Technical Memorandum

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Subject	EES referral for the Geelong Hydrogen Hub - Contamination assessment		

1. Introduction

GHD Pty Ltd (GHD) is engaged by GeelongPort Pty Ltd (GeelongPort) to support the preparation of environmental referral documents in relation to the proposed development of the Geelong Hydrogen Hub at the Port of Geelong. GeelongPort is seeking to undertake the following referrals to the relevant agencies:

– **Environmental Effects Statement (EES) referral** to the Victorian Minister for Planning and the Department of Environment, Land, Water and Planning (DELWP) under the *Environment Effects Act 1978*
– ***Environment Biodiversity and Conservation Act 1999*** **(EPBC) self-assessment**, and potentially a referral under the same Act to the Commonwealth Department of Agriculture Water and Environment (DAWE)

This memorandum has been prepared to support and inform the environmental referral documents, and presents the findings of a preliminary contamination investigation (desktop assessment only) for the proposed development area.

1.1 Project overview and investigation area

GeelongPort propose to develop a facility at Port of Geelong to import liquid ammonia, produce hydrogen and nitrogen by ammonia decomposition (or cracking over a catalyst), and distribute hydrogen to potential offtake users within the Port of Geelong as well as in wider Victoria. Use of hydrogen for these industrial processes will present a strong offset for gas production and consumption needs. The site layout highlights the key process buildings, pipeline routes and structures, and allows for future expansion or alternative applications for the ammonia/hydrogen (Attachment 1). The proposed site for the facility comprises approximately 7.5 hectares of land that is wholly owned by GeelongPort. The key project components comprise:

– New ammonia import berth as an extension of Refinery Pier in Corio Bay
– Transfer pipeline to an onshore storage facility
– Onshore storage facility for liquid ammonia (60m diameter storage tank(s))
– Catalytic cracking plant(s) to decompose ammonia into hydrogen and nitrogen
– Onshore distribution pipelines to potential industrial users either within the Port of Geelong or in adjacent industrial zones
– Vehicle refuelling facility (hydrogen)

An options assessment was undertaken for alternative berth layouts to accommodate future imports of ammonia. The preferred berth layout is located within the existing dredge pocket and therefore no capital dredging is required.

It is acknowledged that dredging has been historically undertaken for the Refinery Jetty and berthing areas, and dredge areas are periodically maintained. For the purpose of this preliminary contamination investigation, however, the investigation area is limited to the footprint of the current proposed layout option and the adjoining vacant areas within the immediate vicinity. The investigation area crosses multiple properties and will subsequently be referred to as the "site".

The investigation area is shown in Figure 1 and proposed layout of the proposed development is provided in Attachment 1.

This memorandum was developed based on the assessment of four potential sites as outlined in Section 2 and Figure 1. Since the development of this memorandum the proposed project footprint has been adjusted as follows:

– One option for the hydrogen fuelling site on Site 2 has been removed entirely
– The hydrogen truck fuelling facility footprint in Site 4 has been removed entirely and replaced with a carpark that is reduced in size and now fits within the Port Zone and does not extend into the coastal reserve.

Although these areas are no longer part of the footprint design they have been left in the memorandum to provide contamination risk in the broader area and design flexibility in the event of subsequent design alterations.

1.2 Objective

The objective of the preliminary contamination investigation is to indicate potential land contamination risks in relation to the proposed development at the site.

1.3 Scope and limitations

1.3.1 Scope of work

To achieve the objective in Section 1.2 the preliminary contamination investigation undertaken included the following scope of work.

– Desktop assessment of following information and documents:
  - Publicly available EPA VIC records including Victorian landfill register, Priority Site Register, GQRUZ, Licences, annual performance reports)
  - Five nearby environmental audit reports
    – CARMS No. 54790-11, Geelong Refinery 2019 53V Environmental Audit Report (GHD 2019)
    – CARMS No. 54790-10, Geelong Refinery 53V Environmental Audit Report (GHD 2016)
    – CARMS No. 62296-1, Report for Station Street, Corio – Environmental Audit Report (GHD 2000)
    – CARMS No. 74827-1, Environmental Audit Report, 121-171 Seabeach Parade, North Shore VIC 3124 (Senversa 2018)
    – CARMS No. 30986-1), Environmental Audit Report, Port of Geelong (Woodward-Clyde 1997)
  - Available historical aerial images from audit reports and Google Earth
  - Review of the GHD groundwater technical memorandum developed in tandem to this memorandum
– Preparation of this Technical Memorandum summarising the findings of the investigation

1.3.2 Limitations

This report: has been prepared by GHD for GeelongPort and may only be used and relied on by GeelongPort for the purpose agreed between GHD and GeelongPort as set out in section 1.3.1 of this report.

GHD otherwise disclaims responsibility to any person other than GeelongPort arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

2. Site identification and physical settings

Site identification details and physical settings are summarised in Table 1 and Table 2 and shown on Figure 1 and Figure 2.

Table 1 Site identification details

Assigned site ID	**Site 1**	**Site 2 (removed from design)**	**Site 3**	**Site 4 (reduced footprint)**
Landowner	Geelong Port	To be confirmed	Crown Land	Crown Land
Parcel identification (Site and Plan Number or SPI)	Centre section of Site 1 PS613947	Northern section of Site 2 PS511647	222\PP3179	Southern and centre section of 2006\PP3179
Address	Multiple addresses	121-171 Seabeach Parade, North Shore	1 Lowe Street, Corio	120 Shell Parade, Corio
Investigation area	Vacant land bounded by Greta and Seabeach Parade / Lowe Street and Shell Refinery Wastewater Channel	A small rectangular area at the south-western corner of St Georges Rd and Seabeach Parade	A parallelogram shaped area at the north-western corner of St Georges Rd and Seabeach Parade	An irregular shaped area along the shoreline, to the east of Shell Parade and Refinery
Area size	22 hectares	1.2 hectares	2.6 hectares	2.8 hectares
Zoning	PZ – Port	IN2Z – Industrial 2	PZ – Port	PZ-Port but adjacent to PCRZ – Public Conservation and Resource
Plan Overlay	Land Subject to Inundation Overlay (LSIO) Special Building Overlay (SBO)	Design and Development Overlay (DDO) Special Building Overlay (SBO)	Land Subject to Inundation Overlay (LSIO) Special Building Overlay (SBO)	Environmental Significance Overlay (ESO)
Current land use	Vacant	Vacant	Vacant, Rollerama Drain	Public open space
Local government	City of Greater Geelong			

Table 2 Site physical settings

Topography and surface water	The topography of the area is highly modified due to the industrial history of the area. The ground surface is generally flat with a gentle slope downward towards Corio Bay. Rollerama Drain runs across Site 1 towards Corio Bay. Rollerama Drain collects surface runoff form Site 1 and immediate upgradient industrial areas. Refinery Channel (also referred to as Oyster Bay Creek or Shell Effluent Channel) runs along the northern boundary of Site 1, towards Corio Bay. Refinery Channel collects surface runoff from Site 1, cooling water from the refinery and surface runoff from upgradient urban area (northwest of the site).
Lithology and geology	, It is known that anthropogenic filling (municipal landfill) has occurred to level the land and reclaim swamps and low lying depressions adjacent to the coastline. Between one to eight metres of fill have previously been recorded. Soil material across the investigation area is generally composed of top fill material and underlying Quaternary and Tertiary aged sediments to depths ranging between 1 to 2 m below ground level (bgl), with silty clay and sandy clay underlying these sediments at deeper depth. The soils fronting Corio Bay at Site 4 has high probability (very low confidence) of occurrence of coastal acid sulfate soils (CASS). There is a low probability (very low confidence) of occurrence of CASS at Sites 1,2 and 3. The local surficial geology comprises Quaternary sandy clay and clay (coastal dune deposits) underlain by the Moorabool Viaduct Sands formation containing calcareous sand, clayey sand, quartzite, ferruginous sand and gravel. Further west of Seabeach Avenue / Lowe Street, lava flows of the Newer Volcanics have been mapped.
Hydrogeology	All of the afore mentioned geologies, where saturated, constitute aquifers including deeper fill material. The Moorabool Viaduct Sand is the principal aquifer in the study area and constitutes a regional water table aquifer. It is interpreted to be hydraulically connected with the coastal dunes aquifer systems, and where present, the overlying Newer Volcanic basalt (further west). Depth to groundwater is expected to be between 1.0 – 4.0 metres depth with salinity (total dissolved solids-TDS) of 3 000 and 6 500 mg/L. This is likely to be higher in Site 4 due to influence of Corio Bay saline seawater in the mixing zone. Local groundwater generally flows easterly towards Corio Bay. Groundwater at Site 2 is likely to flow north-easterly towards the closest natural low point of Rollerama Drain. The aquifers are recharged by infiltrating rainfalls, and potentially from waterway leakage within the greater catchment.
Surrounding land use	**Sites 1, 2 and 3:** – North: Geelong Refinery, industrial and commercial (fertiliser storage and/or manufacturing, bulk liquid storage and bitumen manufacturing), Corio Station and refinery buffer zone to the further north – East: refinery jetty, Corio Bay – South: industrial, a transmission station to the immediate south of Site 2 – West: Rail corridor, industrial and then residential **Site 4:** – North: public open space, agricultural and residential to the northeast – East: Corio Bay – South: Corio Bay, refinery jetty, bulk liquid storage and bitumen manufacturing to the southwest – West: Geelong Refinery

3. Desktop review findings

Potential sources of contamination and associated contaminants of potential concern (CoPC) for sites 1 to 4 are summarised in Tables 3 to 6.

Table 3 Potential sources of contamination and CoPC – Site 1

Known or potential sources of contamination	Description	Contaminants of potential concern (CoPC)
On-site sources: – Historical filling – Possible illegal dumping – Grazing activities prior to 1955	Majority of the land at Site 1 has been engineered and is subject to historical filling. Illegal dumping may also have occurred as majority of Site 1 has been unused for decades. It was noted in an audit (CARM'S number 30986-1, dated 17 June 1997) that the southwestern portion of Site 1 was filled with variegated industrial wastes to at least 1 m including occasionally tarry and slag like material that may have come from a gasworks. However, the exact extent of these fillings was not certain.	– Metals – TRH, PAH, BTEX, phenols, cresols – Ammonia, sulphides – OCP and OPP – Asbestos
On-site sources: – Former landfill (municipal solid waste)	The eastern portion of Site 1 is reported to have been landfilled with municipal solid waste to reclaim swamy coastal land around the original Oyster Cove. The landfill was operated until 1979 and was capped with about a metre of silty clay and sand. An indicative footprint of the former landfill is presented in Figure 2. It was noted in an audit (CARM'S number 30986-1, dated 17 June 1997) that generation of landfill gases was still occurring and the land subsidence was probably continuing.	– Landfill gases including CH_4, CO, H_2S, SO_2 – Landfill leachate and soil (pH, TDS, metals, ammonia, nitrogen, sulphides, TRH, BTEX, VOC, SVOC, PFAS, salinity) – Odorous gases – Asbestos
On-site sources: – Former industrial activities: 1. Fertiliser production and likely subsequent explosives production within a square block to the south of St Georges Rd **2.** Geelong Water (now Barwon Water) pipe maintenance depot and subsequently a second material dealer within a triangle block at the corner of Seabeach Parade and Greta St	A small square area to the south of St Georges Rd was leased by Incitec for fertiliser manufacturing. On-site activities included handling of molten sulphur. The area was then occupied by Orica Chemnet, a manufacturer and supplier of explosives. On-site activities during Orica Chemnet's operation were unknown. The above ground structures appeared to be demolished in 2017. A triangle area at the corner of Seabeach Parade and Greta St was used as a pipe maintenance depot and subsequently a second material dealer. The above ground structure appeared to be demolished in 2011/2012. Footprint of these former industrial activities is presented in Figure 2.	– Nitrogen and Sulphur – Explosives – Metals – TRH, BTEX, PAH – Solvents

Known or potential sources of contamination	Description	Contaminants of potential concern (CoPC)
Off-site sources: – Geelong Refinery (the Refinery) to the immediate north of Site 1	Geelong Refinery is a current Priority Site which requires cleanup and ongoing management. Following refinery activities and incidents have a contamination potential to impact Site 1: – Reported oil spills and leaks into surface water, soil and Corio Bay, hydrocarbon product overflows – Release of SO2 dust into air during operation and in reported discharge exceedance event – Release of hazardous fluoride to the atmosphere during operation and in reported discharge exceedance events – Reported chemical spill (ammonia derivative chemicals) into Corio Bay – Fire training ground, fire station and fire fighting foam storage, reported accidental releases of PFAS containing foam in 2017 and 2019. Geelong Refinery is a known source of LNAPL in groundwater. LNAPL plumes has been mostly contained within the Refinery boundary and a groundwater interception trench has been installed along the east and southeast Refinery boundary to prevent further migration of LNAPL towards Corio Bay and the Terminals.	– Metals – TRH, PAH, BTEX, MTBE, Phenols – PFAS – LNAPL and dissolved phase hydrocarbons in groundwater
Off-site sources: – Adjacent upgradient industrial activities other than the Refinery	Upgradient industrial activities may impact Site 1 via surface run off and through Rollerama Drain and Shell Creek/Refinery Channel. Identified upgradient industrial activities other than the Refinery includes: – a fertiliser plant (Incitec Pivot Fertilisers) – an express self-assistant deiseal service station	– Metals – TRH, PAH, BTEX – Nitrates, nitrogen, phosphorous, ammonia, fluoride, pH – PFAS

TRH- total recoverable hydrocarbons; Polycyclic aromatic hydrocarbons (PAH); Benzene, Toluene, Ethyl-Benzene , Xylene (BTEX); MTBE – Methyl tertiary-butyl ether
VOC - Volatile organic compounds; Semi-volatile-organic compounds (SVOC)
OCP - Organochlorine Pesticides; OPP - Organophosphate Pesticides
PFAS – Per- and Poly-fluoro alkyl substances
LNAPL - Light non-aqueous phase liquids
Metals - arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium & zinc

*Table 4 Potential sources of contamination and **CoPC – Site 2 (removed from project design)***

Known or potential sources of contamination	Description	Contaminants of potential concern (CoPC)
On-site sources: – Former stormwater holding pond in the western portion of Site 2 – Car parking and vehicle wash bays, shipping and receiving – Historical filling – Grazing activities prior to 1955	Site 2 was part of a former metal casting plant which had a history of sixty years. However, metal casting activities occurred mainly to the south of Site 2 and therefore are treated as off-site sources in this investigation. Site 2 was used for car parking, vehicle cleaning, shipping and receiving, and a stormwater holding pond. The pond was likely built in late 1990s and was used to store stormwater from the metal casting plant. The pond was likely filled in 2018 as part of the decommission of the metal casting plant. Off-site metal casting to the immediate south of Site 1 occurred since 1955 and stopped operation in 2016. All related above ground facilities appeared to be removed in the recent aerial image (Google Earth, 2020).	– Metals – TRH, PAH, BTEX – OCP, OPP – PFAS – Asbestos
Off-site sources: – Former metal casting activities to the immediate south of Site 2 – Decommission of the metal casting buildings and infrastructure that likely contained asbestos containing materials (ACM) – Thermal oils associated with former electrical transformers		– Metals – TRH, PAH, MAH, BTEX, VOC, SVOC, Phenols, formaldehyde, triethylamine, solvents, acids and bases (phosphoric and sulphuric) – Asbestos – PCB

TRH- total recoverable hydrocarbons; Polycyclic aromatic hydrocarbons (PAH); Benzene, Toluene, Ethyl-Benzene , Xylene (BTEX); MTBE – Methyl tertiary-butyl ether; MAH - Monocyclic aromatic hydrocarbons
VOC - Volatile organic compounds; Semi-volatile-organic compounds (SVOC)
OCP - Organochlorine Pesticides; OPP - Organophosphate Pesticides; PCBs - Poly-chlorinated biphenyls
PFAS – Per- and Poly-fluoro alkyl substances
Metals - arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium & zinc

Table 5 Potential sources of contamination and CoPC – Site 3

Known or potential sources of contamination	Description	Contaminants of potential concern (CoPC)
On-site sources: – Likely historical filling – Possible illegal dumping – General grazing practices in the region prior to 1955	Considering that Site 3 is a public land located in an area with a long industrial history, illegal dumping of both domestic and industrial waste on the land or into the Rollerama Drain may have occurred at Site 3. Given that Site 3 is located within an industrialised precinct where extensive filling has occurred to level the land, it is likely that filling activities have occurred at Site 3.	– Metals – TRH, PAH, BTEX – OCP, OPP – Asbestos
Off-site sources: – Adjacent upgradient industrial activities including auto service workshops, an express diesel service station, the Refinery tank farm and the Refinery water reclamation plant	Potential contaminants from the upgradient industrial activities will likely impact Site 3 via surface runoff and through Rollerama Drain.	– Metals – TRH, PAH, BTEX, phenols
Off-site sources: – Former coal power station in 1950s and 1960s at 25, 35-49 Lowe St, immediate north of Site 3	Historical power station activities included coal storage, handling and burning, maintenance of generators and transformers, and handling of ash.	– Metals – TRH, PAH, BTEX – PCB – Solvents
Off-site sources: – Former landfill (current the refinery tank farm), 200 m northwest	Victorian Landfill Register recorded a former landfill located where current Western Tank Farm is, 200 m northwest of Site 3. The type of waste accepted at the landfill is uncertain. The landfill was likely closed in 1997.	– Chemicals depending on the type of landfill – Landfill gases including CH_4, CO, H_2S, SO_2 – Landfill leachate and soil (pH, TDS, metals, ammonia, nitrogen, sulphides, TRH, BTEX, VOC, SVOC, PFAS, salinity) – Odorous gases – Asbestos

TRH- total recoverable hydrocarbons; Polycyclic aromatic hydrocarbons (PAH); Benzene, Toluene, Ethyl-Benzene , Xylene (BTEX);
VOC - Volatile organic compounds; Semi-volatile-organic compounds (SVOC)
OCP - Organochlorine Pesticides; OPP - Organophosphate Pesticides; PCBs - Poly-chlorinated biphenyls
PFAS – Per- and Poly-fluoro alkyl substances
LNAPL - Light non-aqueous phase liquids
Metals - arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium & zinc

*Table 6 Potential sources of **contamination and CoPC – Site 4 (reduced project footprint)***

Known or potential sources of contamination	Description	Contaminants of potential concern (CoPC)
On-site sources: – General maintenance of the coastal reserve	Pesticides may have been used for pest control in the reserve. May contain CASS below water table	OCP, OPP Potential CASS
Off-site sources: – Geelong Refinery to the immediate west (upgradient) of Site 4	Geelong Refinery is located immediate upgradient of Site 4. It is a current Priority Site which requires clean-up and ongoing management. Following refinery activities and incidents have a contamination potential to impact Site 4: – Reported oil spills and leaks into surface water, soil and Corio Bay, hydrocarbon product overflows – Release of SO2 dust into air during operation and in reported discharge exceedance event – Release of hazardous fluoride to the atmosphere during operation and in reported discharge exceedance events – Reported chemical spill (ammonia derivative chemicals) into Corio Bay – Fire training ground, fire station and fire fighting foam storage, reported accidental releases of PFAS containing foam in 2017 and 2019 Geelong Refinery is a known source of LNAPL in groundwater. LNAPL was previously detected in the groundwater within the southern portion of Site 4 (see Figure 2 and Figure 3).	– Metals – TRH, PAH, BTEX, MTBE, Phenols – PFAS – LNAPL and dissolved phase hydrocarbons in groundwater

TRH- total recoverable hydrocarbons; Polycyclic aromatic hydrocarbons (PAH); Benzene, Toluene, Ethyl-Benzene , Xylene (BTEX); MTBE – Methyl tertiary-butyl ether
OCP - Organochlorine Pesticides; OPP - Organophosphate Pesticides
PFAS – Per- and Poly-fluoro alkyl substances
Metals - arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium & zinc
LNAPL - Light non-aqueous phase liquids
CASS - Coastal acid sulphate soils

4. Addressing EES referral requirements

4.1 Existing contamination impact on proposed design

Historical land use activities have likely created legacy environmental issues including soil, soil vapour (petroleum hydrocarbons and/or landfill gas) and groundwater contamination that will need to be addressed by the proponent. These are discussed in the sections below.

Rainfall infiltration through the shallow fill materials has the potential to leach constituents into the groundwater, effecting the groundwater quality and potentially, down-gradient receptors such as Corio Bay. The shallow nature of groundwater occurrence, and potentially high hydraulic conductivity of coastal sediments, suggests that the groundwater is vulnerable to contamination from land use practices (both current and historical).

Under the new EPA Act (2017), and irrespective that the contamination may have been a responsibility of legacy land users and managers, the proponent (GeelongPort) has a general environmental duty (GED) to understand and meet their environmental protection duties. Specifically, whether construction of the project and its on-going operation would result in

– Disturbance or exposure of contaminated soil and/or buried wastes and increased migration into surface water via stormwater and overland water flows
– Greater fluxes of contaminated groundwater discharging from the site and resulting in unacceptable adverse impacts to the aquatic ecosystems of the Rollerama Drain or Corio Bay
– Accumulation and concentration of flammable/explosive or toxic gases and vapour in confined or non-ventilated spaces

The New EP act is discussed in more detail in Section 5.

4.1.1 Site 1

The presence of the former landfill within the eastern portion of Site 1 and previously reported landfill gas generation and land subsidence will potentially restrict the design of proposed facilities. Further geotechnical and environmental investigation, and landfill gas risk assessment will be needed to determine the suitability of this area to be used for the proposed development.

Landfill gases generated from the former landfill will likely accumulate in trenches and confined spaces during construction and post construction. Should the former landfill area and the adjacent area (within a buffer of 200 m) be used for proposed construction, ongoing landfill gas monitoring and/or a gas extraction or barrier system may be needed.

Should the former landfill area be used for proposed construction, excavation of buried waste in the former landfill should be avoided where possible through adaption of foundations and geotechnical options such as bored piers rather than bulk excavation. If leachate and/or landfill gas is still being generated then a gas or leachate extraction or barrier system may be needed to mitigate the risk if wastes are not removed. Landfill leachate is often also acidic therefore selection of construction materials would also need to consider the corrosion and aggressive characteristic of the soil.

Should contaminated soils and buried wastes be exposed then management of these wastes, likely as Industrial or Priority Waste would be required. On-site management of the exposed contaminated soils and buried waste would be required to reduce the migration risk of the contaminants into the surrounding environment, in particular Corio Bay. Most buried waste and contaminated soils would likely be unsuitable to remain on-site and would require off-site disposal to operating licensed landfill.

In addition, Environmental investigations were completed a number of years ago, and therefore emerging contaminants such as Per- and polyfluoroalkyl substances (PFAS) and their presence in the study area may not have been assessed.

The northeast portion of Site 1, fronting the Refinery, may have been impacted by the refinery activities. Groundwater may have been affected by LNAPL and other contaminants. Further field investigation will be needed to confirm the current contamination status of this area.

The western portion of Site 1 has been used for grazing and industrial uses. This area can potentially be used for the proposed industrial development. Considering the on-site and adjacent off-site industrial activities, on-site historical filling and potential illegal dumping activities, and adjacency to the former landfill to the east, further field investigation will be needed to confirm the suitability of this area to be used for the proposed development.

4.1.2 Site 2 (removed from project design)

The eastern portion of Site 2 has been used for grazing and car parking. No sources of contamination that would restrict the design of proposed development in this area have been identified.

The western portion of Sirte 2 was used for a stormwater holding pond. The pond was likely built in late 1990s and was used to store stormwater from the metal casting plant to the immediate north of Site 2. The pond was likely decommissioned and filled in 2018 as part of the decommission of the metal casting plant. Soil investigation is recommended to confirm the contamination condition of the filling material and the underlying soils if earthwork is proposed for this area.

4.1.3 Site 3

No on-site sources of contamination that would impact the design or construction of the proposed industrial development have been identified. Off-site industrial activities including a former coal power station, a former landfill (upgradient northwest), the refinery tank farm, upgradient auto service workshops may have impacted the surface water, sediments, soils and groundwater at Site 3. However, the extent and the concentration of CoPC are uncertain. Further investigation is recommended to confirm the contamination status of the land.

Due to historical filling and likely illegal dumping within Site 3, soil and waste management will likely be needed if construction is proposed for this area.

4.1.4 Site 4 (reduced project footprint)

Site 4 is located within a Public Conservation and Resource zone and is subject to an Environmental Significance Overlay (ESO). Permit requirement for the proposed development need to be reviewed.

LNAPL was previously reported in groundwater within the southern portion of Site 4. The Geelong Refinery LNAPL source area has a groundwater interception trench upgradient to Site 4, however some contamination impacts, including LNAPL, appear to still be migrating across the trench.

LNAPL plume at Site 4 may pose a vapour intrusion risk to construction workers and the underground petroleum vapour may accumulate in trenches and confined spaces during construction and post construction. Should the area impacted by LNAPL be used for proposed construction, a vapour extraction or barrier system may be needed to mitigate the vapour risk. Further field investigation and vapour intrusion risk assessment will be needed if construction is proposed for this portion of Site 4.

No LNAPL was previous reported within the northern portion of Site 4. However, considering the history of the Refinery, soils and groundwater within this portion may have been impacted. Further investigation is recommended to confirm the contamination status of the land if construction is proposed.

CASS may be present, therefore the design should consider options to minimise any actions that may expose the CASS to oxygen and cause net generation of sulphuric acid including (but not limited to):

– Subsurface works and infrastructure below the water table
– Sealing of the site preventing surface water recharge or other actions that may result in lowering of the water table (low risk due to coastal waters)
– Significant infilling or addition of infrastructure that add weight that displaces groundwater

Selection of construction materials would also need to conder the corrosion and aggressive characteristic of the soil.

4.1.5 Soil management during construction

Based on this desktop assessment, the following is noted:

- Excavations to construct the onsite infrastructure, and various utility pipelines have a high likelihood of disturbing fill materials which could include contaminated soils and buried wastes
- Sedimentation management will be needed for the construction given the high potential for contamination and close proximity to Corio Bay
- Spoil management may be needed where soil is likely to be contaminated and wastes may be excavated. Contamination of soil may be such that it is not suitable to be re-instated and on-site soil management and/or off-site disposal may be required to mitigate risk. Off-site disposal of contaminated soils or buried wastes may have significant timing, logistic and cost implications depending on the waste category and the volume
- If gross asbestos contamination or of fibrous or friable asbestos contamination is present, particularly in landfills, then any disturbance of these soils and materials should be done under Class A asbestos removal work conditions. This involve additional controls such as PPE, isolation barriers, air monitoring, dust suppression, encapsulation etc. in a designated asbestos works area by a Class A licensed asbestos removal contractor in accordance with Worksafe Victoria guidance. Once disturbed or excavated these materials and any visibly contaminated soil cannot be re-used on the site and will require offsite disposal to an appropriately licenced landfill. If undisturbed, then these materials can remain at depth on-site under an asbestos management plan
- Excavations may remove contaminated material or buried wastes, however, contaminated soils and buried wastes may remain and continue to generate leachate and contamination of the groundwater and the down-gradient receiving environment. Under the new EP Act there is a duty to manage this contamination if it poses a risk to human health or the environment
- Construction of the infrastructure has the potential to hinder or remove access to parts of the landfilled or other contaminated areas and prevent or complicate future clean-up. Therefore, an understanding of the status of contamination and whether it poses an on-going risk to human health or the environment is required
- CASS may be present, particularly on Site 4, therefore if encountered an acid sulphate soil management plan will be required to manage the risk including staged excavation, leachate capture, neutralisation and storage system, addition of lime to neutralise soils, monitoring of surface water and possible offsite disposal of soil. If undisturbed, then these materials can remain on-site under an acid sulphate soil management plan
- There will likely need to be a clean-up or remediation plan, asbestos management plan and acid sulphate soil management plan in addition to the standard environmental controls outlined in a CEMP.

4.1.6 Groundwater management during construction

With shallow groundwater, there is an increased likelihood that excavations to construct foundations, cellars / basements or underground services, may intersect groundwater. Groundwater quality, however, needs to be maintained to protect the aquatic environments, e.g. Corio Bay, immediately down-gradient of the site.

Based on the hydrogeological assessment, impacts to groundwater from dewatering could be reasonably managed through design, and construction environmental management processes. Nevertheless, construction dewatering can create a number of issues that will require management during the design and construction of the project:

- Oxidation of acid sulfate soils. It is noted that the published mapping indicates a low probability of occurrence of CASS at Sites 1-3 but a high probability in Site 4
- Managing volumes of groundwater recovered during dewatering activities, i.e. how is groundwater disposed, particularly given the groundwater is likely to be contaminated and the close proximity of the Corio Bay aquatic ecosystem
- Any LNAPL encountered (particularly relevant for Site 4) will require clean-up as part of management
- Increased risk of the generation of soil vapour and/or landfill gas as the water table is lowered and saturated subsurface materials become unsaturated and exposed to air

There are a range of options to minimise the disturbance of the groundwater environment and dewatering activities, these are outlined further in the hydrogeology inputs. On the assumption that there will be no increase in the dredging area, offshore works are not expected to influence the environment.

4.1.7 Soil vapour /landfill gas management during construction

Soil vapour and landfill gas may be present subsurface in the area and pose a risk to construction and site workers in confined space with no or minimal ventilations. This allows accumulation and concentration of vapours and gases that may result in the following:

– Flammable or explosive atmospheres
– Exposure to hazardous chemicals through inhalation above safe working exposure limits
– Asphyxiation resulting from oxygen deficiency

Mitigation measures to manage this risk may be required during construction such as personal monitoring of worker airspace or confined space work areas, removal of potential ignition sources from works area and/or installation of temporary ventilation systems for subsurface works.

4.2 Potential contamination from proposed site activities

A separate technical memorandum provides the safety, hazard and risk assessment of the proposed site operations. The assessment identified points of the process in which liquid ammonia could be discharged into marine waters of Corio Bay and/or land, or loss of containment of ammonia, hydrogen or nitrogen gas.

The facility is expected to be subject to the requirements and the legal duties described in the Victorian *Occupational Health and Safety Regulations 2017* Part 5.2 Major hazard facilities (MHF) and WorkSafe Victoria requirements. The facility should be designed in accordance with recognised design standards and operated and maintained to comply with applicable safety and environmental requirements. The standards include AS/NZS 2022 Anhydrous ammonia – storage and handling.

Once the chemicals are in gaseous form they may pose an occupational health risk or flammable/explosive risk (refer to the safety, hazard and risk assessment memorandum for more detail) but do not pose a significant risk of soil and groundwater contamination. If liquid ammonia leaks below ground, however, then it may migrate and dissolve into groundwater and continue to act as a source of ammonia gas in the facility and/or discharge into Corio Bay. Ammonia is very soluble in water and higher levels of ammonia in the marine environment can be directly and indirectly acutely toxic to many marine organisms. Ammonia is a non-persistent and non-cumulative toxicant to aquatic life.

To mitigate the risk of liquid ammonia leaks to soil or subsurface, all liquid chemical storage tanks should be situated above ground in enclosed systems with self-contained bunds and gas capture in the event of leaks. The liquid ammonia storage area should have an external bund and dedicated stormwater system that can be isolated from the rest of the site in the event of a major spill or leak.

A site management plan with protocols to manage spills/leaks of various quantities should be developed and implemented. The plan should also outline a program for routine monitoring of stormwater and groundwater discharge for ammonia concentrations with specified trigger levels and actions if exceeded. This monitoring program should include the installation and monitoring of sentinel groundwater wells targeting groundwater discharging along the waterfront.

There may also be a requirement to pre-emptively put in a groundwater interception trench along the water front, particularly if groundwater is already contaminated from historic site activities (under the new EP Act 2017 existing groundwater contamination would need to be managed if posing a risk to human health or the environment, refer to Section 5 for more detail). Groundwater would then be pumped from the trench and require management or treatment as waste water either on-site or at an offsite facility.

5. Changes under *Environment Protection Act* 2017

This section discusses key implications of the new *Environment Protection Act 2017 (Vic)* (as amended by the E*nvironment Protection Amendment Act 2018*) which came into effect on 1 July 2021 and the *Environment Protection Regulations 2021* (Vic), guidelines and standards that will be relevant to the assessment of the environmental effects.

5.1 General Environmental Duty (GED)

The new Act contains a General Environmental Duty (**GED**) that will be applicable to the construction and operation of the Project. The GED (as defined in Section 25 of the new Act) requires a person or entity to:

– identify risks and hazards that may impact the environment or human health that arise from its operations; and
– eliminate or minimise those risks as far as reasonably practicable.

An Environmental Management Framework and Construction Environment Management Plan (CEMP) would be needed to respond to the identified risks to the environment and human health that may arise from the construction and operation of the Project, responding to the requirement of the GED.

A risk based approach to identify the potential presence of contamination within the Project footprint should be undertaken for environmental approvals. This memorandum forms the first stage of this process by reviewing site history investigations within the Project footprint using various sources of information to identify potentially contaminating activities that may have occurred at the site. Where the potential for the presence of contamination was identified, targeted sampling and testing will be required to confirm whether contamination was present.

5.2 Other relevant provisions of the new Act

5.2.1 Duty to Notify and Manage

Part 2.1 of the new EP Act Regulations includes, among other things, thresholds and exemptions for the purposes of reporting notifiable contamination and relevant exemptions, and references to elements of the *National Environment Protection (Assessment of Site Contamination) Measure*. Regulation 8 defines "prescribed notifiable contamination" in or on soil for the purposes of the duty to notify of contaminated land under section 37 of the new Act.

Part 3.5 of the new Act imposes a duty on persons in 'management or control' of contaminated land to:

– Notify the EPA of land and groundwater contamination (including historical contamination) that exceeds set thresholds. The EPA must be notified as soon as practicable after it becomes aware of, or reasonably should have been aware of, "notifiable contamination" (being contamination above the thresholds set out in part 2.1 of the new Regulations); and
– Manage contaminated land to minimise risk of harm to human health or the environment, including identification, investigation and assessment and carrying out clean up of that contamination to the extent reasonably practicable where the contamination presents a risk of harm. Persons in management or control should also provide adequate information to anyone who may be affected by the contamination or who may become a person in management or control.
– EP Act Regulation 15 requires that, if non-aqueous phase liquid (NAPL) is present in soil or groundwater, it must be, so far as reasonably practicable: (a) cleaned up; and (b) if the source of the non-aqueous phase liquid is located on the land, the source of the liquid must be removed or controlled. This is particularly relevant to Site 4 where LNAPL has previously been identified

5.2.2 Waste Management

Relevant provisions in the new Act relating to waste and contamination include the following:

– Under section 3 of the new Act, the definition of 'waste' has been updated to include:
  - Matter that is discarded, rejected, abandoned, unwanted or surplus, irrespective of whether it has any potential use or value; and
  - Any matter or greenhouse gas substance intended for, or undergoing, resource recovery

Therefore, matter (including soil) will continue to remain a waste until it is reused for an original purpose.

Part 6.4 of the new Act sets out duties and controls in relation to industrial waste, including duties to classify wastes and to take reasonable steps to ensure the waste is taken to a place authorised to receive that waste (known as a Lawful Place). Part 6.5 of the new Act sets out the duties and controls relating to priority waste (PW), previously known as "prescribed industrial waste". PW that poses the highest level of environmental risk is known as reportable PW and carries more stringent controls in relation to transport and tracking.

The *Environment Protection (Industrial Waste Resource) Regulations 2009* (Vic) have been replaced by Part 4.2 (Industrial waste and priority waste) and schedule 6 (Categories of priority waste) of the new Regulations, and are supplemented by *EPA Publication 1827.2: Waste Classification Protocol*.

Relevant provisions in the new Regulations relating to waste include the following:

– Chapter 4 of the Regulations addresses waste, including industrial waste and priority waste. Among other things, Part 4.2 prescribes certain waste to be industrial waste (IW), classifies IW, defines a Lawful Place, and describes the requirements for a "Declaration of Use" (a tool that enables waste producers and recyclers to reuse, store and recover materials from low-risk waste)
– Schedule 5 of the Regulations outlines the waste classifications for various waste items

5.3 New Relevant Standards or Guidelines

Relevant new standards and guidance material for contamination is outlined in the below table. It is noted that the table below is not a comprehensive list of all relevant new EPA guidelines, refer to the EPA website for a comprehensive and up to date list of draft and final EPA publications[1].

Table 7 New or updated standards or guidelines

Old standard/publication	New or updated standard/publication
EPA Publication 1828.1: Waste disposal categories – characteristics and thresholds *Industrial Waste Resource Guideline: Soil hazard categorisation and management (IWRG621)*[2]	*EPA Publication 1827.2 Waste Classification Protocol* *EPA Publication 1828.2: Waste disposal categories – characteristics and thresholds*
State Environment Protection Policy (Prevention and Management of Contamination of Land)[3]	Environment Reference Standard (ERS) - Part 4 *EPA Publication 1915: Contaminated land policy* *EPA Publication 1940: Contaminated land: Understanding section 35 of the Environment Protection Act 2017*

[1] EPA website guidelines **https://www.epa.vic.gov.au/about-epa/publications?ps=10&pn=63&t=e2b4ed50532740b4a873a7d963233584&p=fd03c7feab9e46479915eab9fb9dbcc6&s=contentDateRecentFirst**

[2] We note that Publication 1828 supersedes IWRG621 to categorise soil, but IWRG702 continues to be relevant to determine an appropriate sampling and assessment regime. IWRG621 continues to apply only to saved classifications issued under the former IWR Regulations: **https://www.epa.vic.gov.au/about-epa/publications/1828-2.**

[3] SEPPs and WMPs no longer have a formal role under the new Act or Regulations. However, they are treated by EPA as valuable instruments that contribute to the state of knowledge on relevant risks and risk control measures that they address and will, while they remain relevant to each risk, support the operation of the duties under the new Act.

Old standard/publication	New or updated standard/publication
	EPA Publication 1977: Assessing and controlling contaminated land risks: A guide to meeting the duty to manage for those in management or control of land *DELWP Planning Practice Note 30: Potentially Contaminated Land (July 2021)* New Act - Pts 3.2 (ss 25-27), 3.4 (ss 29-34), 3.5 (ss 35-42) New Regulations - Ch 2 (regs 8-15)
State Environment Protection Policy (Waters)	Environment Reference Standard ERS - Part 5 New Regulations - Ch 5, Pt 5.4 (reg 132) *Environment Protection Transitional Regulations 2021* - reg 7[4]
Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999	*EPA Publication 1828.2: Waste disposal categories - characteristics and thresholds*[5] New Act - Part 6.5 (ss 138-141) New Regulations - Pt 4.2 div 2; Pt 10.2 table item 8; Sch 1 item 79; Sch 5, items 26 and 85.

As of 1 July 2021, the formal statutory role of the SEPPs and Waste Management Policies (WMP) as subordinate instruments ended. Much of the content of the SEPPs and WMPs has been replaced by the new Act (in particular by the GED), the new Regulations and the Environment Reference Standard (ERS), or will be reframed in the future as EPA guidance: see *EPA Publication 1994*: *Using SEPPs and WMPs in the new environment protection framework guide*.

Some clauses in SEPP Waters will remain in force for a period of 2 years including requirements around the discharge of saline waters, which may be relevant for this project where any disposal of saline groundwater is required in the event that groundwater pumping is required.

The intent of other clauses in the SEPP largely remains, but noting that the requirements of the General Environmental Duty to manage risks to human health and the environment, is the primary consideration that over-rides the consideration of historical clauses in SEPPs and WMPs. Note that for land and water the requirements specified in the Environmental Reference Standard have not been substantially changed from the SEPPs.

[4] The transitional Regulations save certain clauses in SEPP (Waters) until 1 July 2023. Until then, DELWP and EPA will consult with stakeholders on whether these clauses should be remade in another subordinate instrument: *EPA Publication 1753.2: Guide to the Environment Protection Regulations*.

[5] Potential and actual acid sulfate soils are classified as waste acid sulfate soil (WASS) (Waste code N123) when they do contain: a) contaminant concentrations exceeding the upper limits for fill material in Table 3 of Publication 1828; or b) asbestos, additional relevant codes also apply. Further EPA guidance concerning management of WASS is provided at: **https://www.epa.vic.gov.au/for-business/new-laws-and-your-business/manage-waste/waste-classification/managing-waste-soil**

6. Conclusions

GHD has undertaken a preliminary contamination investigation (desktop assessment only) for four land blocks at the Port of Geelong (Sites 1 to 4) where the Geelong Hydrogen Hub is proposed.

Since the development of this memorandum the proposed project footprint has been adjusted as follows:

– One option for the hydrogen fuelling site on Site 2 has been removed entirely
– The hydrogen truck fuelling facility footprint in Site 4 has been removed entirely and replace with a carpark that is reduced in size and now fits within the Port Zone and does not extend into the coastal reserve

Significant risk of potential existing contamination in soil, soil vapour and groundwater have been identified on all four sites that is likely to impact the Project and surrounding environment. CASS is also considered a potential risk on Site 4. There will likely need to be a clean-up or remediation plan and acid sulphate soil management plan in addition to the standard environmental controls outlined in a CEMP.

Operation of the project is generally not likely to result in further degradation of the environment when the main constituents of the industrial process, ammonia, nitrogen and hydrogen are in gas form and therefore spills and industrial accidents are not likely to impact on the land or groundwater. There remains, however, a risk that liquid ammonia may leak subsurface and migrate and dissolve into groundwater and discharge to Corio Bay. This risk will be mitigated in ammonia storage tank design and a site environmental management plan.

Uncertainties exist over the current contamination condition of the four sites and the previous environment investigations based on the following;

– Various limitations on groundwater, soil and soil vapour assessment
– Occurred up to 20 years ago and may not reflect current conditions
– Some key investigations did not consider emerging contaminants such as PFAS or adequately assess asbestos risk
– Updated contamination assessment and waste management guidance, and Victorian legislative framework, in particular asbestos NEPM ASC (2013), NEMP V2.0 (2020) ANZG (2018-ongoing) and *Environment Protection Act* (2017)
– Additional General Environmental Duty, Duty to Notify and Duty to Manage under the recent implemented EP Act 2017

Intrusive environmental investigations will be required to determine whether the study area soil, soil vapour and groundwater are contaminated and pose an unacceptable risk to human health (both construction workers, and site operators), and down-gradient receiving environments. Such a program may include:

– Delineation of filling extents
– Characterisation of
    - Presence of CASS and risk assessment of proposed high risk activities
    - Capping and fill materials
    - Buried wastes
    - Groundwater flow directions
    - Background groundwater quality (noting that there are current and historical land uses which pose a groundwater contamination risk)
    - Soil vapour and landfill gas
    - Fluxes of constituents in groundwater discharging at the coast (down-gradient quality)

The project site investigation program would be designed in consultation with the hydrogeologist specialist, and any geotechnical assessment of the site.

Regards

Xuting Jian
Environmental Scientist

Anne Whincup
Senior Environmental Scientist

Attachments:

1 Proposed Design – Oct 2021
2 Figures

Attachments

Attachment 1

Proposed Design – Oct 2021

LEGEND

- Hydrogen Off Take Route Options
- Ammonia Import Pipeline
- Road and Power Utilities
- Building/area
- Ammonia Ship
- Fence
- Concept layout footprint

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

GeelongPort
GeelongPort Hydrogen Facility EES Referral

Conceptual site layout

Project No. **31-12559567**
Revision No. **A**
Date **22 Oct 2021**

FIGURE 2

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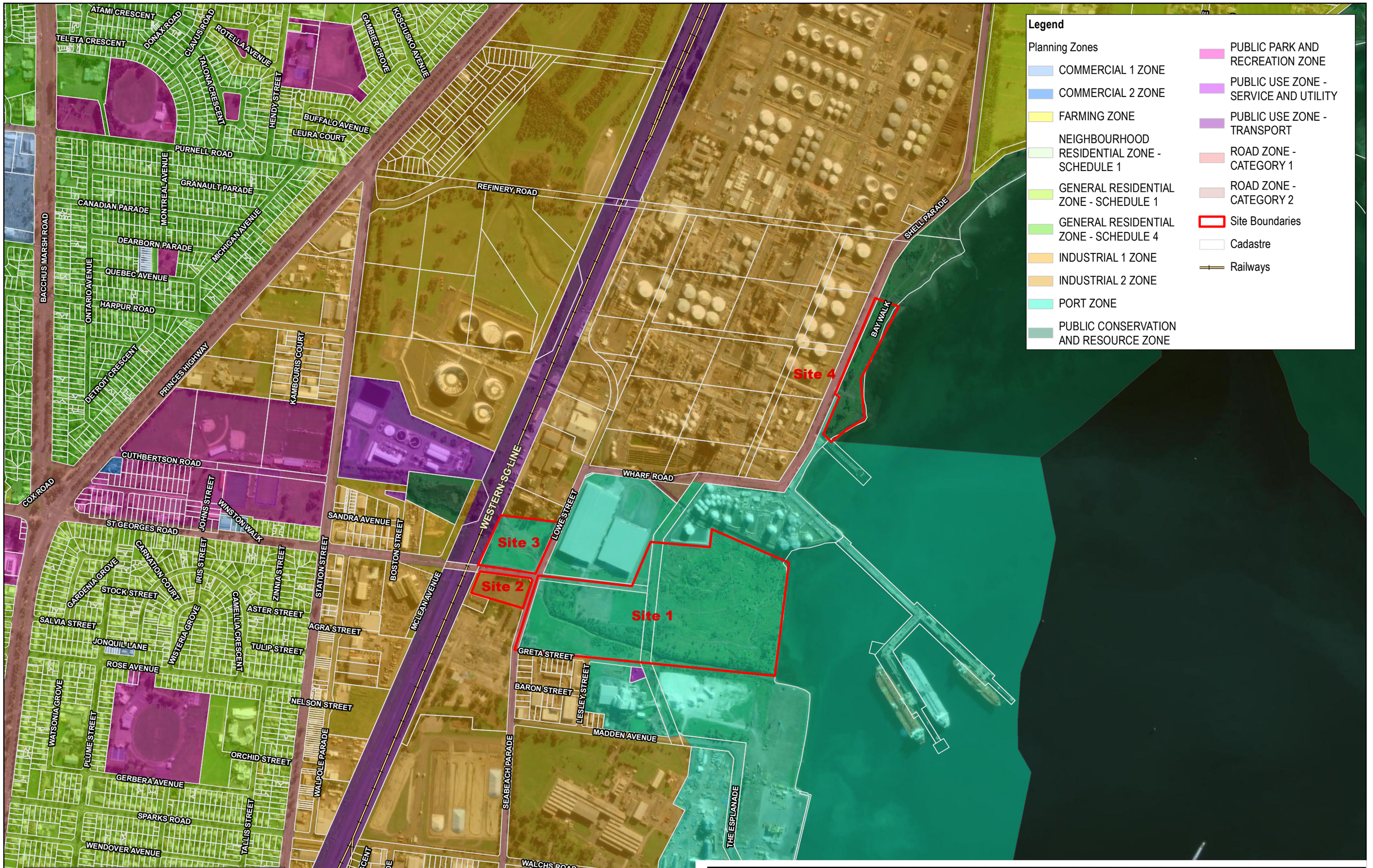
Print date: 22 Oct 2021 - 09:33

Data source: GHD, 2021;Vicmap; 2021. ESRI, World Imagery, 2021. Created by: fcarve

Attachment 2

Figures



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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

N

GHD

Geelong Port Pty Ltd
Geelong Port EES Referral
Contamination Investigation Technical Memorandum

Project No. **12559567**
Revision No. **A**
Date **16 Sep 2021**

Site Planning Zones

FIGURE 1

C:\Users\dbanatin\Desktop\WFH\12559567\12559567_001_SitePlanningZones_revA.mxd
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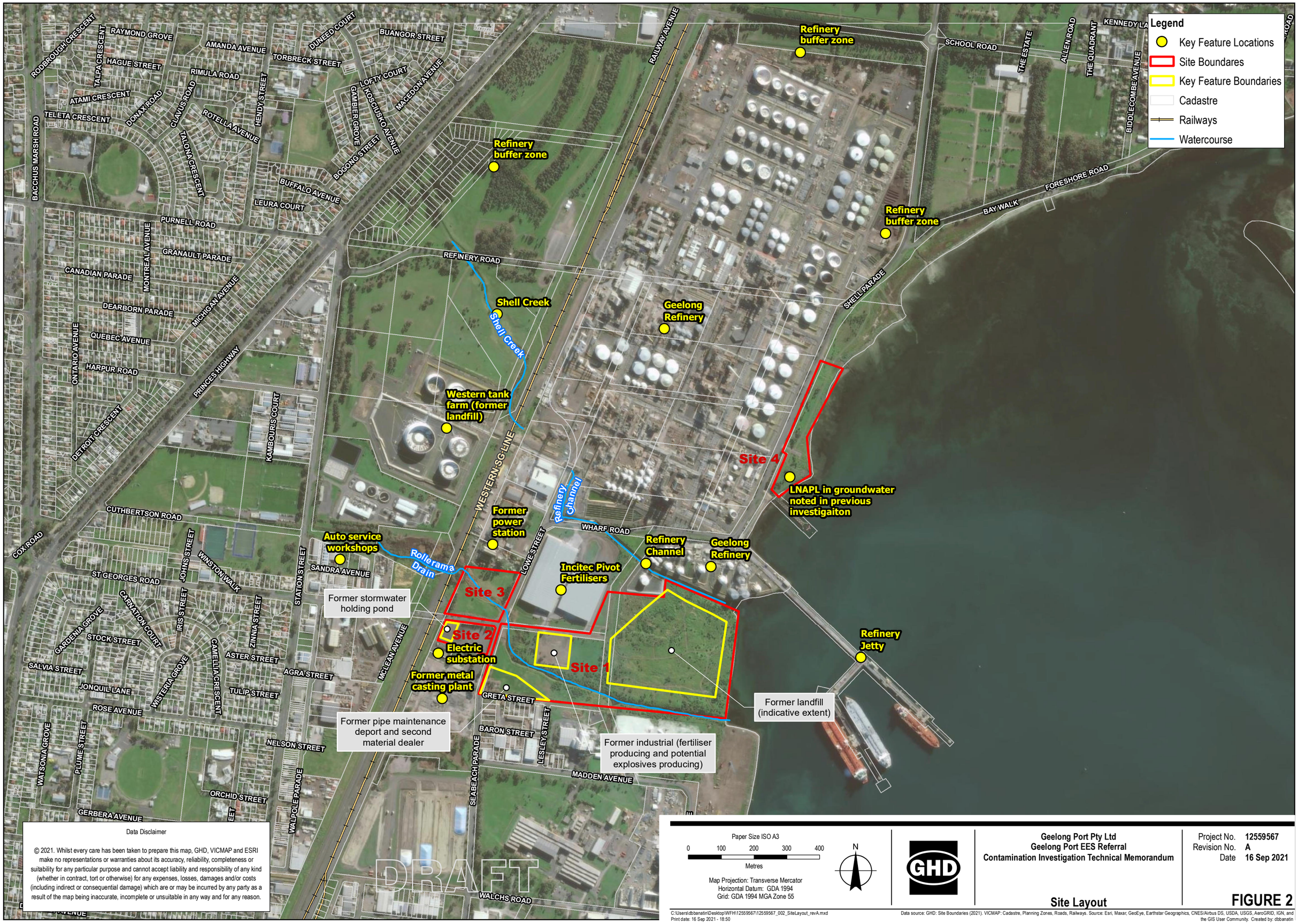
Data source: GHD: Site Boundaries (2021). VICMAP: Cadastre, Planning Zones, Roads, Railways. Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: dbbanatin



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GHD

Geelong Port Pty Ltd
Geelong Port EES Referral
Contamination Investigation Technical Memorandum

Project No. 12559567
Revision No. A
Date 16 Sep 2021

Site Layout

FIGURE 2

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Data source: GHD: Site Boundaries (2021). VICMAP: Cadastre, Planning Zones, Roads, Railways. Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: dbbanatin

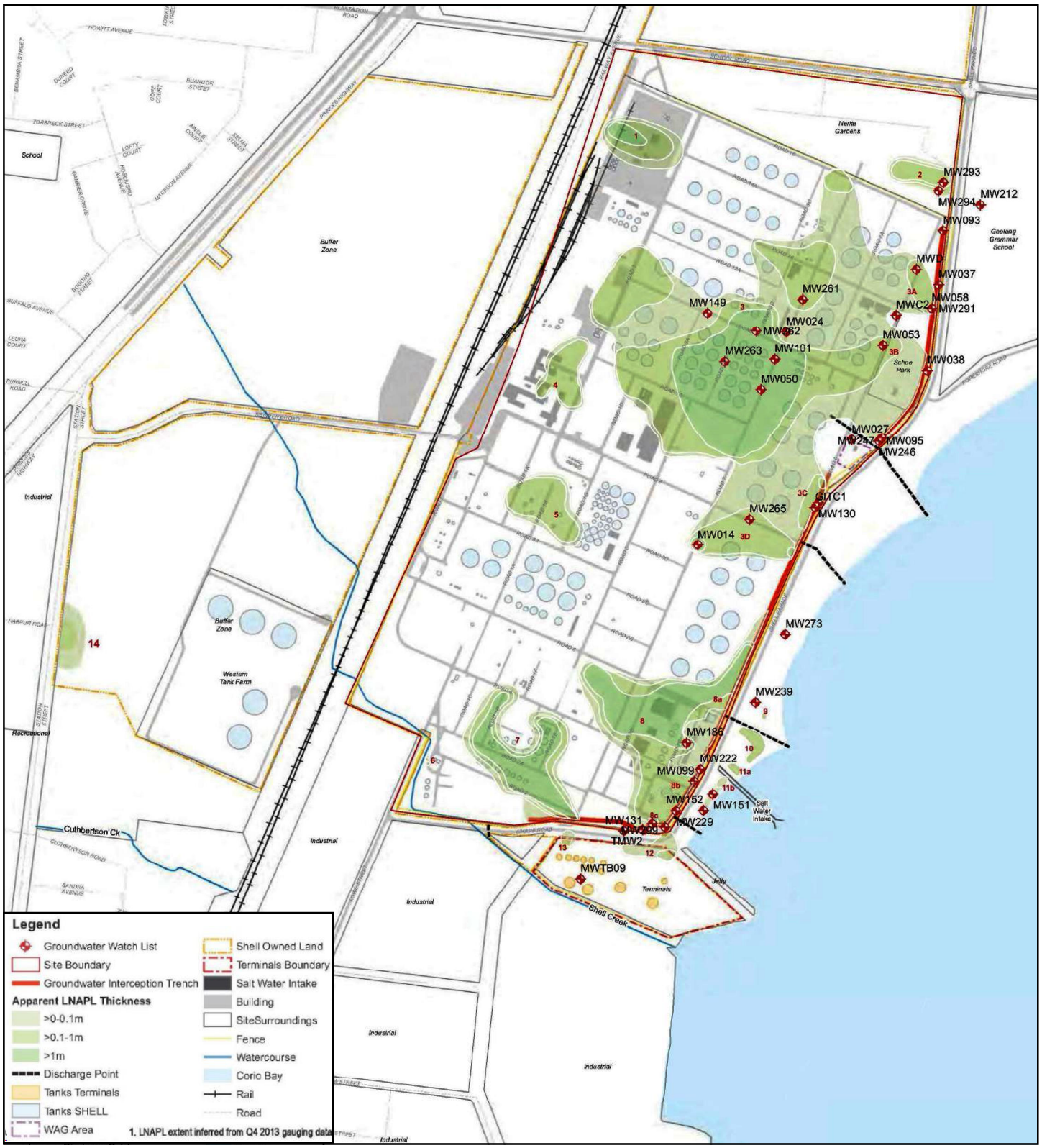

Figure regenerated from ERM 2014 Site Management Plan Annual Report provided in Audit Report CARM'S number 54790-10.

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Grid: GDA 1994 MGA Zone 55

N

GHD

Geelong Port Pty Ltd
Geelong Port EES Referral
Contamination Investigation Technical Memorandum

Project No. **12559567**
Revision No. **A**
Date **16 Sep 2021**

Geelong Refinery LNAPL Plumes

FIGURE 3

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Print date: 16 Sep 2021 - 18:45

Data source: ERM LNAPL Plume. . . Created by: dbbanatin