Chapter 12

Safety

This chapter discusses the potential maritime and port operations safety impacts and the safety, hazard and risk assessments associated with the construction and operation of the Viva Energy Gas Terminal Project (the project).

A safety, hazard and risk assessment has been prepared for the project and is provided in Technical Report N: *Safety, hazard and risk assessments*. **Section 12.2** summarises the outcomes of this assessment. There is no separate technical report for maritime and port operations safety which is discussed in **Section 12.1**.

Overview

The Port of Geelong has developed into Victoria's largest bulk port. The existing operations, including navigation within the port, vessel movements and port protocols, security and emergency management have been described in the context of the proposed project.

The proposed construction and operation of the project has the potential to impact existing and future operations within the Port of Geelong and therefore controls to reduce the impact of the project on vessel navigation and port operations safety have been developed with reference to existing port protocols.

Construction activities for the project are forecast to take up to 18 months. Where possible, work would be scheduled to minimise the overall period that port operations may be impacted by the construction phase. Viva Energy and its construction contractors would work closely with Port of Geelong Marine Control to reduce the probability of any interference of or collision by construction vessels (barges) with existing structures or other vessels. A construction marine traffic management plan will be developed in conjunction with Ports Victoria to ensure that the project effectively manages interactions with other marine traffic.

During operation, protocols associated with existing Marine Controls would ensure minimal impact to the floating storage and regasification unit (FSRU), liquefied natural gas (LNG) carriers or other marine traffic. Both the FSRU and LNG carriers will adhere to specific emergency response regulations and requirements such as MARPOL Annex I, requiring vessels to carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP).

The project, which involves the bulk storage and distribution of hazardous materials such as LNG, liquid nitrogen (LIN) and odorant, could introduce potential safety hazards and risks to human life and the surrounding environment. It is important to understand and identify these potential risks and to ensure that the potential health, safety, and environmental consequences of the project are eliminated, or minimised so far as is reasonably practicable.

Under the *Occupational Health and Safety Act 2004* and Occupational Health and Safety Regulations 2017, the operator of the FSRU is required to identify, assess and mitigate all risks having the potential to cause a major incident as part of a Major Hazard Facility (MHF) safety case to enable an MHF Licence to be granted by WorkSafe Victoria (WSV). Additional safety, hazard and risk studies are also required by the *Pipelines Act 2005* and Pipelines Regulations 2017 as part of the application for a Pipeline Licence. The assessments completed for the Pipeline Licence application will be incorporated into a gas safety case to meet the requirements under the *Gas Safety Act 1997* and the Gas Safety (Safety Case) Regulations 2018.

In order to identify the safety hazards of the project, a number of safety studies have been conducted to date, including hazard identification workshops (HAZID), hazard and operability studies (HAZOP); pipeline Safety Management Studies (SMS) and Quantitative Risk Assessments (QRA). The studies and reviews undertaken have identified all events leading to a potential major incident. The safeguards and controls proposed in the basis of design are consistent with those adopted by hazardous industries and those accepted by the nominated regulators as providing sufficient protections and mitigations against major incidents to reduce these risks so far as is reasonably practicable. These studies and the design would continue to be refined during the project life cycle.

The hazard, safety and risk impacts on the adjacent and nearby land uses during project operations are expected to be limited and not disproportionate to those already experienced by the current operations of product movements across Refinery Pier and operation of the Geelong Refinery.

All components of the project meet the Hazardous Industry Planning Advisory Paper (HIPAP) No.4 *Risk Criteria for Land Use Safety Planning* (NSW Department of Planning, 2011) individual fatality risk criteria based on land use, both on a project standalone basis, and when considered cumulatively with the existing refinery operation. This is consistent with the Greater Geelong Planning Scheme objective "to minimise the potential for human and property exposure to risk from incidents that may occur at a MHF and to ensure the ongoing viability of MHFs." The siting of the FSRU (as a new MHF) aligns with strategies to "ensure MHFs are sited … to minimise risk to surrounding communities and the environment" and "apply appropriate threshold distances from sensitive land uses for new MHFs and between MHFs."

The pipeline SMS allocated route location classes based on current and future land use, assessed threats to pipeline integrity and conservatively applied the highest, most stringent location classification for the pipeline design across the entire length.

With front end engineering design (FEED) now complete and the specific FSRU vessel soon to be finalised, there will be ongoing work as the project moves into the detailed design phase to ensure the safety, hazard and risk assessments remain current and the risks continue to be reduced so far as is reasonably practicable. The HAZOP, QRA, and So Far As Reasonably Practicable (SFARP) workshops and assessments will be revisited and updated to incorporate detailed design refinements.

Consistent with the regulatory obligations for both an MHF safety case (FSRU) and gas safety case (pipeline) a full review of the requirements will be completed, and a formal safety (and property) assessment plan will be developed. Both safety cases are required to demonstrate that the risks have been reduced so far as is reasonably practicable.

EES evaluation objective

The scoping requirements for the project set out the specific environmental matters to be investigated and documented in the project's EES, which informs the scope of the EES technical studies.

The following evaluation objectives are relevant to both the discussion around potential maritime and port operations safety impacts and the safety, hazard and risk assessment:

Evaluation objective
Energy efficiency, security, affordability and safety – To provide for safe and cost-effective augmentation of Victoria's natural gas supply having regard to projected demand and supply in context of the State's energy needs and climate policy.
Social, economic, amenity and land use – To minimise potential adverse social, economic, amenity and land use effects at local and regional scales.

This chapter and Technical Report N: *Safety, hazard and risk assessments* address the project's specific safety matters in response to the EES scoping requirements.

12.1 Maritime and port operations safety

This section provides an overview of existing operations within the Port of Geelong and the potential impacts of the project on maritime and port operations safety during construction and operation. The existing operations, including navigation within the port, vessel movements and port protocols, security and emergency management are described and assessed in the context of the proposed project. Management measures to reduce the potential impacts of the project on vessel navigation and port operations safety have been developed with reference to existing port protocols.

12.1.1 Port of Geelong development

The Port of Geelong has developed into Victoria's largest bulk port, and second largest port overall behind the Port of Melbourne. It has grown from the first channel in 1853 to the second largest port in Victoria by embracing new and varied opportunities as well as welcoming new industries which have helped further Geelong's economic development. **Figure 12-1** shows a timeline of the port development.

Handling 12 million tonnes of product annually, the Port of Geelong is Australia's sixth largest port by tonnage. The port now specialises in bulk goods, trading in petroleum, chemicals and crude oil as well as grains, fertilizers, woodchips and logs, and a range of other bulk and break-bulk goods. Key users of the port in addition to Viva Energy include GrainCorp, Incitec Pivot, Midway and Quantem. **Figure 12-2** shows an overview of the Port of Geelong.

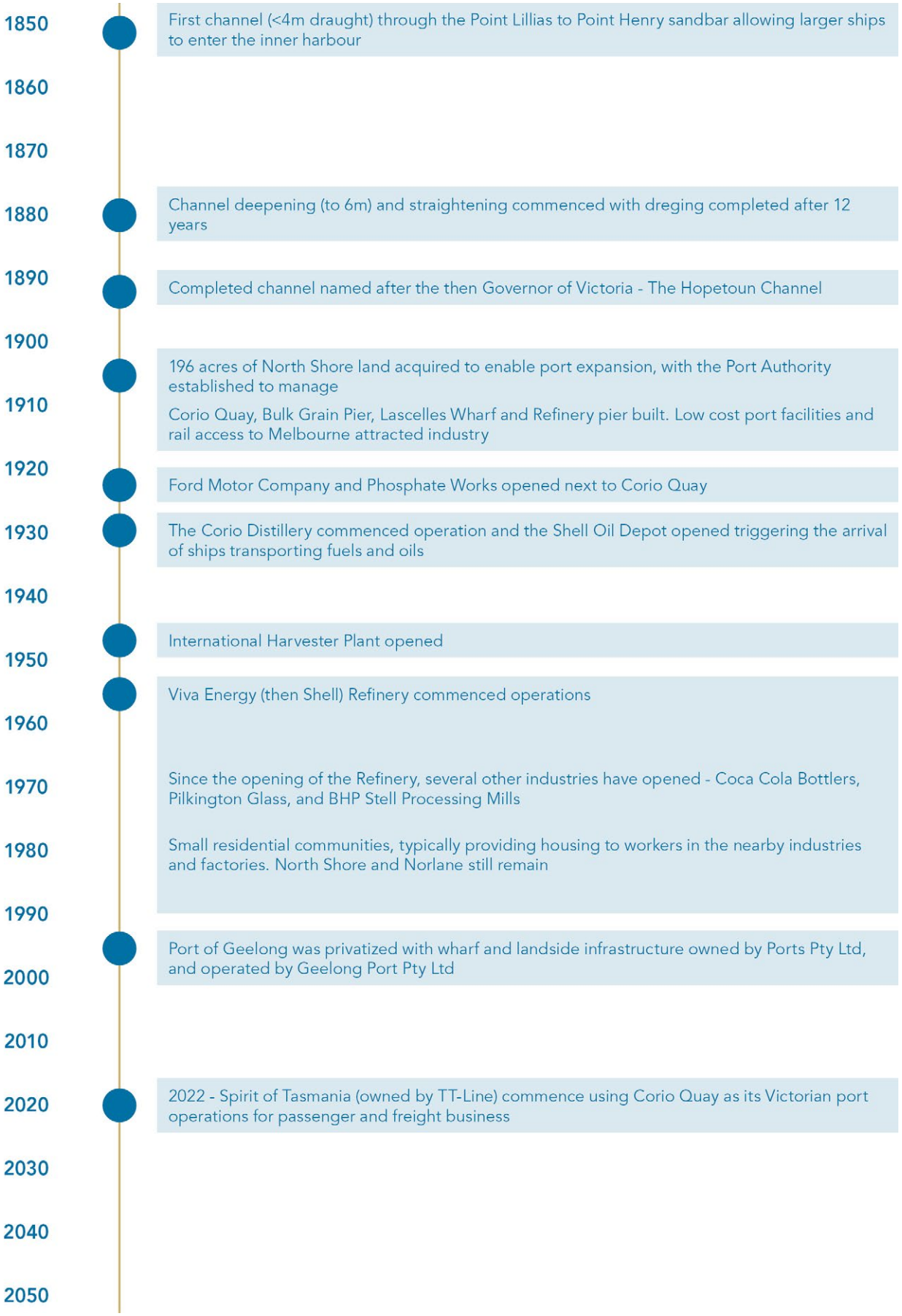

Figure 12-1 Timeline of port development

Figure 12-2 Map of Port of Geelong

12.1.2 Existing port operations

Navigation within the port

Ports Victoria is responsible for the management of shipping operations in both the Port of Geelong and the Port of Melbourne, including the provision of Harbour Master functions, navigation services and ship scheduling. Ports Victoria is responsible for the safe and efficient movement of shipping in port waters and maintaining the shipping channels and navigation aids.

During passage to and from the Port of Geelong, vessels transit through the port waters of the Port of Melbourne passing through Port Phillip Heads / Great Ship Channel into South Channel and Port Phillip Bay prior to entering the Port of Geelong at the Point Richards Entrance beacon.

The Port of Geelong has a 19 nautical mile long dredged shipping channel that can currently accommodate vessels with ship length of up to 265 metres (at nominated Refinery Pier berths). Access to the Port of Geelong is provided by four main channels lit by beacons on either side, namely Point Richards Channel, Wilson Spit Channel, Hopetoun Channel and Corio Channel, providing access from the Hopetoun Channel to the wharf facilities at the west of Corio Bay.

Each channel is 120 metres wide and has a depth of 12.3 metres. Adjacent to much of the Point Richards and Wilson Spit Channels are 200-metre-wide passing channels. The Point Richards Passing Channel has declared depths ranging from 7.5 metres to 10 metres and the Wilson Spit Passing Channel has a declared depth of 7 metres.

Geelong is a tidal port with an average rise of tide of 0.9 metres. The challenge to navigating the channels is that the rise of tide may be insufficient for the safe passage minimum under keel clearance (UKC) (potentially delaying entry or departure while awaiting sufficient tide).

Figure 12-3 below shows the extent of port waters and the shipping channels within Corio Bay that come under the jurisdiction of Ports Victoria. Parks Victoria manages the waters of Corio Bay outside the defined Ports Victoria 'port waters'.

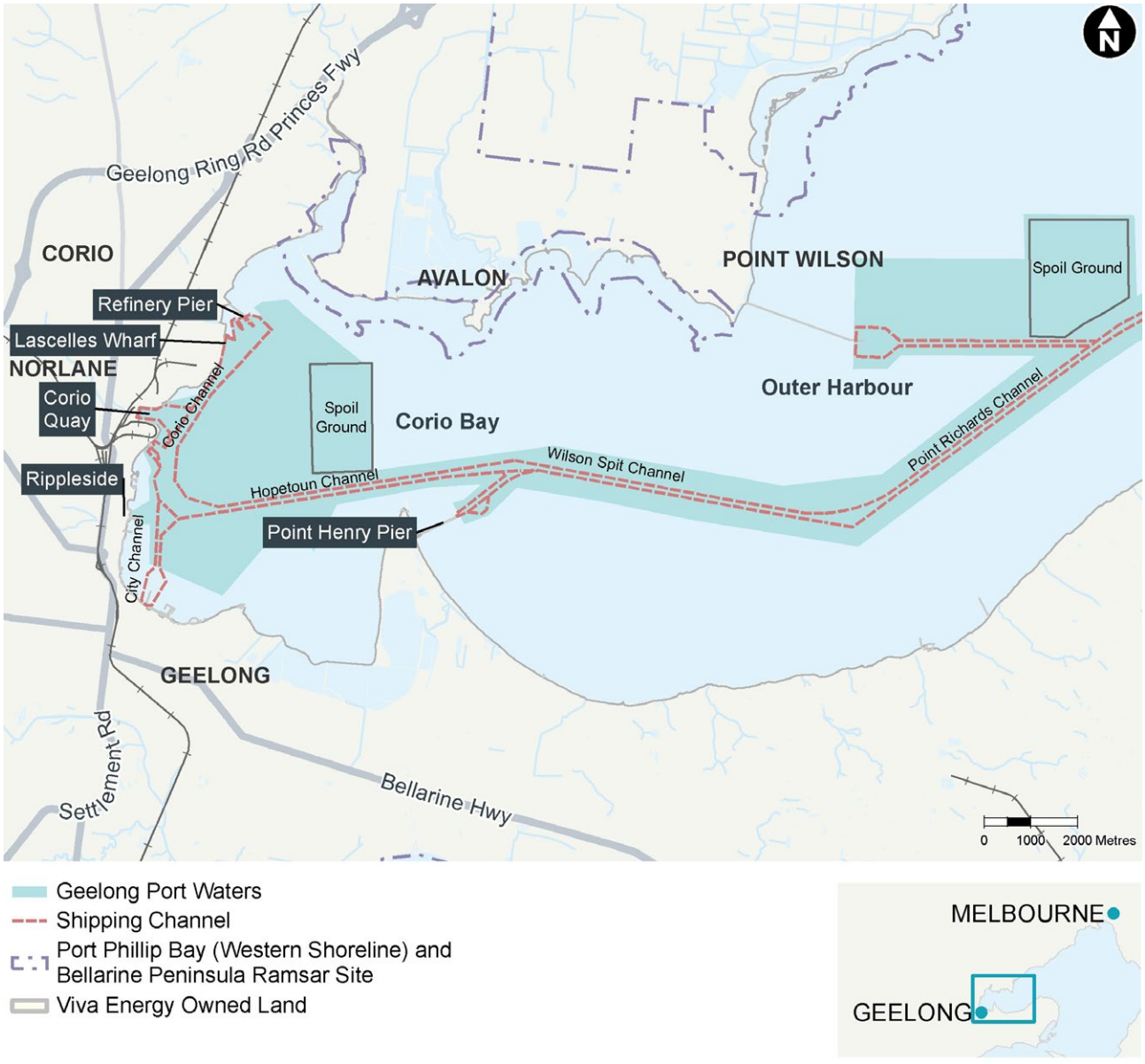

Figure 12-3 Extent of Port of Geelong port waters and shipping channels under Ports Victoria jurisdiction

Vessel movements

The routine movement of vessels in the Port of Geelong is managed by the Port of Geelong Marine Controllers, under the direction of the Harbour Master. The Marine Controllers direct and control:

- The time and manner in which any vessel may enter or leave the port waters
- The navigation and other movements of any vessel within those waters
- The position where and the manner in which any vessel may anchor or be secured within those waters
- The securing or removal of any vessel within those waters, from or to any position as the Marine Controller deems fit.

Ports Victoria operates a Vessel Traffic Service for both Melbourne and Geelong which identifies all commercial vessels and their movements within port waters. Such movements are identified and recorded for port operational and safety purposes.

Port of Geelong Marine Control maintains a continuous Very High Frequency (VHF) radio watch during the transit of vessels in port waters. Inbound vessels proceeding from the Port Phillip Heads to Geelong establish contact with Lonsdale Vessel Traffic Service and/or Melbourne Vessel Traffic Service as required until contact is established with Port of Geelong Marine Control when 30 minutes from the Point Richards Entrance beacon. Outbound vessels maintain contact with Port of Geelong Marine Control until the Point Richards Entrance beacon is reached and communication is established with Lonsdale Vessel Traffic Service or Melbourne Vessel Traffic Service.

Historical vessel numbers provided by Ports Victoria are shown in **Table 12-1** below. The Port of Geelong has averaged more than 600 ship visits each year, and **Table 12-1** shows a significant forecast increase in the number of visits following relocation of the Spirit of Tasmania to Geelong. As a result, it has been assumed that there would be 2,100 vessel movements in the Port of Geelong from 2022 onwards.

Located at the northern end of Corio Channel, Refinery Pier currently has four berths in use for importing and exporting liquid hydrocarbons to and from the Geelong Refinery. The majority of the vessel visits to the Port of Geelong are to the Refinery Pier berths with Viva Energy accounting for over half of the trade through the Port of Geelong.

Table 12-1 Ship visits

Year	Ship visits per year		
	Port Phillip Bay	Port of Geelong	Port of Melbourne
2015/16	3695	651	3044
2016/17	3716	588	3128
2017/18	3795	631	3164
2018/19	3676	599	3077
2019/20	3431	546	2885
Average	3663	603 (over 1200 vessel movements)	3060
Forecast after Spirit of Tasmania ferry relocation to Geelong	3700	1050 (2100 vessel movements)	2650

Port protocols

The Port of Geelong and Port of Melbourne operate under the regulatory umbrella of the Port *Management Act 1995* (Vic), the *Marine Safety Act 2010* (Vic) and the *Maritime Transport and Offshore Facilities Security Act 2003* (Cth).

Ports Victoria appoints the Harbour Master. The Harbour Master, under the *Marine Safety Act 2010*, must ensure the safety of persons and the safe operation of vessels, and in addition minimise the impact of vessel operations on the environment.

Operating standards, instructions and protocols for the Port of Geelong are set out in the Ports Victoria Harbour Master's Directions for the Port of Geelong and Port of Geelong Safety and Environmental Management Plan and Maritime Security Plan managed by GeelongPort.

The regulations and practices that govern vessel operations in the port waters of the Port of Melbourne, including Port Phillip Heads / Great Ship Channel and the South Channel, are contained in the Ports Victoria Harbour Master's Directions for the Port of Melbourne.

The Harbour Master's Directions provide local rules governing all shipping movement including those around communications and signals, anchoring and berthing, traffic control, towage, vessel size, draft requirements and UKC depths.

Key navigational safety requirements required by Ports Victoria include:

- All vessels entering the port waters must comply with relevant international, Commonwealth and State legislation and regulations and the practices of good seamanship.
- Vessels navigating within, into or out of port waters must be under the direction of a marine pilot as per Part 7.2 of the *Marine Safety Act 2010*.
- Vessels are required to actively participate in the Vessel Traffic Service during entry into the port, transit to Refinery Pier as well as on departure. Interaction and mandatory reporting with the Lonsdale Vessel Traffic Service, Melbourne Vessel Traffic Service and Geelong Vessel Traffic Service is required during transit to Refinery Pier. Communications with the Vessel Traffic Service would be in accordance with Harbour Master's Directions for both the Port of Geelong and Port of Melbourne.
- The main Port of Geelong shipping channels are used for one-way traffic only unless prior agreement on the conditions for use of the passing channel has been given.
- For the four main Port of Geelong channels the maximum allowable draft is 11.9 metres with tide or 10.8 metres without tide.
- To allow for safe passage in the port, the UKC for deep draft vessels navigating the channels is required to be a minimum of 1.5 metres, or as required through the use of dynamic under keel clearance (DUKC).
- Alongside berths, anchorages and within swing basins vessels are required to have a minimum UKC of 0.6 metres.
- Speed restrictions are established for all commercial vessels with ship length > 35 metres traversing the port waters of Geelong and for all commercial vessels with ship length > 50 metres for the port waters of Melbourne. Speed restrictions are currently as follows for both entry and departure:
  - South Channel between Beacons 1 and 2 through to Beacons 24 and 25 – 18 knots
  - Port of Melbourne waters between Beacons E1 and E2 and Beacons T1 and T2 – 18 knots
  - Point Richards Entrance Beacon to Port Henry Entrance Beacon – 14 knots
  - Point Henry Entrance Beacon to No 11 Beacon Hopetoun Channel – 12 knots
  - No 11 Beacon Hopetoun Channel to No 5 Beacon Corio Channel – 8 knots
  - No 5 Beacon Corio Channel to No 9 Beacon Corio Channel – 6 knots
- Wind speed limits for vessels entering the port channel are 30-35 knots, whilst exiting the port the wind speed limit is reduced to 25-30 knots.
- Any shipping movement, or decision on whether a vessel is to remain at or leave a berth or anchorage, is based on the expected or actual circumstances. Weather events are continuously monitored on board, at the terminal and by Marine Control.
- A minimum of two tugs is currently required for arrival and departure from Refinery Pier berths, noting that the number is determined by ship size and manoeuvrability. Tugs allocated to an inbound vessel meet the vessel prior to City Bend no later than No 11 Beacon Hopetoun Channel. Port of Geelong currently has a total of four tugs available through two separate companies; two of the tugs have firefighting capabilities.
- Small vessels (< 50 metres in length) must keep clear of big vessels (> 50 metres in length) and a tug or launch assisting another vessel.

Figure 12-4 Existing landside and waterside restriction zones

The interaction of small vessels in and around Refinery Pier is currently controlled by a waterside restriction zone (**Figure 12-4**) into which small recreational vessels are prohibited from entering. Outside that zone, any vessel that could impede the arrival or departure of a large ship is asked to temporarily remove themselves by one of the ship services in attendance.

In addition to the requirements stipulated by Ports Victoria, Viva Energy has a thorough Ship Assessment Vetting Process for ships visiting Refinery Pier for product transfer to and from the Geelong Refinery. This screening is carried out in accordance with the Viva Energy Ship Quality Assurance Standard and includes:

- Meeting the relevant laws, regulations, rules and standards for vessels entering Australian ports
- Having a SIRE (Ship Inspection Report Program) inspection conducted, by independent surveyors that have fulfilled the training and experience requirements of the Oil Company International Marine Forum (OCIMF), within the 6 months preceding the voyage completion date, with zero outstanding high-risk observations. Note: For an LNG carrier, this inspection covers over 300 items including international regulatory compliance and operations as per industry best practice
- Having not had serious Port State Control Inspection deficiencies observed within the preceding 12 months
- Being classed by a member of the International Association of Classification Societies (IACS)
- Holding protection and indemnity (P&I) insurance with a member of the International Group of P&I Clubs, with US$1bn of pollution cover
- Being crewed by qualified officers with minimum experience requirements across the junior and senior deck and engineering officers
- Paying wages not less than those described in the ITF/ILO Minimum Wage Scale 2021.

During the vessel screening, any observation considered to be high risk will be referred back to the vessel's Operator. A vessel will only be accepted for use when Viva Energy is satisfied that the issue has been successfully closed-out, which must be documented in evidence provided by the Operator. It is intended that existing Viva Energy requirements for shipping will be included in any agreements with project partners or 3rd parties who have access to Refinery Pier. These vetting protocols are well established, and Viva Energy has experience over a long period of time in ensuring that shipping associated with its operations are managed in accordance with all company and regulatory requirements.

Quarantine report

Vessels arriving from overseas must submit pre-arrival information using the Department of Agriculture, Water and the Environment's (DAWE) Maritime Arrivals Reporting Systems (MARS). The operator of the vessel is obligated to accurately report information in accordance with Section 193 of the *Biosecurity Act 2015* (Cth). This information must be lodged in MARS no later than 12 hours prior to arrival.

In accordance with the *Biosecurity Act 2015*, and the International Convention for the Control and Management of Vessel's Ballast Water and Sediments, commercial vessels must have a valid Ballast Water Management Plan & Certificate. Vessels that are intending to discharge internationally sourced ballast water must submit a Ballast Water Report through MARS at least 12 hours prior to arrival. Refer to Chapter 8: *Marine environment* and Technical Report A: *Marine ecology and water quality impact assessment* for an assessment of the potential impacts of the introduction of marine pest species.

Port security

Port of Geelong is a security regulated port with GeelongPort having the responsibility for the Port of Geelong Maritime Security Plan as required under the *Maritime Transport and Offshore Facilities Security Act 2003*. Under the port's approved Maritime Security Plan, there already exists a number of landside, waterside and ship restricted zones (**Figure 12-4**).

In addition to being displayed at (nearby) boat ramps, these restricted zones are incorporated into Boating Victoria maps. There is extensive signage along the pier advising that it is a security regulated port area and access to the waterside and landside restricted zones is restricted.

Vessels entering port waters are required to provide Ports Victoria with a valid International Ship Security Certificate or equivalent information upon request.

The Port of Geelong Maritime Security Plan is subject to periodic reviews and revision as required by the *Maritime Transport and Offshore Facilities Security Act 2003*, as well as any triggered review and revision based on a significant change in the threat profile.

Due to the nature and content of security assessments and management plans, these remain confidential, however it is pertinent to note that these assessments are conducted by security specialists drawing on intelligence from relevant government agencies and consider a broad range of threats that include (but are not limited to):

- Insider threat
- Environmental or other activism.

The management of potential port security issues considers not only some of the visible local measures such as restricted access and exclusion zones (where appropriate) but takes into account other countermeasures such as highly controlled access to explosives and associated equipment (across Australia), intelligence (and intervention) and other broader countermeasures. Note that the specific countermeasures applicable for the Port of Geelong cannot be shared due to confidentiality.

Port emergency management

All activities which occur within port waters are under the direction and control of the Harbour Master. Where deemed appropriate, the Harbour Master may prohibit entry or require removal of any vessel where there is reasonable cause to believe that there is an imminent danger of causing serious damage to the marine environment or injury to person or property in those waters.

In the event of an incident (safety, environmental, or security), the Harbour Master or the Duty Marine Controller (being the designated Person in Control) can activate the GeelongPort and Ports Victoria joint Emergency Management Plan and the initial response dictated for the incident. Incidents may include:

- Collision or grounding of vessel
- Marine casualty
- Discharge of marine pollution (oil or other hazardous and noxious substances) from a vessel
- Crash of aircraft
- Natural disaster
- Other special emergencies such as terrorism.

Shipping incidents such as collision, grounding or discharge of marine pollution from a vessel must be immediately reported to the Port of Geelong Marine Control. The Duty Marine Controller will subsequently notify the Harbour Master, who will provide any additional notifications of the incident to Australian Maritime Safety Authority (AMSA), Victorian Department of Transport, and any other relevant government entities.

Oil spill response and management

Depending on the nature and extent of the incident, response activation within port waters is aligned with the *State Emergency Management Plan - Maritime Emergencies (non-search and rescue) Sub-Plan* as this defines control agencies and methodologies.

The Australian Marine Oil Spill Centre (AMOSC) has oil spill response equipment located at Corio Quay which can be quickly deployed to respond to any spill within port waters (or beyond). Viva Energy is a member of AMOSC, so is able to quickly authorise access and use of these resources, including skilled and trained oil spill response personnel.

12.1.3 Proposed project activities and controls

Construction phase

Dredging, construction of the temporary marine loadout facility and Refinery Pier extension, and installation of the seawater transfer pipe and topside piping and ancillary pier infrastructure is anticipated to commence in late 2022. Overall, the construction phase is forecast to continue for up to 18 months. Major construction activities such as dredging (anticipated to take 4 months), piling (anticipated to take 6 months) and Refinery Pier construction and ancillary infrastructure installation (anticipated to take 10 months) would be scheduled to maximise crossover where possible and minimise the overall period that port operations may be impacted by the construction phase.

While construction risk assessments and reviews will aim to minimise risks, there are inherent risks with construction activity (refer to **Section 12.2.3** *Construction Hazards*), with the potential for maritime and port operational safety to be impacted. Viva Energy and its construction contractors would work closely with Port of Geelong Marine Control following established communications protocols to reduce the probability of any interference of, or collision by, construction vessels (such as barges) with existing structures or other vessels, despite the localised increase in marine traffic around Refinery Pier.

The marine construction activities are typical and routine in nature and will be managed through a number of well-established and understood risk control measures, including consent under the *Marine and Coastal Act 2018 (Vic)*. Safety risks would be effectively confined to the construction workforce and to users of the port in the immediate vicinity of work activities and presents a low public safety exposure.

Safe operation of vessels

Dredging barges and tugs will transit outside of the main shipping channel for the majority of its length, limiting potential interaction with other port users. Other construction barges utilised for piling, cranes, or for transfer of materials, modularised components and construction equipment would operate in a localised area at the northernmost end of the shipping channel and are not expected to interfere significantly nor frequently with other port users. Additionally, a temporary construction exclusion zone would be established.

The dredging activity to remove approximately 490,000m^3 of sediment for the new Refinery Pier berth and swing basin would contribute to port traffic during the anticipated 4 months to complete the required dredging. It is proposed that a backhoe dredger would be used to dredge the material which would be placed onto a split hopper barge for transport to the existing dredged material ground east of Point Wilson. In order to maintain continuous operation and minimise the dredging operation duration, two split hopper barges with capacity of approximately 1,200m^3 would be utilised. Each barge would either be towed by tugs or self-propelled. Tug or work boats would assist with dredger positioning and movement of barges.

It is anticipated that two split hopper barge loads per day (i.e., 4 vessel movements per day) would travel from the dredged area to the spoil disposal ground. The small number of additional split hopper barge movements is not anticipated to result in significant disruption to other shipping operations in the port, particularly as the majority of the barge transit would be outside the shipping channels.

Subject to the Harbour Master's approval, split hopper barges may be used at night, provided that coordination is undertaken so as to not impact other vessels and port navigation, consistent with the port instructions and port protocols.

Prior to commencement of construction, a construction marine traffic management plan will be developed in conjunction with Ports Victoria to ensure the project effectively manages interactions with other marine traffic, including additional ship movements associated with the relocation of the TT Line Tasmanian ferry operation.

The Victorian Regional Channels Authority (VRCA) Geelong Dredging Program 2015 involved the removal of approximately 270,000m^3 of seabed material from an area of about the same size as that required for the project. The localised dredging occurred approximately 150 metres from Refinery Pier No. 4 while all berths were operational. Spoil was transported by two split hopper barges of 1,200m3 capacity for placement at the dredged material ground east of Point Wilson, as is intended for this project. The program was conducted in 2016 without incident.

All construction vessels will be required to have established Emergency Response Plans that address the range of potential safety and environmental exposures given both the activities performed and the materials on board (refer to Technical Report N: *Safety, hazard and risk assessment* or **Section 12.2** for further information on emergency management plans and to Technical Report A: *Marine ecology and water quality impact assessment* for an assessment of the potential impacts of shipping-related marine pollution incidents).

Operations phase

Once operational in mid-2024, the FSRU would remain continuously moored at the new Refinery Pier No 5 berth unless required to depart for vessel maintenance. Initially, the FSRU is forecast to have periods where it will not be operational due to low gas demand, however, as gas demand increases, the FSRU would be online continuously except for shutdown maintenance activities.

Relevant local and international regulations, rules, standards and guidelines including those of Society of International Gas Tanker and Terminal Operators (SIGTTO), Oil Companies International Marine Forum (OCIMF) and AMSA would be applied to vessel navigation and port operations as part of gas terminal design and operation.

While operational, LNG carriers would deliver LNG cargoes of approximately 170,000m^3 every 10-20 days, depending on gas demand. The LNG carrier would remain moored adjacent to the FSRU for approximately 36 hours while transferring the LNG. Assuming peak gas demand levels, there is anticipated to be up to 45 deliveries per year, equating to 90 vessel movements, in a total of approximately 2,200 vessel movements in Corio Bay. LNG carriers associated with the project would not constitute a significant addition to shipping traffic in the port, representing even at the maximum predicted frequency, an increase of less than 5%. The LNG carriers would comply with all requirements set out in the Ports Victoria Harbour Master's Directions and Viva Energy would leverage off the existing protocols, including their Ship Assessment Vetting Process, and refinery's experience in managing over 200 ship visits to Refinery Pier each year.

As indicated in **Figure 12-5**, the proposed LNG carriers are shorter than some of the container ships that already enter Port Phillip Bay travelling to the Port of Melbourne, however, they are longer than the largest crude tankers which currently visit Refinery Pier. As the LNG carriers are larger than vessels currently entering Corio Bay, additional consideration is required to ensure safe transit in the shipping channel.

While there is potential for maritime and port operational issues associated with the continuously moored FSRU, these are effectively the same as those associated with the visiting LNG carriers. As such, discussion in this section focuses only on LNG carrier movements as any movement of the FSRU during transit would be the same. The route of entry for LNG carriers would be through the Outer Harbour via the Point Richards and Wilson Spit Channels to the Hopetoun Channel and then Corio Channel, with the reverse for departures.

Table 12-2 Forecast increase in ship visits with project LNG carriers

Forecast LNG carrier visits per year	Percentage increase in ship visits per year		
	Port Phillip Bay	Port of Geelong	Port of Melbourne
Low (10)	0.3%	1.0%	-
Mid (26)	0.7%	2.4%	-
High (45)	1.2%	4.3%	-

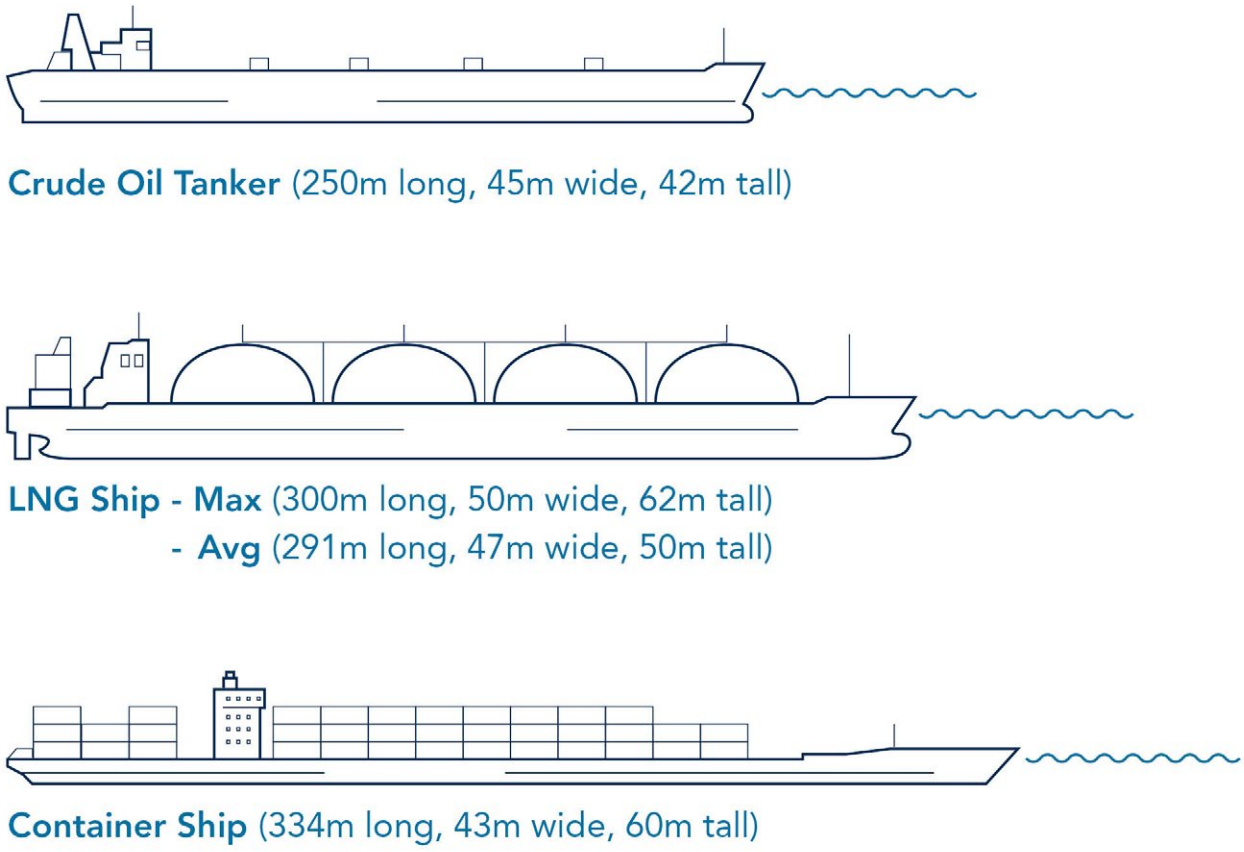

Figure 12-5 Typical vessel lengths

In the event that anchorage is required, either existing anchorage used for vessels entering the Port of Geelong, or a suitable alternative anchorage location in the Port of Melbourne would be agreed with Ports Victoria, which is consistent with existing practice. This location would be used until the vessel is able to proceed.

Similar to all large vessels transiting the Port of Geelong, the LNG carriers are subject to potential hazards including:

- Interference with, or collision with structures or other vessels
- Vessel grounding
- Malicious damage either in transit or when berthed.

Subject to the outcome of the final ship simulation analyses and full assessment based on final design parameters, preliminary discussions with the Harbour Master have indicated that four tugs would be used for berthing and de-berthing operations at the new Refinery Pier berth. Requirements for the navigation of the shipping channel are yet to be finalised, however, would consider the dynamics of the LNG carriers, the known hazards associated with the channel and would identify the appropriate navigation support and potential need for an exclusion zone around the transiting vessel. To reduce the berthing and de-berthing risks, the knowledge and experience of the pilots servicing the Port of Geelong has been extensively utilised in developing the berth layout, approach and turning basin locations.

Preliminary ship simulation and dynamic mooring analyses were conducted to ensure a thorough understanding of any additional requirements or changes in port protocols (such as navigational speeds) that may need to be implemented to accommodate LNG carriers. No issues were identified from the preliminary analysis which would prevent LNG carriers transiting the shipping channel.

It is anticipated that four tugs will be required for LNG carriers (comprising two escort and two berthing tugs), including at least one escort tug for the duration of the channel transit determined by ship size and manoeuvrability. Of these, preliminary analysis suggests that two tugs would be a minimum of FiFi 1 firefighting capability.

The ability to safely navigate the shipping channel ensures that if the channel depth and berthing facilities are appropriately dredged to sufficient depth, and vessels transit within defined draft and speed limits to maintain sufficient UKC, the likelihood of a vessel grounding is remote. As described in **Section 12.1.3** *Construction phase*, localised dredging would be required adjacent to the existing channel for the new berth and turning basin.

The new berthing facility is based on a maximum FSRU draft of 11.9 metres and a minimum UKC of 0.6 metres, requiring a minimum dredge depth of 12.5 metres. The new berth pocket would be dredged to a depth of 13.1 metres and the swing basin would be dredged to a depth of 12.7 metres.

The relocation of the Spirit of Tasmania ferry operation to Corio Quay in 2022 would introduce an additional six marine vessel movements per day. This would require greater coordination of vessel movements within port waters, however existing protocols regarding notification of movements, and appropriate planning, should prevent any significant impact to either LNG carriers or other marine traffic.

Consistent with accepted security assessment methodology and thresholds, the exposure to the LNG carrier and FSRU from a terrorist attack is assessed as "highly unlikely" when existing countermeasures are taken into consideration. With inclusion of the proposed extension to Refinery Pier and FSRU in Corio Bay, the existing Maritime Security Plan will be reviewed and updated with existing restriction zones being redefined to accommodate the project. **Figure 12-7** shows the new landside and waterside restriction zones that would be introduced as a result of the project.

In the unlikely event of an accidental release of LNG from either the FSRU or LNG carrier, most of the LNG will rapidly vapourise as the -162°C LNG comes into contact with the external environment. In the extremely unlikely event of a major breach resulting in LNG spreading as a pool on the water surface the response will depend up the nature and extent of the incident. The objective of any response strategy will be to limit escalation of the event (i.e., prevent ignition, limit severity and extent of fire), and to accelerate the rate of vapourisation of the LNG to facilitate dispersion and reduce fuel availability. Emergency response is discussed further in **Section 12.2.5**.

Figure 12-6 Planned changes to Corio Quay to include Spirit of Tasmania passenger and freight operations (Source: GeelongPort, 2021)

During an emergency event, the FSRU may need to be moved off the berth into the swing basin or channel. With a maintained water depth of 12.3 metres in the channel, this would result in a worst case UKC of 0.4 metres under the most unfavourable tide conditions. During preliminary discussions with Ports Victoria / pilotage providers it was considered that a UKC of 0.4 metres would be sufficient (noting that a UKC of 0.4 metres is currently accepted by Ports Victoria for deep-draft emergency unberthings at Refinery Pier and Lascelles wharf), however this would need to be confirmed through the formal marine risk assessment (scheduled to be completed in early – mid 2022). Once finalised, the emergency procedures would need to be updated to include such an event.

Both the FSRU and LNG carriers will adhere to specific emergency response regulations and requirements such as MARPOL Annex I, requiring vessels to carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). LNG carriers are primarily powered by LNG boil-off gas (BOG) and therefore only carry limited volumes of bunker fuel oil. Additionally, as per MARPOL requirements, bunker oil tanks would be double hulled on both the FSRU and LNG carriers resulting in a very low likelihood of an oil spill incident (refer to Technical Report A: Marine ecology and water quality impact assessment for an assessment of the potential impacts of shipping-related marine pollution incidents).

Outcomes of the preliminary navigational simulation study were used to develop appropriate management measures. With implementation of these measures, along with the additional management measures outlined above, it is anticipated that interaction with other vessels would be managed and the project would not impact on existing port operations. It is also anticipated that risk of collision or grounding impacting port navigation and safety, as well as safety of personnel on or around vessels, would be minimal.

As part of the port's safety and security risk control measures, the Harbour Master's Directions would be updated to reflect both static and dynamic exclusion zones (as required), in addition to any other enhancements that may be required for maritime and port operational controls.

Whilst this section has considered and highlighted the extensive maritime operational risk control measures and evaluation of LNG carrier manoeuvrability within the Port of Geelong, **Section 12.2.4** *LNG carrier (transit through Port of Geelong)* covers the additional control measures specific to the LNG carrier transit.

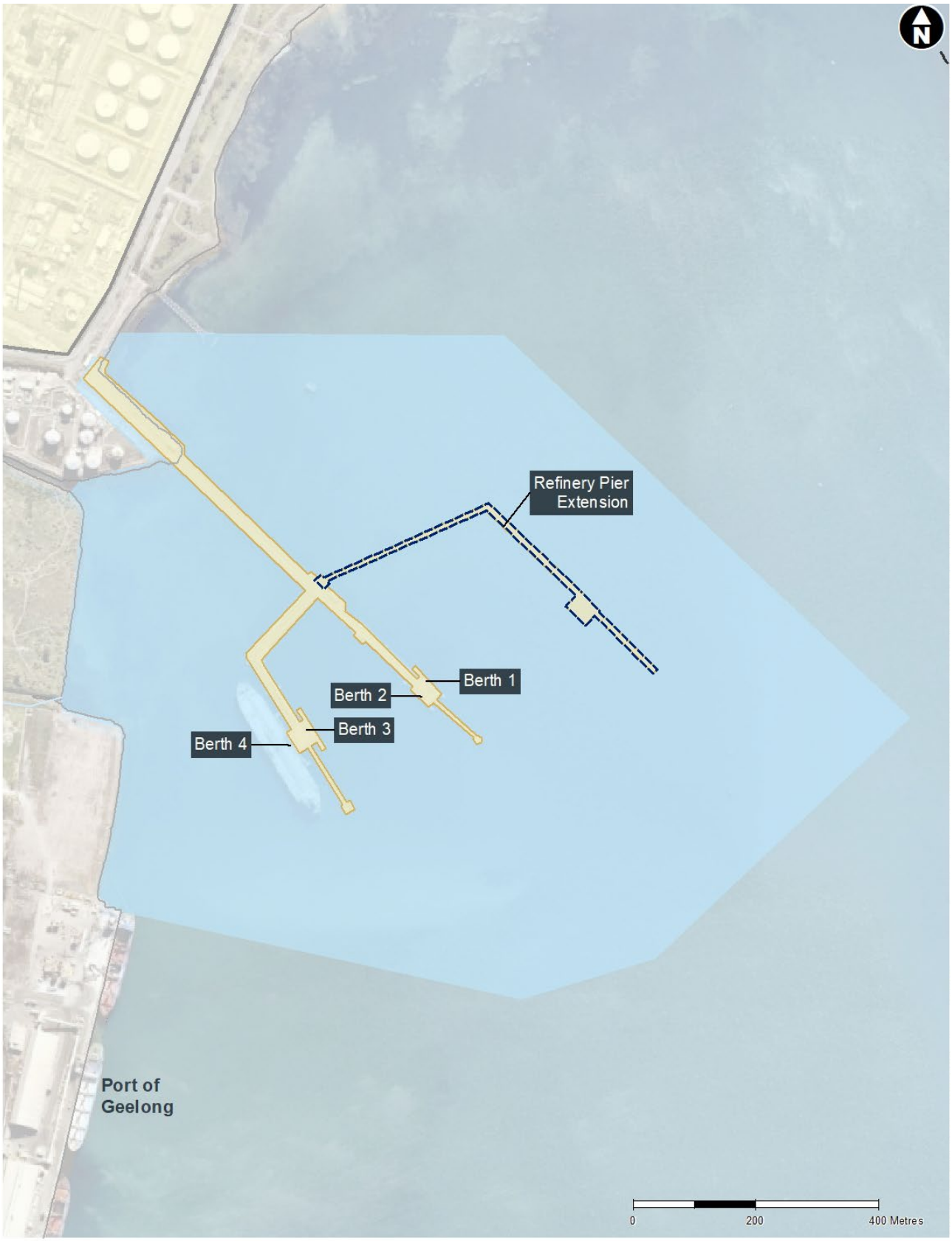

Figure 12-7 New landside and waterside restriction zones

12.2 Safety, hazard and risk

This section provides an overview of the safety, hazard and risk assessments conducted as part of Technical Report N: *Safety, hazard and risk assessment*.

12.2.1 Introduction

Understanding the safety, hazards and risks associated with the design, construction and operation of a project is critical in ensuring that the appropriate systems and procedures are put in place to safeguard human life, assets and the environment. To assess the safety, hazard and risks associated with the project, numerous qualitative and quantitative safety studies have been undertaken by Viva Energy and would continue to be undertaken during the project life cycle.

The safety studies that have been conducted to date include hazard identification workshops (HAZID), hazard and operability studies (HAZOP), pipeline Safety Management Studies (SMS) and Quantitative Risk Assessment (QRA). In the context of these safety, hazard and risk assessments, risk is distinct from the environmental risks assessed in the other EES technical studies. These safety studies are consistent with those adopted by industries dealing with hazardous materials and meet the requirements of the appropriate regulators.

By undertaking these studies, hazards associated with the construction and operation of the project were identified and where appropriate, design implementations and actions were applied to ensure that the risk was mitigated so far as is reasonably practicable (SFAIRP).

12.2.2 Method

The approach adopted for the safety, hazard and risk assessment included the following:

- A review of relevant legislation and policy at Commonwealth, state and local level
- A review of the qualitative and quantitative safety studies completed to date, including HAZID, HAZOP, SMS and QRA
- Consultation with regulatory bodies and key stakeholders including WorkSafe Victoria (WSV), Department of Environment, Land Water and Planning (DELWP) and Energy Safe Victoria (ESV)
- Identification of hazards and potential major incidents relevant to each element of the project
- A risk analysis identifying the consequence and likelihood of the potential hazards to define the tolerable or acceptable levels of risk for the project
- Development of mitigation measures in response to the hazard identification and risk analysis.

Safety studies

A Hazard Identification (HAZID) study is a qualitative technique for the identification of hazards and threats. It aims to identify all significant hazards associated with a proposed activity, with a view to eliminating or reducing the hazards through the application of inherent safety at an early stage of the design.

The Hazard and Operability (HAZOP) study uses guidewords to identify hazards and is typically applied to systems which transfer or process hazardous substances, such as gas pipelines.

A Quantitative Risk Assessment (QRA) involves predicting the level of consequences associated with identified hazards and the frequency at which a potential major incident may be expected to occur. It allows for a more precise and consistent approach to defining the likelihood, consequence and resultant severity of a major incident.

A Safety Management Study (SMS) is a hazard and risk process required by Australian Standard 2885.6, ensuring that all credible threats to the integrity of a pipeline are identified, controls are identified for each threat and residual risk is reduced to a level that is As Low As Reasonably Practicable (ALARP).

Study area

The project would be located at, and adjacent to, the Geelong Refinery and Refinery Pier in the City of Greater Geelong, 75 kilometres (km) south-west of Melbourne. The project area is within a heavily developed port and industrial area on the western shores of Corio Bay between the Geelong suburbs of Corio and North Shore.

The safety, hazard and risk assessment study area encompasses the following project components:

- LNG carriers – in transit through the Port of Geelong shipping channels.
- FSRU – moored at Refinery Pier, within a heavily developed port and industrial area on the western shores of Corio Bay, south east of the Geelong Refinery. The FSRU would be supplied by visiting LNG carriers which moor adjacent to the FSRU.
- Refinery Pier No. 5 – to be constructed as a new pier arm adjoining the existing Refinery Pier in the Port of Geelong. The infrastructure associated with Refinery Pier No. 5 includes marine loading arms (MLA) and aboveground pipeline, potential FSRU excess BOG piping, FSRU seawater diffuser, non-gas piping, a fire protection system and an electrical substation.
- Geelong Gas Terminal Pipeline – the 3km aboveground pipeline section would commence at the MLAs on Refinery Pier No. 5 and continue along the existing Refinery Pier, via an existing pipe trench compound and through the refinery to the treatment facility. From the treatment facility, the 4km underground section of the pipeline would travel north to the tie-in point to the SWP at Lara. The study area for the pipeline encompasses its measurement length, which is the distance from the pipeline considered in determining the location classification as part of the SMS. The measurement length for the aboveground section of the pipeline was calculated at 640 metres and for the underground section of the pipeline was calculated to be 560 metres.
- Treatment facility – to be located at the northern boundary of the Geelong Refinery within an existing laydown area known as Nerita Gardens.

The study area for the safety, hazard and risk assessments for the project infrastructure is shown in **Figure 12-7**. It is noted that the study area presented in **Figure 12-8** does not include the transit of LNG carriers within the shipping channel. Potential hazards from the transit of LNG carriers are presented in **Section 12.2.3** and the LNG carrier safety study results are summarised in **Section 12.2.4**.

Measurement length

Measurement length is a parameter used in Australian Standard AS2885 Pipelines - Gas & Liquid Petroleum to determine the extent of land use considerations when determining pipeline location classification. The measurement length assumes a full bore rupture of the pipeline and is the result of calculating the distance of a 4.7 kilowatt per square metre (kW/m^2) heat radiation contour.

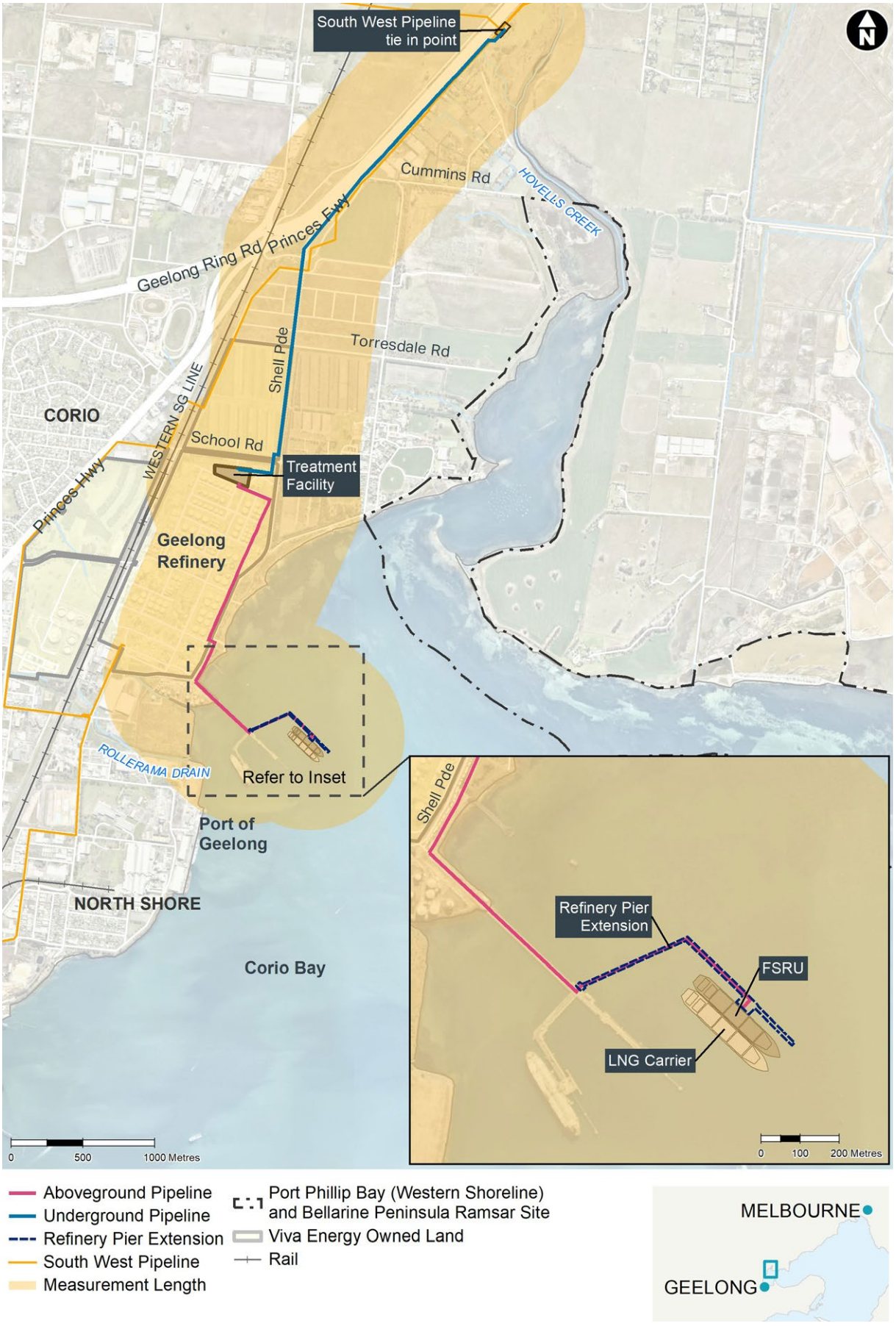

Figure 12-8 Safety, hazard and risk study area

Legislation, policy and guidance

Under the following key pieces of legislation addressing safety and risk, approval is required for the registration, construction and operation of the project:

- *Occupational Health and Safety Act 2004* and Occupational Health and Safety Regulations 2017 – An MHF safety case for the FSRU and an amendment to the refinery MHF safety case for odorant storage within the treatment facility and possible FSRU excess BOG piping (if required).
- *Pipelines Act 2005* and Pipelines Regulations 2017 – Pipeline Licence
- *Gas Safety Act 1997* and Gas Safety (Safety Case) Regulations 2018 – Gas safety case for the licensed pipeline and odorant and nitrogen injection equipment in the treatment facility.
- *Dangerous Goods Act 1985* and Dangerous Goods (Storage and Handling) Regulations 2012 are applicable to liquid nitrogen storage in the treatment facility.

The FSRU would be classified as an MHF under Part 5.2 of the Occupational Health and Safety Regulations 2017 when in port and would require preparation of a safety case, safety management system and emergency management plan. The FSRU operator would be required to submit a safety case to WSV.

The *Pipelines Act 2005* establishes licensing requirements for the construction and operation of high-pressure gas transmission pipelines in Victoria. Prior to any construction, a Pipeline Licence application must be prepared and be supported by a consultation plan, safety management plan and environment management plan. The *Pipelines Act 2005* requires licensed pipelines to be designed, constructed and operated in accordance with Australian Standard (AS) 2885 Pipelines – Gas and Liquid Petroleum. In accordance with AS 2885.6: Pipeline Safety Management, an SMS would be undertaken. An SMS ensures that the following objectives are met:

- All threats to the integrity of the pipeline system are identified
- Multiple independent controls are identified for each threat to pipeline integrity
- Threats not considered to be fully controlled are subjected to risk assessment, with residual risk shown to be reduced to a level that is As Low As Reasonably Practicable (ALARP).

Under the *Gas Safety Act 1997*, a gas company is not permitted to commence operation unless a safety case has been accepted or provisionally accepted by ESV. A gas safety case for the transmission of natural gas and associated distribution infrastructure must comply with the requirements of Part 3 of the *Gas Safety Act 1997* and Part 2 of the Gas Safety (Safety Case) Regulations 2018.

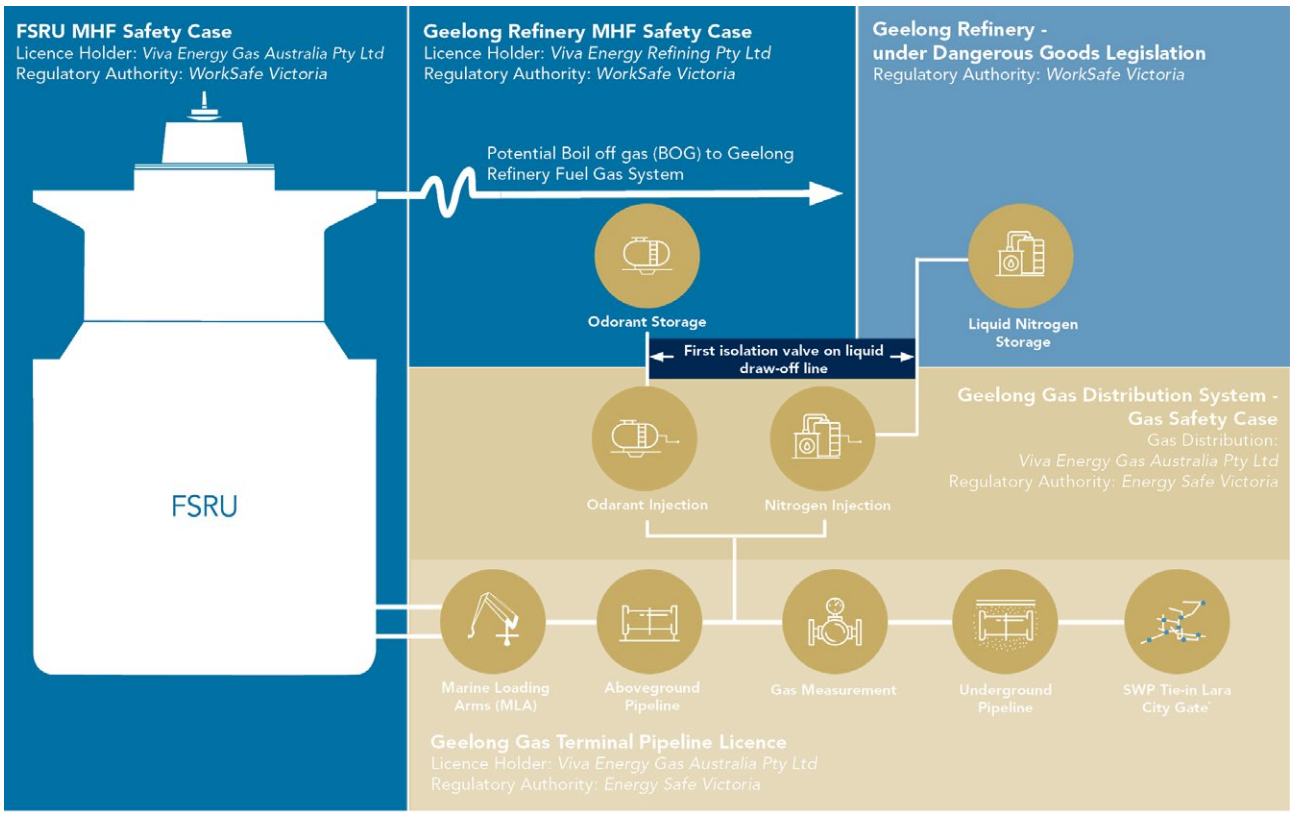

Figure 12-9 Jurisdictional boundaries for project components / facilities

12.2.3 Hazard identification

A number of construction and operational hazards have been identified for the project. These have been summarised below. It is noted that not all hazards identified are applicable to all components of the project.

Construction hazards

During project construction, the public and the workforce would be exposed to hazards routinely experienced in the construction of major infrastructure. While these hazards would not be considered new or unique to major infrastructure projects, there are a number that require management during construction. These include, but are not limited to the following:

- Public safety:
  - Controlling unauthorised access to construction sites
    - Excavation hazards
    - Moving plant and machinery
    - Falling objects from elevated workers or crane assisted lifts
  - Vehicle movements on public roads and at site access points
  - Construction barge and other vessel movements in the vicinity of Refinery Pier
  - Modified road access and crossings
  - Noise and dust
- Workforce safety:
  - Working in the vicinity of moving equipment and vehicles
  - Construction barge and other vessel movements in the vicinity of Refinery Pier
  - Working at heights
  - Falling objects from elevated workers or crane assisted lifts
  - Exposure to electrical hazards
  - Excavation hazards associated with horizontal directional drilling (HDD)
  - Hazards associated with welding activities, such as fumes
  - Noise and dust
  - Confined spaces
  - Working over water during pier and supporting infrastructure construction activities.

Construction of the project would be undertaken in accordance with a Safety Management Plan to control hazards to the public and manage worker safety.

Operational hazards

The project would introduce bulk storage and distribution of hazardous materials of sufficient volume to have the potential for off-site consequences. The primary hazardous materials of interest are LNG, natural gas, odorant (stenching agent) and liquid nitrogen. The dangerous good classification, hazard, location and estimated quantities of materials that would be introduced by the project are listed in Table 12-3.

LNG, natural gas, propane and odorant are flammable, and the predominant risk associated with the storage and distribution of flammable gases and liquids, is unplanned release with subsequent ignition leading to a fire or explosion. Fire and explosion risk represent the greatest potential for off-site impacts.

The ignition of a gas or liquid release can produce a jet or pool fire resulting in damage to unprotected equipment and present hazards to people from thermal radiation exposure. LNG would be stored at ambient atmospheric pressure and approximately -162 degrees Celsius (°C) within the FSRU to maintain it in liquid form. The cargo tanks are not refrigerated but are highly insulated to keep the LNG cold. A release of LNG would form a vapour cloud that disperses in the atmosphere. A portion of the cloud would likely be flammable, giving rise to the possibility of ignition.

Natural gas is odourless, non-toxic and non-corrosive. It has a flammability range of 5 to 15% by volume in air. It is important to minimise leaks and the control and management of ignition sources near to, or in the presence of, natural gas is an important safety aspect of the facility design.

The odorant to be stored is also flammable. In addition, a significant release has the potential to cause general discomfort or nausea in the local community.

In addition to flammability risks, the bulk storage of liquefied gases presents both a cryogenic burn risk and an asphyxiation risk to people handling or working in the vicinity of where these gases are stored. Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures. These liquids have boiling points below -150°C and are gases at normal temperatures and pressures. Both LNG and liquid nitrogen are cryogens. Cryogenic liquids and their associated cold vapours and gases can produce effects on the skin similar to a thermal burn. Brief exposures that would not affect skin on the face or hands can damage delicate tissues such as the eyes. Prolonged exposure of the skin or contact with cold surfaces can cause frostbite and prolonged breathing of extremely cold air may damage the lungs.

When cryogenic liquids form a gas, the gas is very cold and usually heavier than air. This cold, heavy gas does not disperse readily and can accumulate near the ground. Even if the gas is non-toxic, it displaces air. When there is not enough air or oxygen, asphyxiation and death can occur. Oxygen deficiency can be a significant hazard in enclosed or confined spaces. Both nitrogen and natural gas can act as an asphyxiant by displacing oxygen in air to levels below that required to support life.

The project would not introduce any unique electrical hazards that are not already experienced as part of normal operations associated with the Geelong Refinery. The electrical hazards associated with the project would arise from accidental contact with live electrical conductors with the potential for injury and fatality.

Table 12-3 Dangerous Goods (DG) introduced by project

Material	DG Class	HAZCHEM Code	Hazard	Location	Estimated quantity
LNG (Liquefied natural gas)	2.1	2WE	Flammable Cryogenic	FSRU Storage	170,000 m^3
Natural gas	2.1	2SE	Flammable	Pier Infrastructure Pipeline Treatment Facility	1,400 m^3
Propane	2.1	2YE	Flammable	FSRU Process	~50 m^3
Acetylene *	2.1	2SE	Flammable	FSRU Workshops	0.16 m^3 (4×40l cylinders)
Oxygen *	2.2 5.1	2S	Oxidising gas	FSRU Workshops	0.32 m^3 (8×40l cylinders)
Paint Thinner *	3	3YE	Flammable	FSRU Stores	~0.5 m^3
Odorant	3	3WE	Flammable	Treatment Facility	5 m^3
Liquid nitrogen	2.2	2T	Asphyxiant Cryogenic	Treatment Facility	~1,700 m^3 (1,400 tonnes)

**Material present in isolated quantity <2% of individual Schedule 14 threshold quantity.*

LNG carrier hazards

Intrinsic to the operation would be the periodic delivery of LNG by LNG carrier. Each cargo of LNG would be up to 170,000 m^3 stored in 4-5 separate insulated cargo tanks within the double hulled vessel. The operation anticipates a maximum of 45 deliveries per year at peak supply capacity.

As with any other vessel operating in the Port of Geelong, there would be a number of hazards associated with its presence in, and transit through, port waters. These include but would not be limited to:

- Presence of both dangerous goods and hazardous substances (the most significant being approximately 170,000 m^3 LNG stored in 4-5 separate storage tanks)
- Vessel to vessel collision
- Vessel grounding
- Intentional damage.

As described above, the consequences of an unplanned release of LNG would depend on the volume, the rate and the duration of the release, as well as whether or not the release is ignited leading to a fire or explosion.

Completion of a marine operations risk assessment for LNG carrier entry into Port Phillip Bay, transit through the port waters of the Port of Melbourne and into the Port of Geelong, and berthing and deberthing at Refinery Pier will occur in early 2022. Relevant stakeholders including Ports Victoria, pilotage providers, Fire Rescue Victoria, Hoegh (FSRU and LNG carrier operator), GeelongPort and tug providers will continue to be consulted and engaged to ensure thorough consideration of all risks. Findings and any associated actions arising from the risk assessment will be addressed by the relevant stakeholders to ensure the safe and secure transit of LNG carriers to and from Refinery Pier.

12.2.4 Safety study results

Floating storage and regasification unit

The following key studies relating to the safety, hazard and risk of the FSRU component of the project have been completed for an FSRU berthed at Refinery Pier No. 5. These studies consider location specific hazards and the interaction with the rest of the project:

- HAZID
- Fire and Explosion Analysis Study (FEA)
- QRA.

Fire and Explosion Analysis

The Fire and Explosion Analysis (FEA) study is used to identify and assess the impact of accidental releases of hazardous material with the potential to pose major accident risk at the site location. FEA determines the potential impacts associated with release of flammable gas and/or liquid and potential ignition leading to flash fires, explosion, jet fires and/or pool fires.

Completing these safety studies is also required by the rules for classification of ships of DNV (or equivalent classification society). The DNV (or equivalent classification society) classification system has gained worldwide recognition as a demonstration that an adequate level of safety and quality has been implemented in the design, construction, operation and maintenance of the vessel.

The specific operational hazards identified for the FSRU and the storage of LNG and regasification to high pressure gas include the following:

- Fire and explosion
- Cryogenic exposure
- Asphyxiation.

While selection of the specific FSRU vessel which would be utilised for the project is yet to be finalised, a typical FSRU design based on vessels from proposed suppliers was used to conduct a preliminary QRA for hazards and risks associated with the FSRU operation including but not limited to:

- Ship to ship transfer of LNG from the LNG carrier to the FSRU
- Gas operations at Refinery Pier No. 5 including regasification of LNG on the FSRU, gas send out from the FSRU, MLAs and interaction with refinery operations.

A QRA enables consistent and systematic calculation of the risks from hazardous events. It involves predicting the level of consequences associated with a hazard, the frequency at which a potential major incident may be expected to occur and the distribution of onsite and offsite personnel. The output from the QRA is a set of risk numbers that estimate the risk at each specific location. The risk from each individual event is combined to form contours of cumulative risk resulting from all modelled events (Location Specific Individual Risk (LSIR) contours). The inner contours represent the highest risk and contours are plotted in decreasing order of magnitude. The risk numbers provide a likelihood estimation that an incident leading to a specific outcome might occur within this average timeframe.

This project applied the Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 *Risk Criteria for Land Use Safety Planning* (NSW Department of Planning, 2013). The HIPAP No. 4 individual risk criteria and guidance are accepted by WSV and referenced widely in WSV requirements as demonstration of adequacy that risks have been reduced so far as reasonably practicable (SFARP). The criterion uses a representative member of the public in the open at a specific point continuously, i.e., 24 hours per day, 365 days per year without the ability to escape. The units of measure used in determining the risk criteria are 'probability of fatality per year', i.e., an 'individual fatality risk'. In addition, risk criteria relating to injury and property damage have been adopted. **Table 12-4** below summarises the LSIR criteria adopted for the project.

Based on the results of the QRA modelling undertaken for the project, the risk profile of the FSRU and LNG carrier was considered tolerable for the surrounding land uses and all of the HIPAP No.4 criteria were met. This means that the FSRU and LNG carrier do not represent an unacceptable risk to adjacent land uses. The risk contours for the FSRU, LNG carrier and pier infrastructure are represented in **Figure 12-10**. Note that the pier infrastructure discussed in **Section 12.2.4 Refinery Pier No. 5** was included in the QRA modelling for the FSRU and moored LNG carrier.

The following observations were made:

- The 'once in 20,000 years likelihood of fatality' represented by the 5×10^{-5} risk contour (pink), considered tolerable for industrial land use, would be restricted to the immediate area around the FSRU and Refinery Pier No.5. This contour would not reach other Refinery Pier berths, nor reach the shoreline.
- The 'once in 100,000 years likelihood of fatality', represented by the 1×10^{-5} risk contour (yellow), considered tolerable for active open spaces would be restricted to the immediate area around the FSRU and Refinery Pier No.5. This contour would not reach other Refinery Pier berths, nor reach the shoreline. The area inside this risk contour would be a controlled area and would not be a highly trafficable area in terms of people or vehicle movements. With the exception of the LNG carrier mooring adjacent to the FSRU and Port of Geelong tugboats, there would not be any ship or boat movements in this area.
- The 'once in 200,000 years likelihood of fatality', represented by the 5×10^{-6} risk contour (blue), considered tolerable for commercial developments would be restricted to the area around the FSRU and Refinery Pier No.5, and adjacent port waters. This contour would not extend to the shoreline. The area inside this risk contour would be a controlled area and is not expected to be a highly trafficable area in terms of people or vehicle movements. With the exception of tankers berthing at Refinery Pier No.1, the LNG carrier mooring adjacent to the FSRU and Port of Geelong tugboats, there would not be any ship or boat movements in this area.
- The ''once in 1,000,000 years likelihood of fatality', represented by the 1×10^{-6} risk contour (aqua), considered tolerable for residential uses would be restricted to the area around the FSRU and Refinery Pier No.5, Refinery Pier No.1 and No.2, and adjacent port waters. This contour would not extend to the shoreline. The area inside this risk contour would be a controlled area and with the exception of tankers berthing at Refinery Pier No.1 and No.2, LNG carriers mooring adjacent to the FSRU and Port of Geelong tugboats, there would not be any ship or boat movements in this area.
- The 'once in 2,000,000 years likelihood of fatality', represented by the 5×10^{-7} risk contour (green), considered tolerable for sensitive land uses, would extend along the Refinery Pier access route and reach the shore. Access to the pier would be restricted as this is a controlled area, however the risk contour extends to the publicly accessible area immediately in front of the Refinery Pier gatehouse, being the location where the public could have the closest access to the FSRU. There are no hospitals, schools or other sensitive receptors impacted by this contour.

When comparing the risk profile of the FSRU, LNG carrier and pier infrastructure to the risk profile of the existing Geelong Refinery, the conclusions drawn from the QRA include that:

- The cumulative risk profile of the FSRU and LNG carrier with the Geelong Refinery is likely to extend marginally by 50 to 100 metres beyond the existing refinery risk contours, to the south east into Corio Bay.
- The incremental risk near the shoreline, to the North Shore residential area (approximately 1.6 km from the FSRU) and other adjacent land uses would be negligible as the existing risk from the refinery is 1 to 2 orders of magnitude higher than the risk profile from the FSRU and LNG carrier in these locations.
- The FSRU and LNG carrier (when moored) would only result in localised incremental risk in Corio Bay and on the pier over and above the existing refinery risk profile.

Table 12-4 Location specific fatality risk tolerance criteria (HIPAP No. 4)

Land use	Probability of fatality tolerance criteria	Probability of fatality per year (LSIR contour) tolerance criteria
Hospitals, schools, child-care facilities, old age housing	Once in 2,000,000 years	5×10^{-7}
Residential, hotels, motels, tourist resorts	Once in 1,000,000 years	1×10^{-6}
Commercial developments, retail centres, offices, entertainment spaces	Once in 200,000 years	5×10^{-6}
Sporting complexes and active open spaces	Once in 100,000 years	1×10^{-5}
Industrial	Once in 20,000 years	5×10^{-5}

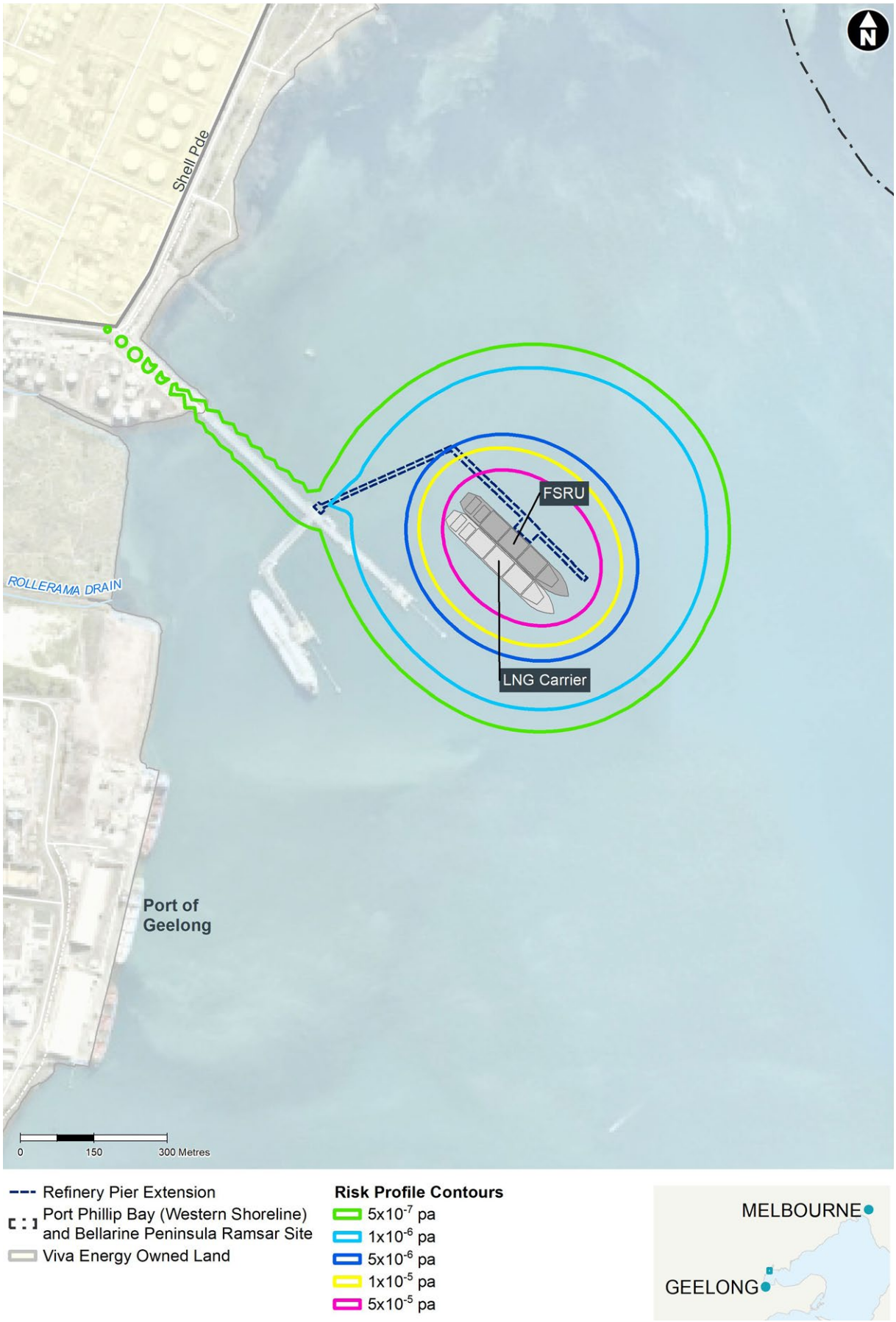

Figure 12-10 FSRU, LNG carrier and pier infrastructure risk profile

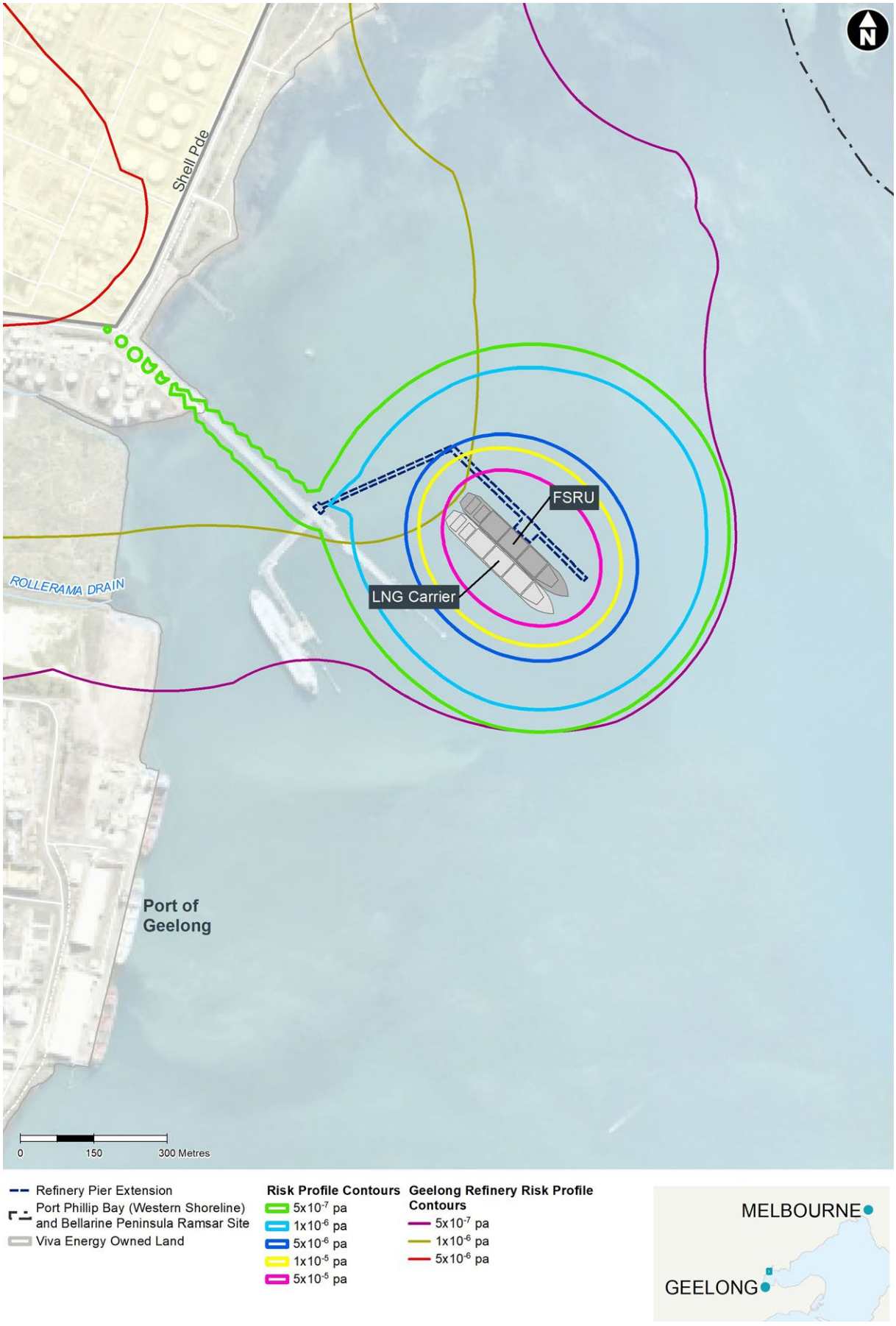

Figure 12-11 Existing Geelong Refinery risk profile and FSRU, LNG carrier and pier infrastructure risk profile

Overall, the FSRU and gas operation on Refinery Pier No.5 contributes to a very limited incremental risk increase over port waters in Corio Bay, with negligible impact on nearby land uses. Risk contours do not encroach on any residential areas, adjacent industrial sites or Geelong Grammar School.

Refinery Pier No. 5

The following key safety, hazard and risk studies for the Refinery Pier No. 5 were completed:

- HAZID
- HAZOP
- QRA (completed as part of the FSRU assessment, refer to previous section).

The infrastructure associated with Refinery Pier No. 5 includes MLAs and aboveground pipeline, potential FSRU excess BOG piping, non-gas piping, a fire protection system and an electrical substation.

The specific operational hazards identified for the pier infrastructure include:

- Fire and explosion
- Asphyxiation.

The failure of an MLA with potential gas leakage could occur if the FSRU suddenly moved away from the Refinery Pier No.5 berth; this would be a very short duration release due to the presence of quick disconnect closure systems on the MLA. Releases from the MLA piping may be sustained for a sufficient duration to cause extensive damage and may prevent escape along the pier. The risk contours for this type of event are shown in **Figure 12-11** and highlight that the probability of fatality at the pier infrastructure ranges between one in 20,000 years and one in 2,000,000 years. It is therefore highly unlikely to occur and meets HIPAP No. 4 criteria. Furthermore, emergency planning and response would be consistent with the conditions of a registered MHF and licensed pipeline, which require that appropriate control measures are in place for identified major incidents and that the risks are reduced so far as is reasonably practicable. Further information on emergency response is presented in **Section 12.2.5**.

Potential radiant heat impacts resulting from the release of any flammable liquid hydrocarbons causing a pool fire near the FSRU (or along the pier access route) would be significantly smaller than impacts from natural gas jet fires. These would be extinguished by emergency responders who would provide the required combatting facilities, such as regularly installed hydrants and access to portable foam appliances.

The results of the QRA are summarised in the previous section.

Aboveground and underground pipeline

The safety, hazard and risk studies completed for the pipeline include the following:

- Safety Management Studies (SMS)
- HAZOP
- Safety Integrity Level (SIL) studies
- QRA.

Safety Integrity Level

The main objective of a Safety Integrity Level (SIL) assessment is to assess the integrity level for all instrumented protection functions (known as safety instrumented functions or SIFs) that have been provided to reduce the likelihood and consequences of major incidents to personnel.

The primary risk associated with the pipeline is a loss of containment (via a leak or rupture) of high-pressure flammable gas, with subsequent ignition potentially leading to fire and explosion.

A risk assessment in the form of an SMS was conducted in accordance with the requirements outlined in AS 2885.6. A key objective of an SMS is for the risk of a pipeline rupture to be designed out and minimised to ALARP. The SMS uses land use classification to inform direct threats to the pipeline and the consequence of a pipeline failure to adjacent existing and reasonably foreseeable future land uses.

Threats covered by the SMS included:

- External interference
- Corrosion
- Natural events
- Faults in design
- Faults in construction
- Intentional and wilful damage.

The SMS conservatively applied the highest, most stringent location classification for the pipeline design across the entire length, consistent with a T1 (Residential) environment, regardless of the actual land use classification. Therefore, the physical protective measures of wall thickness and depth of cover have been designed conservatively and exceed the requirements of AS 2885.1 for the known threats within the measurement length of the pipeline.

As part of the SMS, a total of 103 potential threats to the pipeline and facilities were identified. Of the 103 threats, there were no high or extreme risks identified. 17 of the 103 potential threats were considered non-credible. Non-credible threats do not require controls while credible threats are those that require further risk evaluation. Seven of the 103 potential threats identified were not assessed as they did not give rise to a safety exposure or were not related to current design scope.

79 of the 103 potential threats were considered to be credible, with 36 of the 79 threats identified as either location specific (e.g. excavation threat at a particular road crossing) or non-location specific (e.g. corrosion, which can occur over the entire length of the pipeline). The 43 consolidated credible threats required further risk evaluation to arrive at a 'risk ranking'.

- 30 of the 43 consolidated credible threats required no further risk evaluation as they were considered to be ALARP with the existing controls proposed for the project
- Eight of the 43 consolidated credible threats were evaluated as presenting a low or negligible risk. These low and negligible risks were considered to be ALARP with existing controls
- Five of the 43 consolidated threats were evaluated as presenting an intermediate risk. Three of these threats have been subsequently addressed and closed as ALARP, with the remaining two threats requiring more detailed assessment to inform detailed design:
  - Loss of containment in parallel fuel service within the refinery
  - Impact from boring or exploratory drilling activities

In consideration of the overall threat profile for the pipeline the following threat controls are being implemented for the pipeline design and operation:

- The pipeline would be designed in accordance with AS 2885.1: 2018.
- Corrosion protection through cathodic protection (for the underground section) and a two-layer fusion bonded epoxy coating would be applied for the full pipeline length.
- A conservative pipeline design has been adopted, consistent with a T1 (Residential) environment even though this was not required for the whole pipeline length.
- External loading from traffic (roadways and patrol easement) and earthquake were assessed with no additional protection required other than incorporating earthquake loading inclusion in the aboveground pipe stressing.
- The regular operational patrol regime, as implemented across Viva Energy's existing pipeline network, would be adopted for the gas pipeline area to monitor whether there are activities occurring which could represent a threat to the pipeline.
- An inline gauging tool (pig) data acquisition run would be completed prior to pipeline hydrotesting to provide the "as installed" pipeline physical condition (identification of previously unidentified mechanical irregularities).
- Managing latent dents or defects would be via inline inspection. Inline inspection of the pipeline would be carried out five years post construction and then on a frequency determined by the results of the previous inspection.
- Access to the right-of-way easement would be maintained across the length of pipeline alignment.
- Pipeline markers would be installed along the route and additional marker posts installed in higher risk areas to alert parties conducting works to the pipeline location. Marker tape would be laid in trenched areas.
- Soil conditions do not indicate surface rock. As such, the SMS assessment concluded that a penetration tooth attached to an excavator operated by a third party in the future was not a credible risk scenario. No heavy-duty drilling is anticipated by third parties along the pipeline alignment.
- The pipeline meets the 'no rupture' requirements against a threat from a 40T excavator with a penetration tooth / 55T excavator with a tiger tooth. Use of larger than 30T excavators is not considered credible for the pipeline route. The use of penetration teeth in excavators is not considered credible; the credible tooth type is considered to be general purpose.
- Several sections of the pipeline would be installed via the HDD technique. Coating damage during HDD is a threat to pipeline integrity. It was concluded that this threat can be controlled through improved coatings; an Abrasive Resistance Overlay (ARO); and the requirement to replace the section if flaws are detected. A trenchless crossing construction management plan is a mandatory document to be approved in accordance with AS 2885.1-2018.
- To provide an overview of the contribution of the pipeline risk as part of the overall project **Figure 12-12** provides the combined LSIR contours for the project. The narrow band of risk is below the lowest HIPAP No. 4 criteria (5×10-7pa) for the most sensitive land uses, and is remote (except for along Macgregor Court into Lara City Gate tie-in to the South West Pipeline) from existing residential land users.

The individual fatality risk contours for the Geelong Gas Terminal Pipeline and Lara City Gate tie-in facility are represented in **Figure 12-12**.

Based on the results of the QRA modelling undertaken for the project, with the risk contours for all the project components represented in **Figure 12-12**, the risk profile of the Geelong Gas Terminal Pipeline was considered tolerable for the surrounding land uses and essentially all of the HIPAP No.4 criteria met. As indicated above, there is a single exception based on the QRA modelling where an existing residence (one property on Rennie Street north of the Princes Freeway) is situated within the project's 'once in 1,000,000 years likelihood of fatality' contour. Based on the minor contribution of additional potential leak sources from the new connection to the South West Pipeline at the Lara City Gate tie-in facility to the existing facilities (and potential leak sources) it is considered that the project is contributing only a minor increase in the risk profile to this residence.

Based on the results of the QRA modelling, the following observations were made:

- The 'once in 20,000 years likelihood of fatality' represented by the 5×10-5 risk contour, considered tolerable for industrial land use, and the 'once in 100,000 years likelihood of fatality', represented by the 1×10-5 risk contour considered tolerable for active open space have not been reached at Lara City Gate
- The 'once in 200,000 years likelihood of fatality', represented by the 5×10-6 risk contour (blue), considered tolerable for commercial developments would be restricted to the immediate area around the Lara City Gate tie-in facility. Access to the facility would be restricted by security fencing and is visited as part of daily patrols, and maintenance activities by workforce. This level of risk would be considered acceptable for users of the recreational open space (Hovells Creek Reserve) surrounding the facility
- The 'once in 1,000,000 years likelihood of fatality', represented by the 1×10-6 risk contour (aqua), considered tolerable for residential uses would extend approximately 250 metres around the facility crossing the Princes Freeway. There is an existing residential property situated north of the freeway inside this risk contour, which has been present during the existing operation at the Lara City Gate facility and the pipeline tie-in would represent a small incremental increase to the existing risk profile
- The 'once in 2,000,000 years likelihood of fatality', represented by the 5×10-7 risk contour (green), considered tolerable for sensitive land uses would extend approximately 400 metres around the facility crossing the Princes Freeway. There is an existing residential property situated north of the freeway inside this risk contour, however this property has been present during the existing operation at the Lara City Gate facility and the pipeline tie-in would represent a small incremental increase to the existing risk profile. There are no hospitals, schools or other sensitive receptors impacted by this contour
- The 'once in 10,000,000 years likelihood of fatality', represented by the 1×10-7 risk contour (burgundy) has been included to highlight the lower risk associated with the Geelong Gas Terminal Pipeline and the narrow belt, approximately 120 metres wide either side of the pipeline route, that it covers.

Figure 12-12 Combined project risk profile

Treatment facility

The safety, hazard and risk studies completed for the treatment facility include the following:

- HAZID
- HAZOP
- QRA.

The treatment facility would be located in the Nerita Gardens area of the refinery (refer to **Figure 12-8**) and is where odorant would be added to the gas as well as nitrogen, when required, to meet gas quality specifications.

The predominant risk associated with the treatment facility is the potential loss of containment from the process and associated equipment/plant as potential sources of fire events. The storage of liquid nitrogen also introduces cryogenic hazards, as described in **Section 12.2.3**.

A conservative pressure profile has been assumed for the treatment facility. This pressure profile was based on the system operating pressure history in the Victorian Transmission System. It was assumed to provide risk results that would better reflect the operating conditions of the treatment facility, since the pressure in the treatment facility would closely match the Victorian Transmission System pressure. Based on this assumption, release and subsequent ignition of gas at the facility could cause a jet fire if there is sufficient pressure at the release point. Jet fires generate high levels of radiant heat associated with efficient combustion and could also generate significant damage through erosion and conductive heat transfer where flame impingement occurs. Should the release not immediately ignite, a flammable gas cloud will form, with delayed ignition leading to a flash fire or vapour cloud explosion if sufficient confinement is present. Delayed ignition events could also burn back to a sustained jet fire.

Liquid hydrocarbons at the treatment facility, namely Spotleak 1005 odorant, could result in a pool fire if release of the liquid occurred. A pool fire is a type of fire where a volatile, flammable liquid is evaporating and burning at the same time. For uncontained pool fires, the flammable pool could spread to either a minimum film thickness, or until an equilibrium condition is reached where the burn rate is equal to the release rate.

The storage of liquid nitrogen at the treatment facility introduces cryogenic hazards such as the potential for burns or asphyxiation as described in **Section 12.2.3**. Cryogenic hazards would be considered in the selection, construction, commissioning, operation and maintenance of cryogenic equipment throughout the project life cycle. To reduce the risks of cryogenic hazards, handling of liquid nitrogen would only be carried out by suitably competent personnel wearing appropriate personal protective equipment (PPE). This would include a full face shield over safety glasses/goggles, loose-fitting thermal insulated gloves, long-sleeved shirts, safety shoes and pants without cuffs. Personnel would be thoroughly familiar with the properties and safety considerations of liquid nitrogen before being allowed to handle it and/or its associated equipment.

The treatment facility would be located on cleared land currently in use as a laydown area within the refinery, but some planted vegetation is present in surrounding areas and in the paddocks owned by Viva Energy to the north of the proposed treatment facility location (refer to **Figure 12-13**). As such, there would be potential for a bushfire to impact on the proposed treatment facility location. The safety case(s) for the treatment facility would include an assessment of this risk and include bushfire mitigation strategies as required.

Based on the results of the QRA modelling undertaken for the treatment facility (shown in **Figure 12-13**), the risk profile of the treatment facility met the criteria for the surrounding land uses and the HIPAP No. 4 criteria were met. This means that the treatment facility does not represent an unacceptable risk to adjacent land uses. The results as shown in **Figure 12-13** indicated the following:

- The 'once in 20,000 years likelihood of fatality' represented by the 5×10^{-5} risk contour (pink), considered tolerable for industrial land use, and the 'once in 100,000 years likelihood of fatality', represented by the 1×10^{-5} risk contour (yellow), considered tolerable for active open spaces, would be restricted to the immediate area around the treatment facility. These contours would not impact on any other land other than the industrial zoned land owned by Viva Energy.
- The 'once in 200,000 years likelihood of fatality', represented by the 5×10^{-6} risk contour (blue), considered tolerable for commercial developments would be restricted to the immediate area around the treatment facility and land at Nerita Gardens used by the refinery for waste management and equipment laydown. This contour would cross the currently fenced boundary at Refinery Road 16 between the tank farm and the Nerita Gardens laydown area but would not impact on any other land other than the industrial zoned land owned by Viva Energy.

- The 'once in 1,000,000 years likelihood of fatality', represented by the 1×10^{-6} risk contour (aqua), considered tolerable for residential uses would be restricted to the area around the treatment facility and land at Nerita Gardens used for waste management and equipment laydown. This contour would however extend further south into the refinery crossing the currently fenced boundary at Refinery Road 16 between the tank farm and the Nerita Gardens laydown area. The contour reaches to (but does not cross) School Road to the north, being the location where the public could have the closest access to the treatment facility. With the exception of land used for School Road the risk contour does not impact on any other land other than the industrial zoned land owned by Viva Energy.
- The 'once in 2,000,000 years likelihood of fatality', represented by the 5×10^{-7} risk contour (green), considered tolerable for sensitive land uses extends outside the area around the treatment facility and land at Nerita Gardens used for waste management and equipment laydown. The contour would cross School Road to the north into the paddocks owned and managed by Viva Energy (note there is no public access to this area) and would cross Shell Parade to the east for approximately 150 metres, extending a maximum of 25 metres beyond the eastern edge of Shell Parade onto the treed perimeter of Geelong Grammar School's land. However, it does not extend into the open spaces used by the school for outdoor equestrian activities and would not reach the school's Equestrian Centre building located in the north-east corner of the paddocks.

In considering the risk profile of the treatment facility in conjunction with the risk profile of the existing Geelong Refinery, the conclusions that can be drawn from the QRA results include that:

- The project would result in localised incremental risk in and around where it is located
  - The incremental risk to the west towards the train line beyond the project's 5×10^{-7} (once in 2,000,000 years likelihood of fatality) risk contour (green) would be negligible with the existing refinery risk profile being at least an order of magnitude higher than that of the treatment facility
  - There would be an increased cumulative risk profile of the treatment facility with the Geelong Refinery to the north, as the 5×10^{-7} (green) risk contour would extend by some distance, likely in the range of 50-150 metres, into the Viva Energy paddocks where there is negligible impact to the public
  - The cumulative risk profile would extend to the east by up to 50m, with the 5×10^{-7} (green) risk contour extending slightly into open space utilised by Geelong Grammar School for outdoor equestrian activity; however, not extending to the school's Equestrian Centre building.
- When considering the cumulative risk, the HIPAP No.4 criteria would continue to be met for the treatment facility components of the project on the basis that the Geelong Grammar School land used for equestrian activities (excluding the Equestrian Centre building in the north-east corner) is considered as "sporting complexes and active open space" as per HIPAP No.4 and the risk profile shown in **Figure 12-14** is acceptable.

Based on the HAZID, HAZOP and QRA safety studies undertaken, the following fire prevention and mitigation strategies would be included in the design of the treatment facility:

- The treatment facility would include the minimum process equipment necessary to provide a reliable supply of natural gas. Where operationally allowable while still meeting gas quality specification, equipment items would be bypassed to reduce the potential for leaks.
- Legislated hazardous area standards codes would be applied in detailed design of the treatment facility meaning any equipment used in the hazardous zone would be appropriately certified for use. The hazardous zone represents the area where a potentially flammable atmosphere may exist and would be determined during detailed design through the application of AS 60079.10.1: Explosive atmospheres.
- Active fire protection and suppression would be provided for liquid fires and gas fires at the treatment facility in compliance with relevant Australian Standards, including AS 2941: Fire hydrant installation – System design, installation, and commissioning.

Figure 12-13 Treatment facility risk profile

Figure 12-14 Existing Geelong Refinery risk profile and treatment facility risk profile

LNG carrier (transit through Port of Geelong)

The safety, hazard and risk studies completed for LNG carrier transit through port waters included the following:

- HAZID
- QRA
- Review of published LNG release consequence studies not within the QRA scope.

The predominant safety concern associated with the LNG carrier transit would be the potential impact to public safety from a large uncontrolled release. The potential consequences of a large LNG release have been covered extensively in a number of reports published by Sandia Laboratory indicating hole sizes ranging from 1-2m^2 (accidental breaches) to 5-12m^2 (intentional breaches) with a total spill volume of 12,500m^3 of LNG. Despite the significance of these scenarios, they are considered to have very low likelihood of occurrence with the accidental release probability below 5×10^{-7}pa (below HIPAP No.4 criteria for sensitive land use).

The very low likelihood of an intentional breach reflects that no successful adversarial threat causing such a large breach has ever occurred, the countermeasures in Australia which control and restrict access to the resources required to cause this extent of damage, and that Australia is considered a safe (and secure) location. The active consideration of potential incidents for LNG carriers followed the incidents surrounding 11 September 2001 in the United States, with recommendations made within the context of credible threats under the United States security environment. Detailed consideration of the applicability of this work to the project is included in Section 6.6.2 of Technical Report N: *Safety, hazard and risk assessment*.

The LNG carrier would transit the port waters of Melbourne and Geelong using the existing shipping channels passing within 300m of residential land at North Shore on approach to Refinery Pier from Corio Channel (refer to **Figure 12-16**). The LNG in the LNG carrier would be stored at atmospheric pressure and -162°C.

LNG carriers have multiple layers of protection to prevent a significant loss of containment given the potential public safety and vessel integrity concerns. These multiple layers of protection in the very few instances of low speed ship collisions have demonstrated their effectiveness in that no significant release of LNG has occurred during transit operations in the last 50 years, which represents over 135,000 voyages.

Figure 12-15 below provides a breakdown of shipping incidents (by number of casualties, including both injuries and fatalities) from the OCIMF from 1995 to 2021, based on over 20,000 global incidents reported and included in their database. Whilst acknowledging LNG carriers constitute a small proportion of international marine vessel movements, no significant incidents involving release of LNG have been reported. An LNG carrier release has never resulted in a fatality.

The safety control measures that provide the layers of protection include:

- Double hull design and construction
- Modern safety technology to detect and address on-board process safety issues
- Use of active escort tug vessels during shipping channel transit - four tug vessels when berthing at Refinery Pier
- Experienced pilot on board the vessel
- Limited vessel speed
- Port operations control managing vessels within the shipping channels – ships are only able to move with the Harbour Master's authorisation.

In addition to the specific safety controls, there are a number of security counter measures in conjunction with security intelligence analysis implemented for port activities that would minimise the likelihood of security threats developing into safety incidents. The security of port operations is managed by GeelongPort and documented in the Maritime Security Plan which must be approved by the Aviation and Maritime Security (AMS) Division (Commonwealth Department of Home Affairs) under the Maritime Transport and Offshore Facilities Security Act 2003.

Based on the results of the QRA modelling covering accidental releases, the risk profile associated with the transit of the LNG carrier was at least one order of magnitude below the most sensitive HIPAP No.4 criterion. The results indicated the following:

- The 'once in 2,000,000 years likelihood of fatality' considered tolerable for sensitive land uses was not exceeded, and the resident LSIR exposure is less than 1×10-7pa (once in 10,000,000 years likelihood of fatality) arising from incidents associated with the LNG carrier in transit.

It should also be noted that the LSIR contour assumes a person will be present on any point along that contour for 365 days 24 hours/day and is unprotected in the open. A person situated within a building would be protected against the initial flash fire exposure and would provide temporary shielding from the ensuing heat radiant from a pool fire.

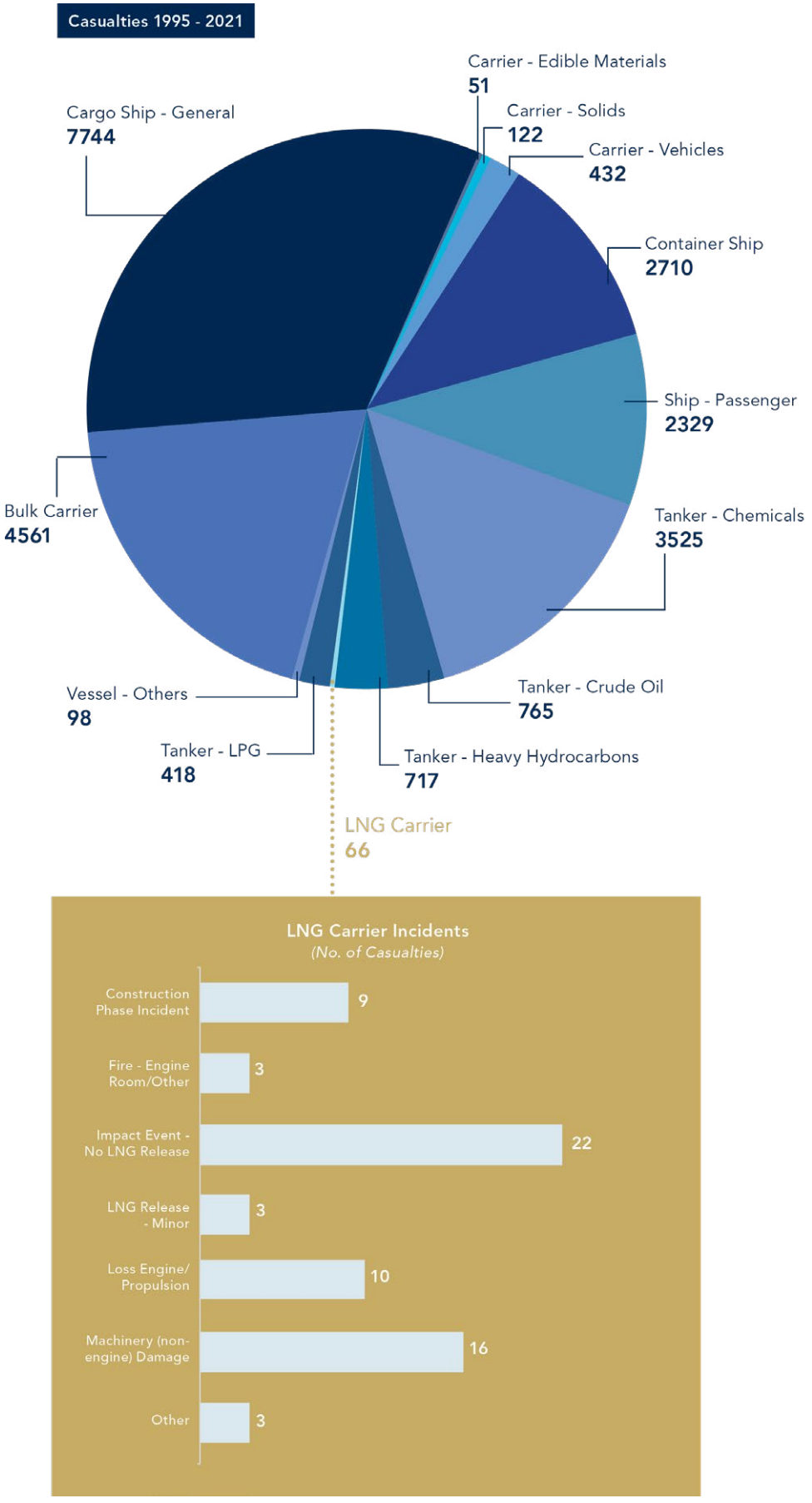

Figure 12-15 Breakdown of marine vessel incidents by number of casualties (1995-2021) (OCIMF incident database)

**Note: A casualty refers to a person killed or injured in an accident*

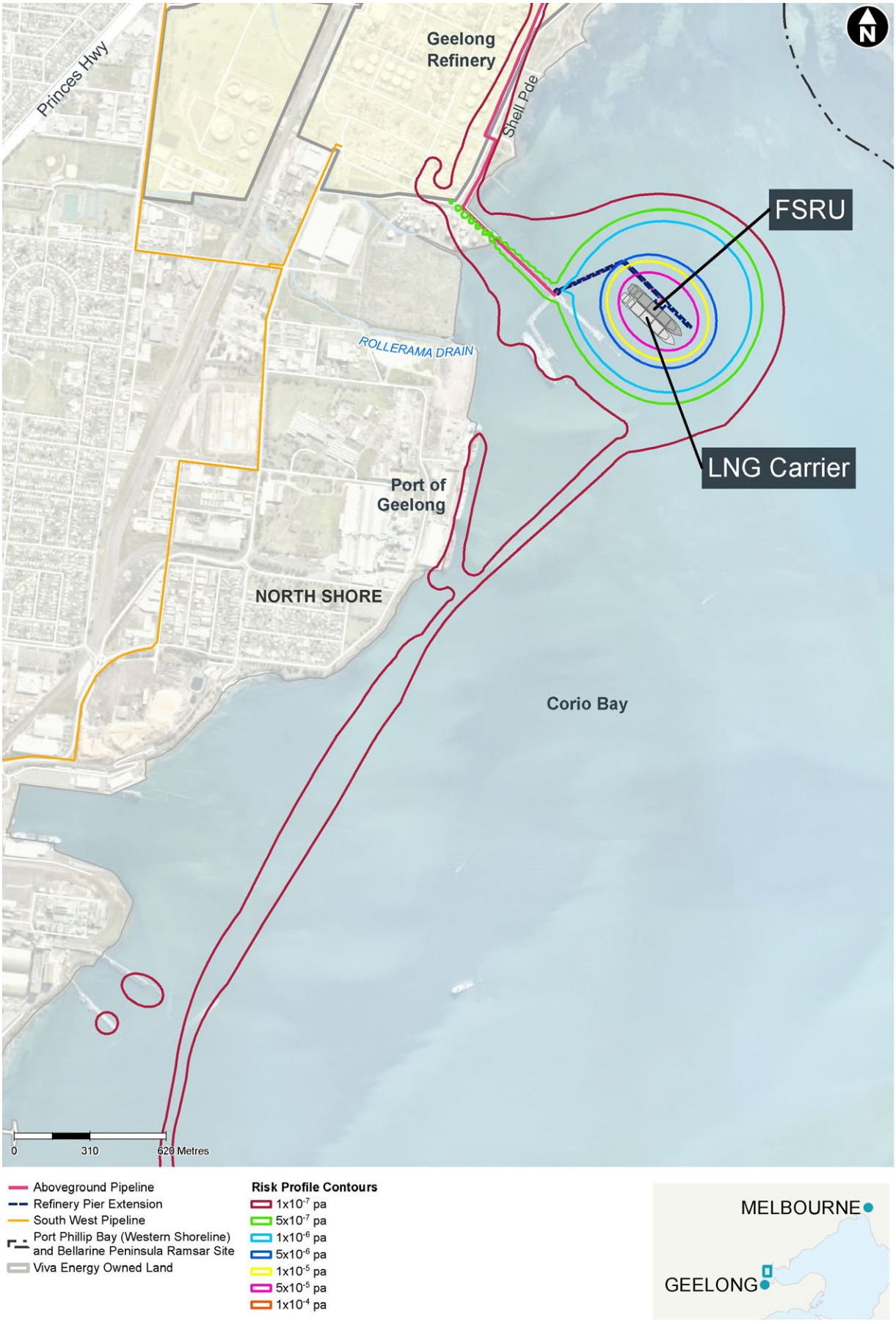

Figure 12-16 LNG carrier risk profile

12.2.5 Emergency response

The approach to emergency management and response for the project would be aligned with the Emergency Management Victoria framework and will address the following objectives from the *Emergency Management Act 1986*, Section 4A:

- Prevention—the elimination or reduction of the incidence or severity of emergencies and the mitigation of their effects
- Response—the combating of emergencies and the provision of rescue and immediate relief services
- Recovery—the assisting of persons and communities affected by emergencies to achieve a proper and effective level of functioning.

Emergency management and response would be a component of the existing emergency management structure implemented at Refinery Pier under the umbrella of the GeelongPort Emergency Management Plan. The following would be undertaken during the planning phase of the project:

- Preparation of an Emergency Response Plan (ERP) undertaken in consultation with Ports Victoria, GeelongPort, FSRU Service Provider, WSV, ESV and Victorian emergency service providers (Police, Ambulance Victoria, the Country Fire Authority and Fire Rescue Victoria)
- Consultation and coordination with GeelongPort and Quantem on the Refinery Pier emergency response
- Consultation with Greater Geelong City Council, and Regional and State Emergency Management Committees
- Emergency response planning involving the movement of vessels prepared in consultation with Ports Victoria
- Consultation with relevant neighbouring facilities and the community.

The ERP would be developed specifically for the project and would include the following:

- What defines an emergency
- The hazards related to constructing and operating the FSRU and pier infrastructure
- The potential for emergencies occurring
- The characteristics of emergencies that could occur
- An estimation of the potential consequences of hazards on people, the environment and property
- What is required to activate the ERP and de-activate the ERP.

The ERP would set out contingency planning for responses to foreseeable incidents, an implementation strategy for managing the ERP and development and maintenance of procedures to align with AS 3745:2010: Planning for Emergencies in Facilities. All the major incidents identified as part of the preparation of the safety case(s), plus any other foreseeable scenarios requiring emergency response including, but not limited to safety and environmental incidents. In addition, the Geelong Refinery emergency response plan will be updated to reflect the gas pipeline running through the refinery process area and the additional storage facilities at the treatment facility. The emergency response plan(s) would cover:

- Unignited LNG spill
- LNG pool fire (including spill to water)
- Unignited gas release
- Gas jet fire (FSRU / pipeline / treatment plant)
- Liquid nitrogen release (potential asphyxiation)
- Unignited toxic odorant release or spill
- Toxic odorant pool fire
- Medical emergency
- Chemical or oil spill.

The emergency response plan proposed during the construction phase would be implemented by the construction contractor. The Construction Emergency Response Plan would be aligned with the requirements of the GeelongPort Emergency Management Plan and existing Geelong Refinery emergency management plans.

12.3 Mitigation measures

Table 12-5 outlines the mitigation measures proposed to avoid, minimise and manage safety risks associated with the project. The focus of these mitigation measures is to reduce the level of risk to as low as reasonably practicable (ALARP) as well as so far as is reasonably practicable (SFAIRP).

Table 12-5 Safety mitigation measures

Mitigation measure ID	Mitigation measure	Project phase
Safety, hazard and risk		
MM-SHR01	**FSRU safety standards** The Floating Storage and Regasification Unit (FSRU) will be designed, constructed and operated to meet relevant safety standards. The FSRU will be designed, operated and maintained under the purview of DNV GL (or equivalent classification agency). It will comply with the Rules for Classification as required to retain its Class Notation. This will include requirements for inspection, maintenance and functionality of all on-board safety systems.	Design Construction Operation
MM-SHR02	**Pipeline standards** The pipeline will be designed, constructed and operated in accordance with AS2885 and consistent with a T1 (Residential) environment. This will include completion of a Safety Management Study with the identification of threats and appropriate mitigation measures including increased depth of burial, heavier duty piping and protective slabs.	Design Construction Operation
MM-SHR03	**Facility Standards** The Refinery Pier No. 5 extension, the equipment installed on Refinery Pier No. 5, and the Treatment Facility will be designed, operated and maintained in accordance with relevant Australian and international standards.	Design Construction Operation
MM-SHR04	**Automated systems – safety and process control** The operation of the FSRU, pipeline and Treatment Facility will be monitored using appropriately SIL rated process automation and shutdown systems. Abnormal conditions will alarm locally and remotely to fully attended control rooms. Out of normal conditions will result in an automatic shutdown of gas operations via closing of emergency shutdown valves with de pressuring of inventory through vent stacks to be initiated remotely. The control, monitoring and shutdown systems will be fail-safe and be designed to best industry practices with redundancy.	Design Construction Operation

Mitigation measure ID	Mitigation measure	Project phase
MM-SHR05	**Dangerous goods storage and handling** Dangerous goods, as defined by the Australian Dangerous Goods Code, and flammable and combustible liquids will be stored and handled in accordance regulatory requirements, EPA Victoria Publication 1698 – Liquid Storage and Handling Guidelines and all relevant Australian Standards – including but not limited to the requirements of: • AS1940 – The storage and handling of flammable and combustible liquids • AS1210 – Pressure vessels • AS4343 – Pressure equipment – hazard levels • AS3846 – The handling and transport of dangerous cargoes in the port areas • AS2941 – Fixed fire protection installations – pumpset systems • AS/NZS60079 – Explosive atmospheres	Design Construction Operation
MM-SHR06	**Monitoring of chemical and fuel storage facilities** Routine visual monitoring and recording of chemicals and fuel storage facilities will occur as part of routine operational practices.	Construction Operation
MM-SHR07	**Emergency response plans** Emergency response plans, such as for spills, will be developed and implemented for both the construction and operations phases of the Project.	Construction Operation
MM-SHR08	Fire and gas protection The FSRU or LNG carrier will be provided with their own onboard fire protection and suppression systems. This is a requirement of the DNVB GL (or other equivalent classification society) class notation. Active fire protection and suppression will be provided for liquid fires and gas fires on Refinery Pier in compliance with Australian Standards. The design fire case for fire systems is a jet fire in the MLA area. The required firewater cooling rate is for the ship/shore manifold area, which is defined as the MLAs and associated piping and valves as well as for FSRU hull cooling. The diesel fuel supply will be designed for six hours of firewater per pump. The existing refinery current design will be upgraded to provide 2×100% or 3×50% capacity fire water pumps to provide 50% of the required firewater with the remaining firewater to be provided by firefighting tugs located with the Port of Geelong. Fire and gas detection will be provided in key locations piping on Refinery Pier and within the Treatment Facility.	Design Construction Operation

Mitigation measure ID	Mitigation measure	Project phase
MM-SHR09	**Separation distance** The location of the FSRU provides sufficient separation distance from sensitive receptors (North Shore, Geelong Grammar School) to be outside impact zones for significant breach events. The refinery process area is located over 600m from the FSRU to minimise the potential for escalation of an incident from one facility to the other.	Design Operation
MM-SHR10	**Site Safety Advisor** A suitably competent person will be appointed as Site Safety Advisor during construction and will have on-site a set of the relevant safety data sheets (SDS) for hazardous and dangerous materials.	Construction

12.4 Conclusion

The proposed construction and operation of the project has the potential to impact on maritime and port operations safety within the Port of Geelong. Through the development of controls to reduce the impact of the project on vessel navigation and port operations safety, it is anticipated that the project would not impact on existing port operations. It is also anticipated that risk of collision or grounding impacting port navigation and safety, as well as safety of personnel on or around vessels, would be minimal.

The safety, hazard and risk studies undertaken have identified all events which could lead to a potential major incident. The safeguards and controls proposed for design of the project are consistent with those adopted by hazardous industries and those accepted by the nominated regulators as providing sufficient protections and mitigations against major incidents.

The potential hazard, safety and risk impacts on adjacent and nearby land uses during project operations are expected to be limited and not disproportionate to those already experienced by the current operations of product movements across Refinery Pier, as well as the operation of the Geelong Refinery.

The results of the QRA confirm that the risk profile within the study area, and on nearby public land uses, would be within the suggested acceptable thresholds as defined by the standard used in Australia for assessment of potentially hazardous facilities (HIPAP No.4). As the project transitions into detailed design, construction, and operational phases, further safety and risk analysis would be completed to ensure that these risks continue to be reduced so far as is reasonably practicable. The project will need to comply with all regulatory requirements and be approved/accepted by key agencies including WorkSafe, Energy Safe Victoria and DELWP.