Technical Memorandum

April 27, 2022

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From	Greg Burkhalter	**Ref. No.**	12559567
Subject	EES referral for Geelong Hydrogen Hub – safety, hazard and risk 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 Protection and Biodiversity Conservation Act 1999* (EPBC) self-assessment, and potentially a referral under the same Act to the Commonwealth Department of Agriculture, Water and Environment (DAWE)

1.1 Purpose of this memo

This technical memorandum has been prepared to support and inform the environmental referral documents, and consists of a high-level review of the proposal from a safety, hazard and risk perspective using the following methodology:

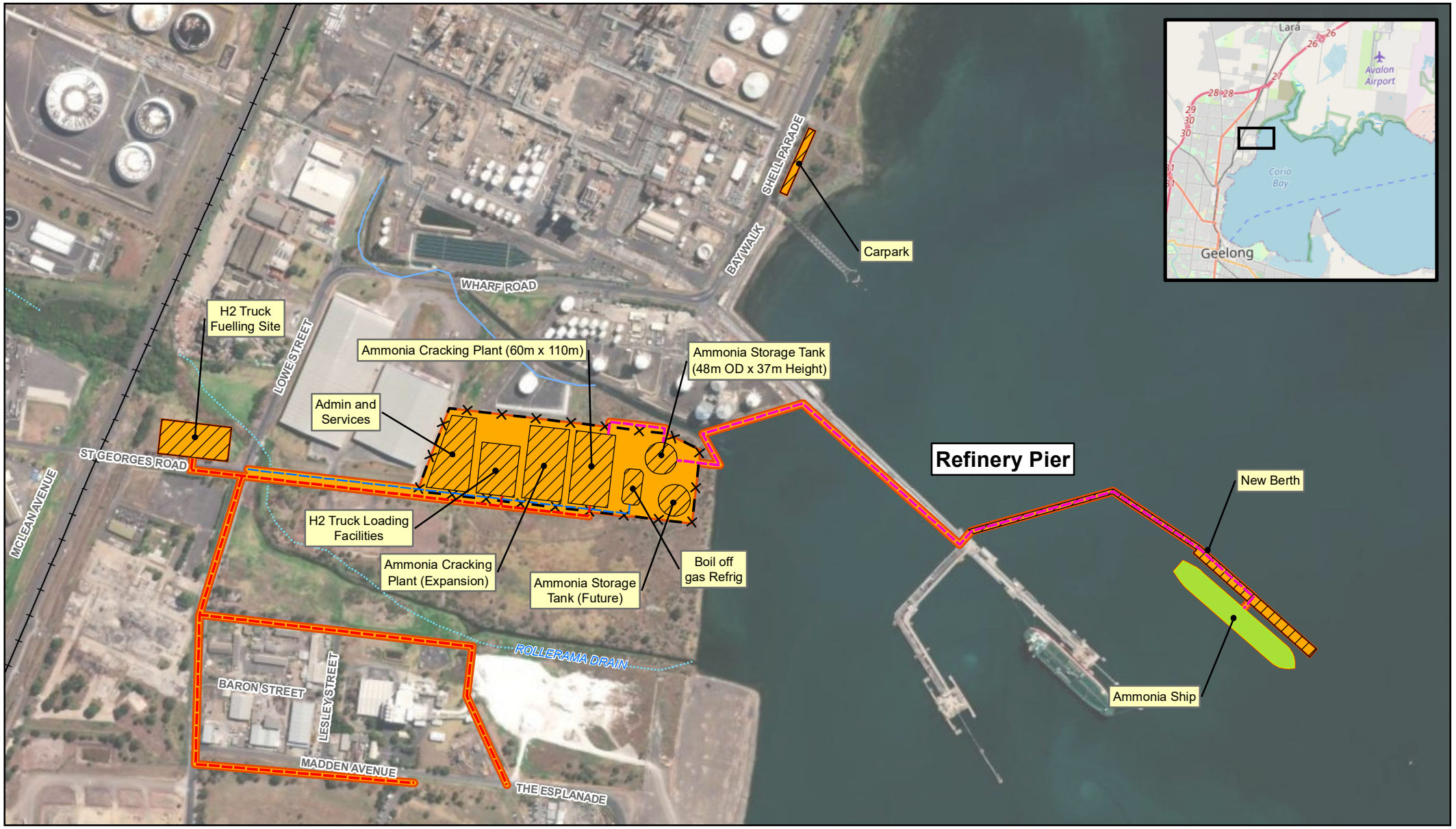
– Undertake a review of the proposed design/layout for the facility
– Undertake a review of relevant legislation
– Prepare a summary of findings

2. Project overview

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 (Figure 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)
– Carpark.

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.



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. **0**
Date **26 Apr 2022**

FIGURE 1

G:\31\12559567\GIS\Maps\Deliverables\12559567_002_ConceptualSiteLayout_A4L_Rev0.mxd
Print date: 26 Apr 2022 - 15:30

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

3. Legislative context

The *Occupational Health and Safety Act 2004* is the primary legislation regarding workplace health and safety in Victoria. WorkSafe is responsible for administering the OHS Act along with the *Occupational Health and Safety Regulations 2017*.

Relevant to this project, a Major Hazard Facility (MHF) is an industrial site that stores, handles or processes large quantities of chemicals and dangerous goods. MHF requirements and the legal duties for MHF operators are described in the Victorian *Occupational Health and Safety Regulations 2017* Part 5.2. The requirement for a licence to operate a MHF is generally dependent on the quantity of chemicals or dangerous goods on the site.

The basis for calculation of the requirement to notify WorkSafe and be licensed to operate as a MHF is provided in Schedule 14 of the Victorian Occupational Health and Safety Regulations 2017. It is based on the idea of threshold quantities, where the quantity of chemicals or dangerous goods on the site is compared as a ratio to the threshold quantity listed in Schedule 14. The proposed quantity of ammonia (>200 tonnes) to be stored onsite will trigger the need for a licence to operate a MHF. A MHF operator is required to prepare a safety case that demonstrates that appropriate measures have been taken to ensure that these facilities operate safely.

The MHF licensing provisions are important in the context of informing the potential adverse impacts that a hydrogen energy facility may have on adjacent land uses, particularly in relation to health and safety. The outcome of the licensing process under the Regulations 2017 and the development of a robust safety case would inform the planning approvals, and other approvals that may be required under other legislation, in particular the *Marine and Coastal Act 2018,* and the *Environment Protection Amendment Act 2018*.

3.1 MHF Triggers

The basis for calculation of the requirement to notify WorkSafe and be licensed to operate as a MHF is provided in Schedule 14 of the Victorian *Occupational Health and Safety Regulations 2017*. It is based on the idea of threshold quantities, where the quantity of chemicals or dangerous goods on the site is compared as a ratio to the threshold quantity listed in Schedule 14.

A MHF is either:

– A site at which *Occupational Health and Safety Regulations 2017* Schedule 14 materials are present, or likely to be present, in a quantity exceeding the threshold quantities outlined in Schedule 14 of the OHS Regulations, or
– A site determined by WorkSafe to be a major hazard facility, based on a number of factors

The Schedule 14 threshold quantities for Ammonia and Hydrogen are provided in Occupational Health and Safety Regulations 2017 (legislation.vic.gov.au), as copied below.

Table 1 ***Schedule 14 Threshold Quantities***

	Material	CAS No.	Threshold quantity
1.	AMMONIA (anhydrous, liquefied)	7664-41-7	200 tonnes
2.	HYDROGEN	1333-74-0	50 tonnes

The relationship between chemical quantity and MHF requirements are shown in in Occupational Health and Safety Regulations 2017 (legislation.vic.gov.au), as copied below.

Table 2 ***Chemical Quantity and MHF Requirements***

Schedule 14 Chemical Quantity	MHF Requirement	Examples
Above 100% MHF threshold	**Must** be registered as a MHF to operate	A large facility where the inventory of Ammonia exceeds 200 tonnes, or the inventory of Hydrogen exceeds 50 tonnes. For import or export scale facilities, this will be classified as a MHF
10 – 100 % of the threshold	WorkSafe will review the information received in the notification and may determine the site to be a MHF	A medium sized facility where the inventory of Ammonia is 200 tonnes or less, or the inventory of Hydrogen is 50 tonnes or less. For example – 20 – 200 Tonnes NH_3 (and no H_2) 5 – 50 Tonnes H_2 (and no NH_3) If both NH_3 and H_2 are on site 10% threshold - 10 Tonnes NH_3 + 2.5 Tonnes H_2 100% threshold - 100 Tonnes NH_3 + 25 Tonnes H_2 Operations at these scales are not deemed practical and are unlikely to be considered.
Below 10 % of the threshold	No requirement to notify and no duties apply under the Part 5.2 of the OHS regulation	A small facility such as a hydrogen vehicle filling station (i.e. hydrogen inventory of 1 tonne)

Schedule 14 provides the formula for determination of the quantity of chemicals or dangerous goods relative to the threshold

Thus if a facility contains only Ammonia and Hydrogen, the threshold will be exceeded if:

$Q_{ammonia}/200 + q_{hydrogen}/50 > 1$ *(with all quantities in tonnes)*

Other dangerous goods on site will contribute to the threshold quantity on site.
The MHF notification and registration process is prescribed by WorkSafe Victoria (Guidance note; Notification and registration of a major hazard facility; Advice for operators of dangerous goods sites on notification and registration (worksafe.vic.gov.au)).

4. Hazards

It is proposed that liquid ammonia will be transported by ship to a new ammonia import berth which will be an extension of the existing Refinery Pier in Corio Bay.

Hazards associated with operation of the facility will include hazardous substances, including:

– Ammonia liquid
– Ammonia gas
– Hydrogen gas
– Nitrogen gas

Other hazards that could lead to environmental impact include shipping activity including docking and ship unloading, and operation of pipelines.

5. Environmental and safety risks

Ammonia liquid is typically stored at -33^{o}C and at ambient pressure. It will arrive on a ship, then will be unloaded to the wharf and transported via a pipeline to the shore facility where it will be stored in a 60 m diameter tank(s) prior to processing.

Risks arising from this process include:

- **Ship related risks** including collision with other ships or collision with the wharf, potentially leading to releases of contaminants such as ammonia liquid or gas, ship fuel or other contaminants
- **Ammonia related risks** including:
  - **Loss of containment of liquid ammonia into the sea** during the ship unloading operation or from the transfer pipeline along the wharf to the onshore storage facility.
    - Liquid ammonia is cold and contact with the sea would initially cause the sea water to freeze in the local area, and the ammonia would rapidly begin to boil off as ammonia gas. Ammonia has a high volatility and thus is unlikely to cause significant water pollution. However, when in water, ammonia is very toxic to aquatic life and organisms, but is non-persistent and non-cumulative. The gaseous ammonia will become airborne and will travel with the prevailing wind.
  - **Loss of containment of liquid ammonia on to the land** from the transfer pipeline or from the 60 m diameter tank(s):
    - Liquid ammonia is cold and contact with the ground would initially cause local freezing. Ammonia liquid has a high volatility and thus is unlikely to cause ground or ground water pollution. However, ammonia in soil absorbs into particulate matter, or undergoes microbial transformation to nitrate or nitrate ions
    - It is also possible that a loss of containment of liquid ammonia on land could result in it going to the stormwater system. It could result in initial freezing of any water in the system, then the release of ammonia gas as the liquid evaporates. It has a high volatility and thus is unlikely to cause significant water pollution. However, when in water, ammonia is very toxic to aquatic life and organisms, but is non-persistent and non-cumulative. The gaseous ammonia will become airborne and will travel with the prevailing wind.
  - **Loss of containment of ammonia gas** from water or from land will result in the gas travelling with the prevailing wind. It is lighter than air when it is at the same temperature, so will tend to rise over time. It will potentially impact the city or suburbs of Geelong or marine traffic on Port Phillip Bay, depending on the wind direction.
    - Ammonia is easily detected by people as an irritant to nose, throat and lungs, and can cause difficulty breathing. At higher concentrations it can be toxic if inhaled, leading to chest pain, bronchial damage, pulmonary oedema or death.
    - While not regarded as a highly flammable gas, fires are possible at concentrations between 15.5 and 20%
- Hydrogen will be generated by the catalytic cracking process that separates the ammonia into hydrogen and nitrogen. **Hydrogen related risks** include:
  - **Loss of containment of hydrogen gas**. Hydrogen is flammable and has a low ignition energy which means the gas is easily ignited including as a result of the leak itself. As a low density gas, hydrogen disperses rapidly on release if the leak is not confined however is subject to form explosive mixtures if the gas accumulates or the leak is significant. Thus, loss of containment from processing equipment or from the proposed hydrogen vehicle filling station could result in a fire.
- Nitrogen will be generated by the catalytic cracking process that separates the ammonia into hydrogen and nitrogen. **Nitrogen related risks** include -
  - **Loss of containment of nitrogen gas**. Nitrogen is an asphyxiant gas and has about the same density as air when at the same temperature

As the facility is expected to have more than 200 tonnes of ammonia on site, it 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 (Occupational Health and Safety Regulations 2017 (legislation.vic.gov.au)). If this is the case, the facility will be designed and managed in accordance with WorkSafe Victoria requirements, in their role as the MHF regulator. Guidelines for operators of MHF sites are provided on the WorkSafe website (Major hazard facilities - WorkSafe).

The facility will 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

6. Safety

The safety risks on and around the proposed site will be associated with the hazards addressed in the previous section. The primary safety risk is loss of containment of ammonia as gaseous ammonia will become airborne and will travel with the prevailing wind with potential to impact the city or suburbs of Geelong or marine traffic on Port Phillip Bay, depending on the wind direction.

As an MHF, the project will require development and implementation of a safety case. Fundamental to this process is the identification of potential major incident scenarios. An effective safety case should include the following features:

– Full understanding and analysis of the nature of the facility, the Schedule 14 materials and other dangerous goods held at the facility, the activities performed involving these materials and the surrounding environment
– A complete understanding of the hazards associated with the facility and the likelihood and consequences of those hazards
– Safe design and construction of the facility, in particular any engineered control measures for major hazards and major incidents
– Safe operation and maintenance of the facility
– The processes by which health and safety representatives, employees and third parties are consulted and involved in preparation of the safety case
– The safety case describes how it will be maintained and updated in response to any changes in MHF design or operation
– The processes used to review and revise any previous safety case for the facility.

When a licence to operate a MHF is granted, it is an expectation that the facility will be managed in accordance with the measures outlined in the Safety Case.

Regards

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