- 1,2-Dichloroethane
- Hexachlorobutadiene
- 1,2-Dibromoethane (EDB).

While the laboratory LOR for the above compounds is greater than the adopted groundwater quality objectives, it is noted that PAHs, pesticides and chlorinated hydrocarbons have generally not been detected in groundwater. Chlorinated hydrocarbons and pesticides are a potential contaminant of concern in the Pipeline Works area (particularly within agricultural land) but the absence of other associated compound indicates that the laboratory LORs adopted are acceptable for interpretation of the results.

#### **6.3.2 Data Quality Indicators - QA/QC data validation**

Data quality analysis was undertaken in general accordance with the ASC NEPM 2013, EPA Victoria Publication 669 and the PFAS NEMP (2018). A detailed summary of the validation of groundwater analytical data is presented in Appendix A-E. In summary, no QA/QC issues were identified in the field or laboratory datasets that could have a material implication to decision-making on the Project. Where sample discrepancies in the triplicate sample QC202\_25/01/19 were reported by the secondary laboratory, a re-run of the analysis was undertaken and results consistent with the primary and duplicate were reported.

QA/QC data for duplicates and triplicates is included in analytical results Table B12, Appendix A-B, while RPDs, field blanks, rinsates and trip blanks tables are presented in Appendix A-E. On the basis of the data validation, the overall quality of the analytical results is considered to be acceptable and suitable for assessment of the conditions of groundwater.

## 7.0 Findings of marine sediment investigation

### 7.1 Field observations

Marine sediment at Berths 1 and 2 were described as silty fines through to medium sands with shell fragments. Sampling location NRA located north of Berth 1 was described as clean medium/coarse sand and SRA located south of Berth 2 was described as silty fine sand, black in colour with high organic content and worm tubes. No visual or olfactory indicators of potential marine sediment contamination were observed.

Description of sediment at each sample location, including photographs of collected samples are provided in the *AGL Gas Import Jetty Project Crib Point, Western Port* (CEE, 2019) report included in Appendix A-I Marine sediment sampling report.

#### 7.1.1 Results

A total of 20 marine sediment samples, including four samples from reference sites located approximately 500m north of Berth 1 and South of Berth 2, were collected during the two rounds of sampling undertaken on 1 March 2019 and 18 July 2019. The analytical results are presented in Tables B13, Appendix A-B and NATA certified laboratory reports are included with the chain of custody documentation in Appendix A-D.

Marine sediment analytical results for all samples were either below the laboratory LOR or below the adopted sediment quality guidelines values (SQGVs) with the following four exceptions presented in Table 20, and in Figure A8, Appendix A-A.

**Table 20 Marine sediment exceedances**

Analyte	Sample ID	ANZECC & ARMCANZ 2013 Guideline Values	Analytical results
Arsenic	NRA	20	24.2 mg/kg
	NRB		25 mg/kg
Tributyltin (TBT- normalised to 1% TOC)	CPB1b	9	16,621 µg Sn/kg
	CPB1c		1,691 µg Sn/kg

Arsenic was detected in all marine sediment samples analysed at the same order of magnitude including both northern and southern reference points. The samples with the two highest recorded concentration of arsenic were detected in the reference points located to the north of the berths. Based on this it is considered that arsenic is naturally elevated / is indicative of background conditions and is widely distributed. The concentrations of arsenic detected are not considered to present a risk to the protected beneficial uses.

Tributyltin (TBT) was detected in two marine sediment samples above the adopted criteria, however both were located beneath the Berth 1 area (i.e. outside of the Project Area). TBT is generally below the laboratory LOR in the marine sediment sampled in the vicinity of Berth 2. On this basis it is considered that relevant beneficial uses at Berth 2 are protected.

All marine sediment samples were analysed for PFAS, and samples with detectable PFAS are summarised in Table 21. Note that Australian guideline values for maintaining ecosystem health are currently not available for PFAS in marine sediment, and this site investigation is limited to sediment quality only; a full ecological risk assessment would require weight of evidence (WOE) assessment as recommended by the Revision of the ANZECC & ARMCANZ Sediment Quality Guidelines (Simpson, et al., 2013). It is noted that concentrations of PFAS are low (i.e. within the same magnitude of the laboratory LOR); suggesting that the relevant beneficial uses are protected.

**Table 21 Detectable PFAS compounds in marine sediment samples**

Analyte	Sample ID	Analytical results
Perfluorooctane sulfonic acid (PFOS)	CPB2f	0.0002 mg/kg
	CPB2h_i	0.0005 mg/kg
Sum of PFAS	CPB2f	0.0002 mg/kg
	CPB2h_i	0.0005 mg/kg
	CPB2k_i	0.0004 mg/kg

### 7.1.2 Data quality indicators for QA/QC

Data quality analysis was undertaken in general accordance with ANZECC & ARMCANZ (2000) and NAGD (2009). A detailed summary of the validation of marine sediment analytical data is presented in Appendix A-E.

In summary, no QA/QC issues were identified in the field or laboratory datasets that could have a material implication to decision-making on the Project.

The NAGD (2009) states that the Relative Percent Differences (RPD) for split triplicates should be within 35 percent. Intra laboratory RPDs exceeded the 35 percent guideline level for PFOS only, while inter laboratory RPDs exceeded the 35 percent guideline level for TOC, PAHs (Sum) and mercury. Additionally, it should be noted that low levels of contaminants where laboratory LORs are different for mercury can exaggerate the RPD.

The NAGD (2009) states that the Relative Standard Deviation (RSD) for field triplicates should be within 50 percent. The RSD for all analytes reported above the laboratory LOR were below 50 percent. This shows that the chemical composition of the marine sediments within the investigation area can be considered relatively homogenous.

QA/QC data for duplicates and triplicates is included in analytical results Table B13, Appendix A-B, while RPDs and RSD tables are presented in Appendix A-E. On the basis of the data validation, the overall quality of the analytical results is considered to be acceptable and suitable for assessment of the conditions of marine sediments.

## 8.0 Summary of potentially contaminated areas and ASS

All exceedances of the adopted criteria for this contamination and ASS investigations are summarised below. The summary, however, does not present all exceedances of the adopted screening criteria; rather it focuses on source areas.

### Soil exceedances

Soil conditions encountered within the study area as summarised below:

- BH42, GW04, BH216 and BH219 recorded high PID readings; however, analytical results were either below the laboratory LOR or below the adopted beneficial use guideline values, suggesting that it is unlikely to present risk to human health or the environment. The cause or source that contributes to the high PID readings has not been identified.
- Light green staining was observed at MW21 at 2.2 mbgl, however, laboratory results indicated that it is unlikely to be related to contamination due to the absence of potential source/odour or other sign of contamination.
- Trace concentrations of xylene were detected in seven soil samples (BH214, BH216, BH219, BH37, BH42, BH44 and BH47) located within paddocks between KP33 and KP49.4. The concentrations are below sensitive land use criteria. The cause or source has not been identified.
- Surface soil samples collected from the Crib Point Receiving Facility reported zinc and benzo(a)pyrene exceeding the adopted EIL and ESL for commercial/industrial land use, respectively. However, the elevated zinc concentration is considered unlikely to impact on ecology at the Crib Point Receiving Facility as the sample was collected within imported crushed rock; and laboratory analysis results indicated that it has not leached into the underlying sample at 0.4 mbgl, thus it is considered unlikely to present risk to off-site receptors. Based on the proposed use and location of the Crib Point Receiving Facility, benzo(a)pyrene is also considered unlikely to present a risk to ecology at the site and as it is not a leachable compound, it will also not present risk to off-site receptors.
- Concentrations of benzo(a)pyrene in a sample collected adjacent to the former Western Port BP refinery (near the Esplanade) exceeded the ESL for Coarse Soil, Urban Residential/Public Open Space and Commercial/Industrial. The exceedance, however, was within gravelly sand fill soil only and is likely to be associated with asphalt and roadmaking materials. Based on the existing use and proposed Pipeline Works, it is considered unlikely to present risk to ecology at the site and as it is not a leachable compound, it will not present risk to off-site receptors.
- Concentrations of arsenic in samples from bores located adjacent to the former Tyabb landfill exceeded the EILs for areas of ecological significance. The exceedances, however, were detected within natural soil at a depth of 0.5 – 1.0 mbgl, whereas surface samples reported concentrations of 6 mg/kg and less than the laboratory LOR, indicating that arsenic is likely to be naturally elevated within the area (not due to recent anthropogenic site use e.g. orchard). Additionally, leachability analysis returned results below the laboratory LOR, therefore it is considered unlikely to present risk to off-site receptors.
- Concentrations of TRH fraction >C<sub>16</sub>-C<sub>34</sub> fraction in samples from bores located at KP36.4 (BH35), KP37.5 (BH36) and KP44.2 (MW19) exceeded the ESLs (Coarse Soil, Urban Residential/Public Open Space). It is noted that these bores are located within the middle of a paddock away from hydrocarbon sources. Silica Gel clean-up on soil sample from BH36 returned results below the laboratory LOR indicating the absence of petroleum hydrocarbons and that the TRH was likely to be natural organic matter (NOM). As such, the soil would remain classified as Fill Material (in the absence of other contaminants).
- Laboratory analysis indicated soil samples collected from the proposed location for the Crib Point Receiving Facility, the former Western Port BP refinery, the area adjacent to the former Western Port BP refinery (The Esplanade), and railway corridor between High St and Cool Store Road in Hastings exceeded the EPA Victoria Publication IWRG621 thresholds for Fill Material. Soil samples collected from these areas are classified under IWRG621 as Category C, except at the

Crib Point Receiving Facility where it was classified as Category B. The contaminants of concern include arsenic, copper, lead, zinc, fluoride, PAHs and polychlorinated biphenyls.

### **ASS exceedances**

Targeted ASS investigation within the study area concluded that:

- There is presence of existing acidic soils throughout the study area. This is evident from the presence of low pH and general low sulfate concentrations (<0.03%S) in the soil samples, indicating that the soils have already been acidified.
- PASS was identified at the following locations:
  - MW09 at depth of 3.0 mbgl
  - MW10 at depth of 3 mbgl
  - BH207 at depth of 0.5 mbgl
  - BH209 at depth of 0.5 mbgl
  - BH34 at depth of 2.0 mbgl.
- Net acidity exceeding the 'Action Criteria' of 0.03%S for disturbance exceeding 1,000 tonnes (BPMG, 2010) was exceeded in 78 samples of a total 180 samples. Therefore, soils must be managed in accordance with the EPA Victoria Publication IWRG655.1.

### **Groundwater exceedances**

Groundwater conditions encountered along the proposed pipeline alignment are summarised below:

- Depth to groundwater ranged between 0.995 mBTC (MW22) and 4.834 mBTC (MW18). Four locations, MW04, MW23, MW17 and MW19 were noted to be dry during the gauging round. Groundwater elevations ranged between -0.909 mAHD (MW18) and 22.907 mAHD (MW22), consistent with the general topography and ground elevations along the pipeline alignment.
- No non-aqueous phase liquid (NAPL) (either dense (D) or light (L)) was encountered in any of the groundwater monitoring wells during gauging and groundwater sampling.
- Concentrations of TDS exceeded the adopted ANZECC & ARMCANZ 2000 - Livestock Watering (Beef Cattle, Poultry or Sheep) criteria except at MW07, suggesting that the groundwater along the proposed pipeline alignment is naturally saline. MW07 is located adjacent to the Mckirdys Road Drain and therefore the salinity may be influenced by surface water. It is noted that TDS concentrations at MW9 (13,800 mg/L) and MW11 (18,700 mg/L) are higher than the rest of the locations. This is likely due to tidal interaction associated with the adjacent Watson Creek and rivers that discharge to Western Port.
- Concentrations of copper exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at eight out of 15 locations with detected concentrations ranging between 0.001 and 0.009 mg/kg. The distribution of copper along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and does not represent contamination.
- Concentrations of iron exceeded the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria at eight out of 15 locations with detected concentrations ranging between 0.05 to 3.59 mg/kg. Iron is naturally encountered in groundwater in the region. It is noted that concentrations of iron in groundwater from MW09 (3.59 mg/L) and MW10 (3.02 mg/L) are higher than other wells. Based on the location of MW09 and MW10, it is considered likely that Watson Creek is influencing results. It is considered that the iron naturally fluctuates along the pipeline alignment and does not represent contamination.
- Concentrations of nickel exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at five out of 15 locations with detected concentrations ranging between 0.002 and 0.019 mg/L. The distribution of nickel along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and generally does not represent contamination. However, it is noted that groundwater from GW04

(0.019 mg/L located adjacent to the former Tyabb landfill) and MW05 (0.012 mg/L) located adjacent to a metal recycling yard recorded highest concentrations of nickel, indicating potential impact from the adjacent land uses.

- Concentrations of zinc exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at all 15 locations with detected concentrations ranging between 0.014 and 0.179 mg/L. The distribution of elevated zinc along the pipeline alignment would indicate that it is naturally present / elevated within the aquifer and does not represent contamination.
- Concentration of PFOS exceeded the PFAS NEMP 2018 - PFAS Guidelines Freshwater Marine 99% criteria at GW05 located adjacent and down gradient from the former Tyabb landfill. It is noted that the laboratory LOR is higher than the criteria and PFOS was only detected in the triplicate sample at LOR. However, other PFAS compounds were detected in the primary sample at trace concentrations and therefore it is considered likely that PFOS is present and exceeds the Maintenance of Ecosystems criteria. It is noted that this criteria only applies upon discharge to surface water body.
- Concentration of ammonia exceeded the ANZECC & ARMCANZ 2000 - Maintenance of Ecosystems Marine Water 99% protection level criteria at MW09 (0.5 mg/L). It is noted that the concentration of ammonia fluctuates along the pipeline alignment generally within an order of magnitude and only meets the criteria and does not exceed it. It is considered likely that ammonia detected is associated with broad acre fertiliser use or stock grazing, based on the predominant land use throughout the proposed pipeline alignment.
- Concentrations of total phosphorus exceed the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria in groundwater sampled from all 15 locations. The phosphorous concentration ranges between 0.07 and 0.048 mg/kg and similar to ammonia may be present regionally as a result of stock grazing or fertiliser use. The concentration of phosphorous in groundwater from all wells sampled is below the short-term irrigation criteria by an order of magnitude. Based on the proposed construction period for the Pipeline Works, it is considered that short-term irrigation criteria can reasonably be applied to assessing risk.
- Concentrations of calcium exceeded the ANZECC & ARMCANZ 2000 - Livestock Watering (Beef cattle) criteria at MW11 (1,270 mg/L). The increase in calcium in groundwater from well MW11 is consistent with an increase in general TDS in this area, which is considered likely to be associated with the topography and hydrology of the area and does not represent contamination.
- Concentrations of Sulfate as  $\text{SO}_4$  - Turbidimetric (Filtered) exceeded the ANZECC & ARMCANZ 2000 - Livestock Watering (Beef cattle) criteria at MW09 (1,220 mg/L) and MW11 (1,170 mg/L). The increase in sulfate in groundwater from wells MW09 and MW11 is consistent with an increase in general TDS in these areas, which is considered likely to be associated with the topography and hydrology of the area and does not represent contamination.
- Field measured pH exceeded the NHMRC 2008 - Guidelines for Managing Risks in Recreational Waters criteria at eight out of 13 locations, ranging between 5.96 and 7.34. MW14 (pH 5.96) also exceeded the ANZECC & ARMCANZ 2000 - Irrigation LTV criteria. Acidic pH of groundwater is consistent with the presence of AASS as detected throughout the proposed pipeline alignment and is therefore considered to be naturally occurring and does not represent contamination.

### Marine sediment exceedances

Marine sediment conditions encountered within the marine sediment study area at the Crib Point Jetty are summarised below:

- Marine sediment samples collected from Berth 1 exceeded adopted SQGVs for arsenic and TBT (normalised to 1% TOC).
- Concentrations of PFAS compounds were detected in the marine sediment samples collected from Berth 2; however, Australian guideline values for maintaining ecosystem health in marine sediment are currently not available for PFAS to allow for an assessment of whether the relevant beneficial uses are protected. It is noted that the reported concentrations were low i.e. within the



same order of magnitude as the LOR (0.0002 mg/kg); suggesting that the relevant beneficial uses are protected.

## 9.0 Conclusion

### Contaminated soils and groundwater

Based on broadly spaced intrusive investigations undertaken as part of the field assessment, soil contamination is considered to be limited in extent. Contaminated soils were identified at the Crib Point Receiving Facility proposed location, along The Esplanade adjacent to the former Western Port BP refinery, the former Western Port BP refinery and within the railway corridor between High Street and Cool Store Road in Hastings. It should be noted that localised impacts may be present and may be encountered during Project construction works.

The extent of groundwater contamination is also limited, based on available data. Excluding compounds considered likely to be naturally sourced / background (TDS, selected metals, sulfate, phosphorous, calcium, etc.), contamination was only encountered adjacent to the former Tyabb landfill (PFAS and nickel) and metal recycling yard in Hastings (potentially nickel). It is noted, that while likely areas of concern were assessed as part of this investigation, localised groundwater contamination may be encountered within the Project Area during construction of Project.

### Acid sulfate soils (ASS)

Analysis of soils within the study area confirmed the presence of AASS throughout the study area, and PASS at the following locations:

- MW09 at depth of 3.0 mbgl
- MW10 at depth of 3 mbgl
- BH207 at depth of 0.5 mbgl
- BH209 at depth of 0.5 mbgl
- BH34 at depth of 2.0 mbgl.

The net acidity in soil in 78 of 180 samples exceeded the 'Action Criteria' of 0.03%S for disturbance exceeding 1,000 tonnes (BPMG, 2010). Therefore, this must be managed in accordance with EPA Victoria Publication IWRG655.1.

Further ASS assessment may be undertaken to comply with IWRG655.1 sampling frequency, however the distribution of ASS would suggest that this is not required and that all soils be managed as AASS or PASS in accordance with CASS BPMG (2010). It is recommended that the Project adopt management strategies that prevent or limit oxidation of sulfides and generation of potential acidity such as adopting staging of soil excavations such that ASS are exposed to oxygen for the minimum amount of time possible. Should treatment of ASS be required, further assessment to refine liming rates may be undertaken.

It is noted that although the Pipeline Works and the Gas Import Jetty Works are assessed as a full Project under the EES, the construction works will be undertaken separately under separate approvals and management plans. Therefore, for the purpose of ASS classification under the CASS BPMG (2010), specifically the requirement for an Acid Sulfate Soil Management Plan (ASSMP), the classification will need to be completed for both sets of works independently. The action criteria for each Works would be determined by the volume of soils to be disturbed during construction. It is noted that EPA Victoria was consulted on 19 August 2019, and it was agreed that the Pipeline Works would not require an EPA Victoria approved ASSMP, instead ASS Management Protocol will be developed and included in the Pipeline Works Environment Management Plan (EMP) which will be approved in accordance with the *Pipeline Act 2005*, in consultation with EPA Victoria. This is discussed in the EES Technical Report E: *Contamination and acid sulfate soils impact assessment*.

### Marine sediment

The marine sediment quality investigation undertaken at the Crib Point Jetty identified that contamination from historical and/or existing activities is limited to Berth 1. The marine sediment quality in the Berth 2 area is below the adopted criteria for the assessment of potential ecological risk; therefore, relevant beneficial uses are considered to be protected.

Overall, this investigation concluded that the risk to receptors including human health and the environment from the construction and operation of the Project can be minimised with appropriate mitigation measures in accordance with applicable regulations, guidelines and standards.

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