Environment Victoria submission to Viva Gas Terminal Supplementary EES

Holding submission lodged 24 October 2024 via online form at https://engage.vic.gov.au/Viva-Supplementary-EES-IAC
Full submission lodged 31 October 2024 via email to Planning.Panels@transport.vic.gov.au

Summary

To the Inquiry and Advisory Committee,

Environment Victoria welcomes the opportunity to make a submission to the Viva Gas Terminal Project Supplementary EES Inquiry (SEES).

Environment Victoria (EV) is an independent and not-for-profit organisation that has been campaigning to look after Victoria's environment since 1969. With more than 40 grassroots member groups and 200,000 individual supporters, Environment Victoria represents a growing community of Victorians standing up for a safe climate, healthy rivers and a sustainable future.

EV was a party to previous EES inquiries for gas terminal proposals – the AGL Crib Point IAC and the first Viva Energy Gas Terminal Inquiry that led to this supplementary statement.

We make the following points in relation to the Relevant Environmental Effects that are within scope for this inquiry:

- **The Proponent's Supplementary Environment Effects Statement (SEES) is incomplete and does not fully satisfy the Minister's recommendations.** The Cultural Values Assessment (Recommendation 12) has not been completed and the chapter on this topic amounts to little more than an explanation of work to be done. The Stantec peer review of the marine ecology sections includes comments that have not been fully resolved.
- **A review by independent marine ecologist and dredging expert Dr Parry, attached to this submission, finds fatal flaws in the SEES studies and a concerning lack of detailed reporting**. These are covered in more specific detail below and in the Appendix.
- **The Proponent has likely underestimated the amount of dredging involved, and the yet-to-be-released safety and navigation studies may impact on the extent of this dredging along the Corio Bay shipping channel.** This is an issue that was noted by the IAC report after being raised by GeelongPort and several expert witnesses during the previous EES inquiry. Dr Parry has also raised it in his independent review attached.

- **The trigger values for turbidity in the Environmental Management Framework (EMF) are far less stringent that those used in past dredging in Corio Bay or in the Victorian Dredging Guidelines.** This mitigation measure should be updated in line with the dredging guidelines recommended values.

We have also included an additional section covering climate change and new Victorian Government legislation introduced after the previous EES inquiry. While not within the Relevant Environmental Effects of this inquiry, we believe it is important to put the implications of this new policy on the public record.

We would welcome the opportunity to elaborate on our submission at the inquiry hearings.

Sincerely,

Greg Foyster
Rivers and Nature Campaign Manager
Environment Victoria

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Marine ecology and dredging – expert review by Dr Parry

EV engaged marine ecologist Dr Gregory Parry to review Chapter 3 and Technical Report A of the SEES, and some relevant sections of the proposed Environment Management Framework related to dredging. Dr Parry is not available to be an expert witness during the three-week period of the hearings, so we have attached his report to this submission.

Dr Parry has a PhD in marine ecology and was previously the Manager of Dredging during the 1997-98 Geelong Channel Improvement Program. He also wrote the Victorian Dredging Guidelines, which are cited extensively – but selectively – in the Proponent's documents. He has published over 25 articles in refereed journals and more than 100 reports. Recently he has been engaged in studies of impacts of effluent from both the Western (sewage) Treatment Plant (Werribee) and the Eastern Treatment Plant (Gunnamatta) on the ecology of their very different receiving waters.

Dr Parry was asked to cross-reference recommendations from the Minister for Planning with the SEES documents. Here we summarise his comments for a general audience:

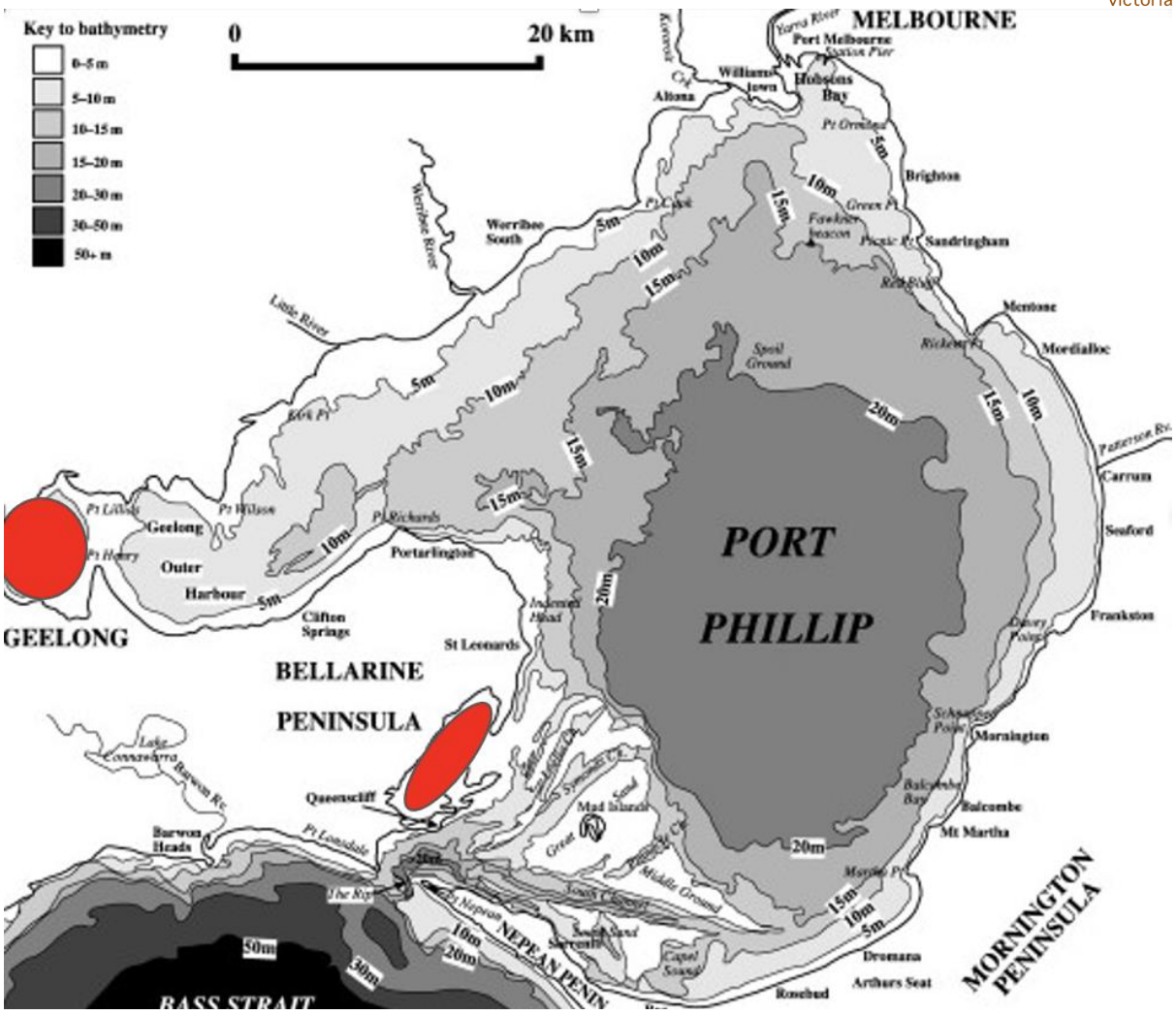
Comments on recommendation 1a: monitor extent of existing refinery plumes

No details on water volume in experiment estimating chlorine plumes
The Technical Report does not specify the volume of water in the experimental tank used to estimate rate of loss of chlorine.[1] Since the rate of loss is likely dependent on the surface-volume ratio, it is difficult to independently verify this study without the missing information.

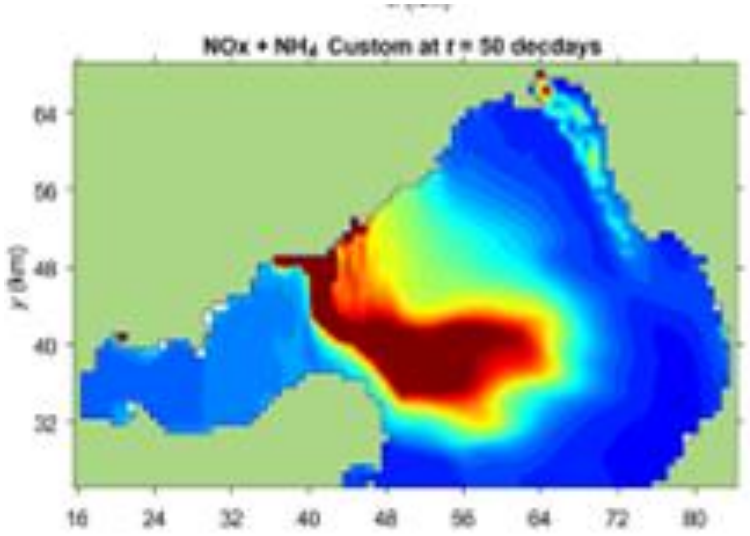
Comments on recommendation 1b: update seagrass mapping

Inappropriate comparison between Corio Bay and other areas
The ecology of Corio Bay differs from broader Port Phillip Bay. In Corio Bay and Swan Bay nitrogen is mostly sourced from microbes associated with seagrass roots, and most of this nitrogen is retained because seagrass leaves stay within the enclosed embayment. The following map shows how Corio Bay (red circle) and Swan Bay (red oval) are sheltered from broader Port Phillip Bay.

[1] SEES Technical Report A (P3-29)



In Port Phillip Bay, by contrast, the Yarra River and the Western Treatment Plant provide a large external source of nitrogen, and seagrass leaves are mostly not retained. The following illustrates the extent of this nitrogen plume into the Bay.



This makes seagrasses within the plume of the Western Treatment Plant an inappropriate comparison with seagrasses in Corio Bay. And yet Technical Report A Figure 3-6 includes plots for seagrasses at Bellarine Bank and St Leonards, which are at the north and north-eastern sections of the Bellarine peninsula, likely affected by the plume from the Western Treatment Plant. These plots are used to show a significant year-to-year variation in seagrass cover, which the SEES argues would also apply to Corio Bay – but the comparison is not appropriate, given the very different sources of nitrogen, a limiting nutrient for growth.

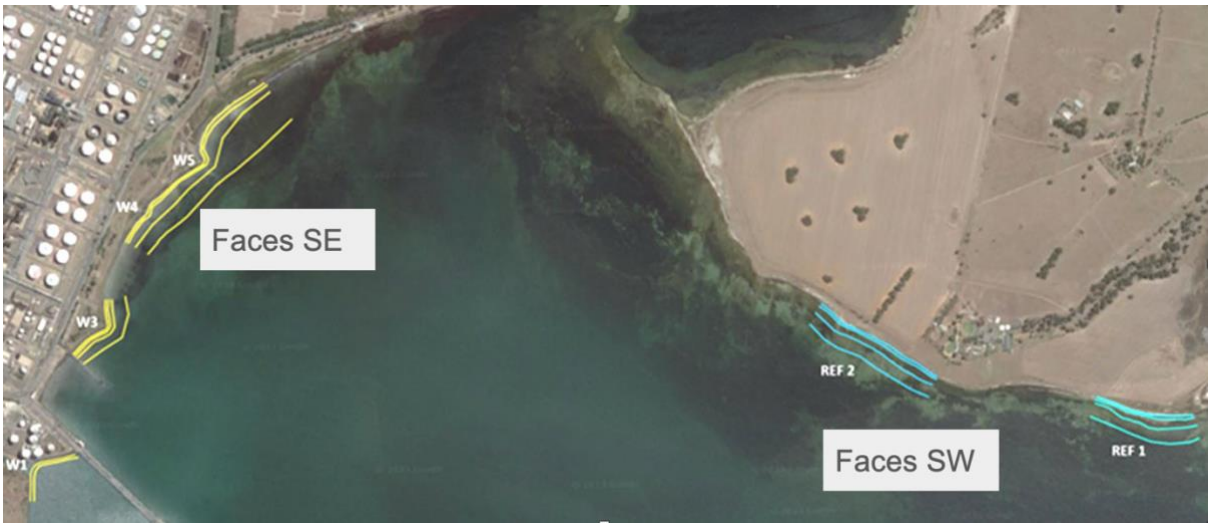
It's worth noting that Stantec's peer review of this chapter also raised issues with this figure as being 'of questionable relevance as it is nowhere near the area of interest'.[2] The comment was closed with no change made.

This assertion that Corio Bay and Bellarine Bank/St Leonards are directly comparable is later relied upon to dismiss changes in seagrass cover near refinery outfall W5 (Figure 3-19) but the evidence presented does not support this claim.

Study on existing discharges 'fatally compromised' by differences between impact and references sites, incorrect assumptions and use of a 'generic' seagrass category

Dr Parry's report points out several concerns with the study into the impact of existing discharges on seagrasses (Technical Report A, P3-40), including the following:

- The areas impacted face East and are sheltered from prevailing wind and waves, but the reference sites face Southwest and are exposed (see image below).



- As the seagrass species under consideration prefer sheltered sites, the more exposed reference sites may ***naturally*** have less seagrass. Thus a finding of equal amounts of seagrass at both sites may indicate that the impact sites have less seagrass than they would without the refinery being there. The absence of data from before the refinery makes it critically important to select appropriate reference sites.

[2] Peer Review Report B, Appendix: Comment Register, page 29 of PDF, Comment ID#7

- The differences between impact and reference sites is further compromised because the study assumes each seagrass class had a particular percentage of cover, instead of calibrating this relationship, or analysing the proportions of different density classes.
- The analysis of a generic 'seagrass' category rather than individual species also biases the outcome towards finding non-significant differences between control and impact sites if one species is more susceptible than another.
- Plots of seagrass density vs distance from the outfall should provide a stronger design for detecting impacts, however the spatial scale chosen – with 15m spacings – is far too coarse to detect any effects. Samples should have been analysed at much closer intervals. Dr Parry's report describes in more detail how this study could have been designed better.
- Where statistical tests show no statistical difference between an impact and control site this may be the result of a very insensitive test. However, no power analysis was undertaken to detect this.

Environment Victoria has additional comments on this section to add. The Stantec peer review of this section 3.5.4 notes: 'The original reviewer's comment, which is unfortunately very valid, has not been addressed in the slightest by the response, which is of great concern'. It does not appear that the peer review round 2 feedback has been addressed, as neither SEES Chapter 3 or Technical Report A mention ANOVA or analysis of variance, let alone the detailed description of the method and results requested.[3]

Comments on recommendations 1c and 1d: proposed baseline surveys prior to dredging

Concerning underestimate of dredging required

The Victorian Dredging Guidelines state that 'the proposed amount of dredging must be justified' but Dr Parry's report raises concerns that the SEES significantly underestimates the amount of dredging. The dredging proposed involves removal of 490,000 m^3 from Corio Bay, considerably less than dredging in 1997-98 for the Channel Improvement Program, which deepened the entire length of Geelong shipping channel and removed 4.5 million m^3 of spoil, which is ten times the proposed dredging (although only one-quarter of this dredging was in Corio Bay).

Dr Parry argues 'there is a strong likelihood' that the Geelong Channel will need to be further deepened to accommodate the large LNG tankers required to feed the gasification plant. To quote:

- 'the Geelong Channel can accommodate vessels with draft of up to 11.9 m with tide and 10.6 m without tide (Geelong Harbour Masters Directions 2020) and is only 120m wide accommodating 'typical' LNG carriers will be hazardous.'
- 'The largest and most economic LNG carriers will be unable to access the proposed terminal and there will be pressure to deepen and widen the Geelong Channel.'

[3] Peer Review Report B, Appendix: Comments Register, page 31 of PDF, Comment ID#17

Environment Victoria makes some additional comment on the likely underestimate of dredging. First, the IAC report from the previous EES inquiry noted concerns about Corio Bay channels being too shallow: 'tidal influence may mean at times there is insufficient under keel clearance for safe passage of an LNG carrier.'[4] Second, the IAC also noted this concern was held by multiple submitters and experts, including Geelong Grammar School, GeelongPort and expert witness Mr Mannion:

> *GGS (D379) submitted that the dredging impact assessment assumes that the EES correctly identifies the extent of dredging required. However, the dredging volumes could be significantly larger than modelled if a greater amount of dredging is required for safe navigation as discussed in GeelongPort's withdrawn submission and evidence from Mr Mannion (D70).*[5]

We also note the IAC considered Mr Mannion a credible witness and his concerns and recommendations are included in the current Environment Management Framework (MM-SHR11). The relevant mitigation measure reads: 'Issues raised and recommendations made in the written expert evidence of Mr Martin Mannion and Dr Anand Pillay in the IAC hearings (Documents 70 and 69) must be explicitly considered and responded to in the further detailed design stages of the project.'

While the Proponent may argue that 'further design stages' refers to later regulatory approvals, such as under the Marine and Coastal Act or through WorkSafe Victoria, we contend that navigational concerns raised by Dr Mannion, Anand Pillay and GeelongPort have direct bearing on the Relevant Environmental Effects which are the subject of this inquiry. If the navigational studies show the Geelong channel needs to be deepened or widened, further dredging will be required. If further dredging is required, it will affect turbidity, light availability, suspended solids and the amount of material to be dumped. The dredging program would need to operate well beyond the currently proposed eight-week window. All of this is directly relevant to the impact on the ecology of Corio Bay and the nearby Ramsar site.

GeelongPort made these links clear in its submission to the first EES:

> *... A further measure may be the need to undertake additional dredging in Corio Bay to create safe anchorages for the LNGC and FSRU.*
>
> *Of course, changes of that kind have very serious implications for other aspects of the EES assessment – such as marine impacts, dredging, air quality, noise, safety, etc – and are not appropriate changes to make on the run during an EES hearing; changes of that significance warrant re-assessment.*[6]

[4] *Viva Geelong Gas Import Terminal Inquiry and Advisory Committee Report No. 1*, 5 October 2022, p.117
[5] *Viva Geelong Gas Import Terminal Inquiry and Advisory Committee Report No. 1*, 5 October 2022, p.85
[6] *Viva Gas Terminal EES inquiry submission 381.GeelongPort*, 19-July-2022, p.63

The trigger values for turbidity in the Environmental Management Framework are far less stringent than for past dredging or in the Victorian Dredging Guidelines

Dr Parry was Manager of Dredging during the 1997-98 Geelong Channel Improvement Program. During that dredging, the turbidity trigger values were set at 3 NTU (median) and 6.6 NTU (80th percentile). However in the SEES the Environment Management Framework mitigation measure MEO5 sets these values much higher at 12 and 15 NTU. This very high turbidity level is not justified.

Recommendations for the IAC regarding dredging

Based on Dr Parry's review, EV argues that the IAC should:

1. Write to Ports Victoria to:
    a. seek assurances that the channel meets the international PIANC standards for the size of vessels proposed
    b. request clarification on the status of the Proponent's navigation and safety studies
2. During the hearings, inquire into the impact of further dredging on the marine environment not currently accounted for in the SEES studies.
3. Update Environment Management Framework mitigation measure MEO5 with more stringent turbidity guideline values – based on the previous Geelong Channel Improvement Program and/or the Victorian Dredging Guidelines.

Improved data collection in monitoring dredging

Dr Parry's report also includes details for how the dredging program could better meet the Victorian Dredging Guidelines to contribute to 'ongoing improvement'. For example, the proposed monitoring could collect data on turbidity (NTU), light (PAR) and suspended solids (SS) at the same sites. These variables are interrelated and collecting data on all three at the same location would help validate and improve conditions for future dredging.

Comments on recommendation 7: assessment of light available for seagrass growth

Underestimating light requirements of seagrass species

Dr Parry's report points out that the light requirements of *Heterozostera nigricaulis* are given as a range of 5% to 13% of surface radiation in the Victorian Dredging Guidelines, but only the lower 5% figure is mentioned in the supplementary EES Technical Report A (P9-144).

It's worth noting that the first IAC report stated that the 5% threshold is 'not sufficiently conservative'. The Committee found: 'The Victorian Dredging Guidelines considered the Bulthuis paper and other literature, and state that "**most seagrass species require more than 10 percent light for survival; typically, they require nearly 20 percent for survival**". On that basis, the IAC considers the 10% SI and 20% SI thresholds in the Victorian Dredging Guidelines provide an appropriate basis for assessing the effects of dredging on

seagrass, with the 20% SI threshold given greater weight at the Ramsar site to minimise risk.' [7]

Stantec peer review and unaddressed comments

It is concerning that the Proponent was dismissive to some comments raised in the peer review by Stantec. We will not go through the detail of that review, other than to highlight two quotes that echo concerns from Dr Parry:

- 'An on-going concern is the lack of detail and definition of the statistical methods used in the analysis'
- 'the results...lack the appropriate level of analytical detail and associated explanation for a modern environmental impact assessment'[8]

Comments on air quality studies

Numerous epidemiological studies have indicated there is no safe exposure for air pollution, including by the pollutants that will increase as a result of this project – nitrogen oxides (NOx), sulfur dioxide (SO2) volatile organic compounds (VOC) and fine particulate matter (PM10 and PM2.5). The monitoring station located in South Geelong may not accurately capture the small variations in air quality around North Shore.[9] The introduction of new Volatile Organic Compounds (VOCs) can lead to the formation of secondary air pollution in the area, but it's unclear which VOCs are included in the modelling.

Climate and the energy transition

The scope of this SEES does not include climate as a Relevant Environmental Effect. Greenhouse gas emissions were considered in the previous EES and we are not seeking to re-prosecute those arguments relating to transport emissions, offsets and other concerns raised at the time. However, we would like to highlight significant changes to Victorian Government climate policy since then.

New Victorian climate targets have now been legislated to reduce emissions by 75 to 80% by 2035. These targets were announced after the first EES hearings had finished and have not previously been taken into account in this process.

In March 2023, Environment Victoria released a report analysing Viva Energy's proposal to import 160 petajoules (PJ) of gas in the context of these new climate targets.[10] Figures from Technical Report C in the original EES estimate that 'emissions associated with the end use of natural gas equivalent to the project's maximum annual supply are 8,884,800 t CO2-e.'

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[7] *Viva Geelong Gas Import Terminal Inquiry and Advisory Committee Report No. 1*, October 2022, p.80
[8] *Attachment I Peer Review Report B, p.7*
[9] *Technical Report C: Supplementary air quality impact assessment – Viva Energy Gas Terminal Project Supplementary Statement*, Table 13, Note 1 gives the location of Geelong south station for background air pollution monitoring of NO2
[10] *Gas sector emissions and Victoria's new 2035 climate targets*, Environment Victoria, March 2023. Appendix, p.19-21 https://environmentvictoria.org.au/2023/03/07/gas-sector-emissions-and-victorias-new-2035-climate-targets/

Comparing this with the total amount of allowable emissions, the EV report finds that **the volume of gas Viva Energy plans to import could be responsible for 30% to 37% of Victoria's emissions in 2035** (the range depends on whether Victoria meets the upper or lower target).

These estimates are conservative because they do not consider fugitive emissions, nor emissions from the transportation or production of LNG. Recent research from the US has quantified the additional emissions of LNG exported from the US due to production, liquefaction and transport and found it to have 33% higher greenhouse gas footprint than coal.[11] Calculations sourced by Environment Victoria have estimated that, compared to domestically sourced gas, importing LNG would produce 2.4 to 4.9 times more emissions pre-combustion.[12] No country takes responsibility for emissions from international shipping, but clearly these greenhouse gases would not be emitted if Victoria did not import LNG and should be taken into account by the Victorian Government.

The Proponent has argued that it is not responsible for the emissions from burning the gas it imports because it does 'not have any ability to influence the end-use consumption of the gas'. While we understand the technical basis for this argument – that downstream emissions are 'Scope 3' and not included in the project's operational boundary – we believe that the Victorian Government should assess the total emissions associated with a project of this scale before making a decision. This is especially the case when the associated emissions are large enough to affect Victoria's chances of meeting its new climate targets.

The Victorian Government has released a Gas Substitution Roadmap, which demonstrates a clear intention to shift homes and businesses from gas to cleaner sources of energy. The gas demand assumptions underpinning Viva Energy's proposal are wildly out of step with that trajectory.

EV has grave concerns about the government approving a new gas supply project that is at odds with the stated intention to reduce Victoria's gas consumption. It also means Viva Energy will have a vested interest in slowing the transition off gas in order to keep its terminal operating longer to recoup investment costs. This would be a worrying development for Victoria's chances of achieving the state's new 2035 climate targets.

We understand these climate concerns may be out of scope for this inquiry, but believe it is important to put them on the public record, especially considering Victoria's new 2035 climate targets will not be considered in any other forum or assessment of the Proponent's gas terminal.

[11] Howarth, Robert W. 'The Greenhouse Gas Footprint of Liquefied Natural Gas (LNG) Exported from the United States'. Energy Science & Engineering, 3 October 2024. https://doi.org/10.1002/ese3.1934.

[12] Including upstream, midstream, liquefaction, transport, transmission and distribution emissions and assuming importation from Qatar as the swing producer internationally. Gas sourced from Bass Strait emits 485 g CO2e/kg before combustion by the end user, compared to 1169 g CO2e/kg using a modern ship or 2400 g CO2e/kg using a heavy fuel oil powered ship (all GWP100).

Report to Environment Victoria.

Review of marine ecology and dredging aspects of Viva Supplementary EES.

No.27
October 2024

MES

Cover Photos: Two species found more frequently in Corio Bay than elsewhere in Port Phillip Bay. (Upper: hermatypic coral, *Plesiastrea versipora*. Lower: Balmain bug, *Ibacus peroni*.)

Review of marine ecology and dredging aspects of Viva Supplementary EES.

Gregory D. Parry

October 2024
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Introduction

In March 2023, after an assessment of the original EES by an Inquiry and Advisory Committee, the Minister for Planning directed that a Supplementary Statement was required for the Viva Energy Gas Terminal Project. The Minister made 8 recommendations specifying where additional information was required to satisfy concerns raised in the initial EES.

This assessment focuses on current impacts and particularly on recommendations 1 and 7. Most of the remaining recommendations concern modelling which the author does not have the expertise to comment upon.

Recommendation 1

Undertake further survey work to better establish the existing environment and the impacts of existing wastewater discharges from the refinery to enable better understanding of Project impacts. The survey work should:

a. Cover intertidal, littoral and subtidal habitats that could potentially be affected by the project, including the Ramsar site.
b. Update seagrass mapping to include the intertidal zone and information on the different seagrass species.
c. Be carried out over a period of at least 12 months before construction or dredging starts, with a minimum of four sampling runs (one in each season) to address seasonal variability.
d. Establish a better baseline for monitoring during and after the project to confirm predicted outcomes on shoreline and benthic communities, including seagrasses and macroalgae.

Recommendation 7

Undertake further assessment of dredging impacts on seagrass based on:

a. The revised sediment transport modelling.
b. Revised light thresholds of 10 % to 20 % surface irradiance (20 % surface irradiance should be applied to any sediment plumes that extend to the Port Phillip Bay (western shoreline) and Bellarine Peninsular Ramsar Site).
c. The updated seagrass mapping (Rec. 1b).

Review

Recommendation 1

Task 1a: Monitor Extent of Existing Refinery Plumes

The means of estimating the chlorine plumes from the existing outfalls, given that chlorine concentrations are too low to measure in the field, may be adequate, but it is difficult to determine this from the description of the methods. Firstly, the rate of loss of chlorine vs temperature in an experimental tank is measured in a tank described only as "large" (Technical Report A, P3-29). Specifying the volume of water in the tank or its dimensions is a minimum requirement for any scientific document. The rate of loss of chlorine is likely dependent on the surface-volume ratio of the tank. Second, the only description of the process for linking temperature and chlorine in the field is "The plume temperature survey results were processed to determine the shape and extent of the chlorine plumes" (Technical Report A, P3-29). It is not clear whether these plumes are from a numeric model or some other process and how dilution and decay have been treated. Again, further information is needed for the story to be complete and convincing.

Task 1b: Update Seagrass Mapping

Overview of ecology of Corio Bay

The ecology of Corio Bay is surprisingly intact given the extensive dredging it has been subject to, and the many industries that have discharged into the bay in the past. In the 1970s discharges via Cowies Creek meant that cadmium levels in mussels in Corio Bay were the highest recorded in the world. Controls on discharges, the solubility of cadmium (cf other heavy metals) and the passage of time has meant that levels of cadmium are now near background levels. The fish community there is distinctive within Port Phillip Bay (Parry *et al*. 1996) and the diversity of fish found there is higher than elsewhere in Port Phillip Bay (Parry unpublished data).

The ecology of Corio Bay, like that of Swan Bay, is highly dependent on seagrasses and the ecology of both these bays is strongly influenced by their enclosed geography. In these bays nitrogen is mostly sourced from nitrogen fixed by microbes associated with seagrass roots and most of this nitrogen is retained within these bays because seagrass leaves, when detached by swan grazing or storms, are mostly retained within these enclosed embayments. This contrasts to the situation throughout the rest of Port Phillip Bay where nitrogen, the limiting nutrient, is provided by inputs such as the Yarra River and the Western Treatment Plant. In most of Port Phillip Bay seagrasses are dependent on external sources of nitrogen (Yarra River and WTP) and seagrass leaves are mostly not retained near where they are produced (Parry and Black 2023). This means that seagrasses within the plume of the WTP show greater interannual variation in abundance than would be expected in Corio Bay. We note that the discussion in Technical Report A (P 3-32) is consistent with the above description, yet they show plots of variation in seagrass cover for two areas "which are in the vicinity of Corio Bay", but in locations where large variations in nitrogen supply and seagrass cover is expected. We can see no reason to include these plots (Fig 3-6) as they imply more variation in seagrass cover in Corio Bay than would be expected. Indeed, the same misleading argument is repeated later to imply large amounts of year-to-year variation in seagrass cover is to be expected in Corio Bay as it is in other (quite different) parts of Port Phillip Bay (E.g. Fig 3-19) and used to dismiss as unimportant observed

changes in seagrass cover near the W5 outlet during the study. These changes while apparently on a small scale suggest that the studies were themselves focused on the wrong spatial scale and that changes can be measured near the outfalls, although only on a small spatial scale.

Seagrass distribution in Corio Bay

Seagrass maps are provided based on a combination of observations, drone, towed video and aerial photographs. The deep boundary of *Heterozostera/Halophila* shown in Technical Report A Figure 3-7 is inconsistent with the towed video in plots in Figs 3-8 and 3-9. The towed videos do not extend beyond the depth at which seagrass is observed, except in a small area near Limeburners Lagoon, so it is unclear how the deep edge of seagrass was mapped. The deeper edge of the seagrass distribution appears to be a guess, possibly based on a depth contour. This should be stated and justified.

It is claimed (P3-33 and P3-34) that seagrass was "analysed" in over 11,300 underwater images taken along 15 kms of transects across the discharge area and Ramsar zone over a period of six months with ground truthing of seagrass images by marine biologists (P3-34). But this appears to be a significant exaggeration as on P3-59 it is indicated that there were only 900 seagrass cover measurements in total. It appears that 11,300 images were taken, but only 900 were analysed. These data should have been presented more accurately.

Impact of existing discharges on seagrass

This statistical design of the impact of existing discharges on seagrass is poor. The comparison between impact and reference sites is fatally compromised by the likely differences between the impact and reference sites due to their different aspects. Both the impact sites face East and are largely sheltered from the prevailing wind and waves, while both the reference sites face SW where they are exposed to the prevailing winds/waves. As all the species of seagrass considered prefer sheltered sites, the more exposed reference sites may naturally have less seagrass, so a finding of equal amounts of seagrass may indicate an impact. The absence of pre-impact data makes the selection of reference sites critical and even when they are well selected there remains significant uncertainty in interpretation of any differences between impact and reference sites.

In this study the differences between impact and reference sites is further compromised by the conversion of proportions of 4 seagrass classes into overall percentage cover on transects, by **assuming** each seagrass class had a particular % cover (dense=95% cover, mod=50% cover and sparse=10% cover and more reasonably that no seagrass=0% cover). The analysis should not have used this assumption. The assumption could have been avoided by either calibrating the relationship between density classes and % cover or analysing the proportions of different density classes. This analysis would likely have showed all transects differed as $\chi 2$ tests are typically more sensitive than the t-test employed.

While the means of classifying each species of seagrass is explained, the means of classifying combinations of species is not, and as only data on these combinations is analysed the means of classifying them should have been described. The analysis of a generic "seagrass" category rather than individual species also biases the outcome towards finding non-significant differences between control and impact sites if one species is more susceptible than another. The only justification for analysing the species in combination is that they are "intermingled" (P3-40). This may make the task of analysing each species separately more difficult but is not a good reason for combining coverage of different species.

It is also worth noting there were sites where the amount of seagrass cover was obscured by

algae on top of the seagrass (see P3-36), but there is no description of how this complication was handled in the analysis.

Plots of seagrass density vs distance from outfall (for *N. muelleri*, Figs 3-13, 3-14, 3-15 and subtidal seagrass Fig 3-16) provide a much stronger experimental design for detecting impacts of outfalls than the large-scale comparisons of seagrass abundance in broad areas near and distant from the discharges in Corio Bay. However, the spatial scale chosen looks to be far too coarse (15m spacings) to detect the effect of the outfall. Samples should have been analysed at much closer intervals near the outfall so that patterns of decline (if any) could have been detected. The study should have used the model showing the footprint of elevated temperature and chlorine concentrations to design the spacing of samples near the outfall and the analysis should have compared the distribution of seagrass vs distance from outfall and vs chlorine concentration as derived from the model. Observations by divers that seagrass occurs in the discharge plumes is informative, but it is concerning that there were marked changes in seagrass within the plumes during this study. It is a poor reflection on the EPA and Shell/Viva that the actual spatial extent of the impacts of their effluent over 60 years has never been characterised.

Statistical tests included in EES technical reports often conclude that there is no statistical difference between impacted and control or reference sites. Such a statistical outcome is far less powerful/reassuring than a test that shows a significant difference between impact and control sites, but where the difference measured is small. Where statistical tests show no statistical difference between an impact and control site this may be the result of a very insensitive test. To ensure that the test is sensitive enough, power analysis should be undertaken to show what magnitude of impact the test undertaken would have detected. This test has not been undertaken in this study and should have been, although the means of converting abundance classes to % cover, and the difficulty of analysing % values (arcsine transformations are usually recommended) means that the data quality barely justifies the use of power analysis.

Task 1c/d Proposed Baseline Surveys Prior to Dredging

Comparison with previous dredging works

The data presented suggests that the impacts on the marine environment should be manageable and short-lived, but this is based on estimates of minor dredging only. The report draws attention to the scale of the dredging, which involves removal of 490,000 m^3 from Corio Bay and dumping this in a declared spoil ground in the Geelong Arm. This dredging is considerably less than dredging in 1997-98 for the Channel Improvement Program, which deepened the entire length of Geelong shipping channel and removed 4.5 million m^3 of spoil, ~10X the proposed dredging, although only ~1/4 of this dredging was in Corio Bay. The volume of material dredged just from Corio Bay in 1997-98 was approximately 2-3X the amount proposed to be removed as part of this project and while the dredging increased turbidity there was no measurable effect on the seagrass, although it reduced epiphytes on seagrass in some areas (MSE 2006). The capacity to investigate impacts on seagrass has increased massively since 1997-98, but minimal use of technological advances has been used to investigate impacts on seagrass.

We note that the 1997-98 dredging project was subject to continuous real-time monitoring and lines drawn around seagrass habitats and when turbidity along these lines exceeded specified values the dredge was shifted to a new site. A similar approach is suggested in Environmental Management Framework (Chapter 9 of the EES, P9-26), but the Technical Report A (P3-60) suggests turbidity controls have been delegated to the Marine and Coastal Act Consent process, where there is limited expertise in controlling

dredging impacts. However, the trigger values for turbidity in the Environmental Management Framework (Chapter 9 of the EES, P9-26) are far less stringent that those used in past dredging in Corio Bay or in the Victorian Dredging Guidelines. Chapter 9 of the EES (P9-26) provides the following recommendation:

> *"Turbidity monitoring at edges of seagrass*
>
> Turbidity will be monitored during the dredging program continuously in north Corio Bay, with a minimum of three sites along the 3 m depth contour at the offshore boundary of the main seagrass beds proximate to dredging activity which may be affected by turbidity, including seagrass in the Ramsar site.
>
> The following limits are proposed as thresholds for action to restrict turbidity releases:
>
> 12-hour concentration above 15 NTU (trigger warning)
> 24-hour concentration above 12 NTU (action required)"

These guideline values are greatly in excess of those used in major dredging in Corio Bay in 1997-98, when the maximum allowable turbidity at the 5 fixed site meters over seagrass beds was set at 3 NTU (median) and 6.6 NTU (80th percentile) (ERC 1999). Subsequently the Victorian Dredging Guidelines recommended a guideline trigger value of 5 NTU (P 81). The reason for the very high turbidity trigger values in the EES needs to be justified.

Economic controls on dredging will also be more difficult in the proposed dredging than in 1997-98. Only one site will be dredged so there will be no alternative sites (c.f. 1997-98) if turbidity guideline values are exceeded. The only option will be to cease dredging.

Proposed Methodology for Baseline Monitoring for Dredging Impacts

The monitoring of dredging impacts is not consistent with the Victorian Dredging Guidelines (VDG) despite these being extensively quoted in the document (P 3-51). There are two areas where the VDG are not followed.

1. "A consent will only be issued if there is evidence of long-term planning…the proposed amount of dredging must be justified".

It is not clear that the amount of dredging specified in the EES is adequate. There is a strong likelihood that the Geelong Channel will need to be further deepened to accommodate the large LNG tankers required to feed the gasification plant.

An LNG carrier is typically about 300 meters long, 43 meters wide, and has a draft of around 12 meters. As the Geelong Channel can accommodate vessels with draft of up to 11.9 m with tide and 10.6 m without tide (Geelong Harbour Masters Directions 2020) and is only 120m wide accommodating 'typical' LNG carriers will be hazardous. Currently, oil tankers visiting the Port of Geelong enter the channel only partially laden and are a maximum of ~240 m long and have much less windage than LNG carriers. Cruise ships avoid the Port of Geelong because of the narrowness of the channel and their high windage. The largest and most economic LNG carriers will be unable to access the proposed terminal and there will be pressure to deepen and widen the Geelong Channel.

The description of the vessels to be used in the Geelong Channel looks to have been obscured by the different units used in the EES documentation: "The FSRU would receive up to 160 PJ per annum (approximately 45 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m^3". (P1-8).

If LNG PJ is converted to LNG volume then 160 PJ= 7,960,991 m^3. If divided by 45 vessels=177,000 m^3 per vessel. The vessel numbers are all based on a size of vessel than is likely unsafe travelling the Geelong Channel and a ship of this volume is unlikely to be able to navigate the Geelong channel fully loaded and partially loading a LNG carrier will increase its windage.

Prior to finalisation of the EES assurance should be sought from Ports Victoria that the channel meets the international PIANC standards for the size of vessels proposed. This would also provide evidence of long-term planning and ensure further studies of much larger marine impacts were not needed.

2. The VDG state that "monitoring should address specific objectives, either contributing *to ongoing improvement of dredging methods* or providing reassurance to the public through accurate information on measurable impacts". The proposed monitoring sites collect NTU and PAR at different sites (see Fig 3-22) and do not collect data on suspended sediment (SS). If these data are to be useful to better predict future dredging on plants then data that relates SS to NTU and NTU to PAR are required. This means all 3 variables need to be collected and at the **same** sites. The relationship between SS and NTU is important as sediment transport models use SS rather than NTU, and the effect of NTU on PAR is important to establish the effect on plants, including seagrass. The same sites should be chosen for measurements of seagrass length, NTU, PAR and SS measurements. On P8-127 modelling was used to predict SS sediment loads from dredging at 4 sites in Corio Bay. These 4 sites should be sampled for SS, NTU, PAR and seagrass length. This would enable the model results to be validated and improve predictions for future dredging, which is a stated aim of the dredging guidelines. Model predictions use old data in Figure 9-5 and these data can be improved by more thoughtful design of the baseline monitoring.

The VDG for state "Clearly, more accurate data is required on the light requirements of seagrass, natural background values of turbidity and the effect of sediment on light penetration and turbidity. Unfortunately, the last two relationships appear to vary significantly with the sediment type, so relationships must be established under a range of circumstances." The baseline monitoring should contribute to improving our understanding of the relationship between PAR, NTU and SS in a range of circumstances.

Infaunal surveys

The infaunal surveys are presumably to check that massive changes to infauna do not occur following dredging. The sites selected for monitoring should be altered so that they provide additional information on long term change in Corio Bay. Site 940 in Poore and Rainer (1979) should be included as this would enable an assessment of long-term change in Corio Bay by enabling comparison with data collected over three years between 1973-75. This is the last detailed assessment of infauna in Corio Bay and it would be valuable to see how much has changed over this period.

Recommendation 7

The calculations to estimate the light requirements of seagrass during dredging are complex and involve many uncertain relationships between SS and NTU, between NTU and PAR and indeed the light requirements of *Heterozostera nigricaulis* itself is uncertain. The Victorian Dredging Guidelines, which are extensively quoted in estimating the light attenuation due to dredging, are only selectively quoted when estimating the light requirements of *H. nigricaulis,* which were estimated to be between 5-13% of surface radiation in the guidelines but only the lower 5% figure is mentioned in the supplementary EES Technical Report A (P9-144).

The complex and uncertain measurements upon which the light attenuation in Corio Bay in seagrass habitats is estimated should have meant that during the proposed dredging that measurements to improve the relationships between SS, NTU and PAR were front of mind. That the proposed monitoring does not propose to measure SS and proposed to measure NTU and PAR at different sites, making comparisons between these variables problematic, indicates the baseline monitoring has given a strangely low priority to improving these predictions for future dredging.

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Qualifications of the author

Dr Parry completed a PhD in marine ecology at the University of Melbourne in 1977. He worked as a Senior tutor at Monash University for 4 years, and subsequently as a marine researcher at Victorian Institute for Marine Sciences, Coastal Planning Unit, Victorian Fisheries (25 years), EPA and has run his own consultancy (Marine Ecological Solutions P/L) for the past 12 years. During his two years at the EPA he was Manager of Dredging during the 1997-98 Geelong Channel Improvement Program and also wrote the Victorian Dredging Guidelines.

His career has spanned a wide range of ecological research including studies on animal energetics, long term monitoring (including a 20year trawl monitoring program in Port Phillip Bay and a 3-year seagrass monitoring program), and environmental impact studies (including a large experimental study of effects of scallop dredging on Port Phillip Bay, channel dredging impacts and exotic species impacts). Recently he has been engaged in studies of impacts of effluent from both the Western (sewage) Treatment Plant (Werribee) and the Eastern Treatment Plant (Gunnamatta) on the ecology of their very different receiving waters.

He is on the board of the Western Port Seagrass Partnership and in this capacity is the scientific advisor to their mangrove re-establishment program and a seagrass monitoring program which is scheduled to commence in November 2024.

He has published over 25 articles in refereed journals and more than 100 reports (https://www.researchgate.net/profile/Gregory-Parry).