PORT PHILLIP BAY CHANNEL DEEPENING PROJECT

ASSESSMENT

under

ENVIRONMENT EFFECTS ACT 1978

Minister for Planning

November 2007

ISBN 978-1-74208-165-6

Assessment: Port Phillip Bay Channel Deepening Project

FOREWORD

This Assessment of the environmental effects of the Port Phillip Bay Channel Deepening Project (CDP) completes the assessment process under the *Environment Effects Act 1978* for this proposal. It also constitutes the Assessment Report required as part of the accredited assessment process under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999.*

This Assessment process has entailed an unusual intensity of effort on the part of the Port of Melbourne Corporation (PoMC), as the proponent, as well as by agencies and submitters in response to the 2004 Environment Effects Statement (EES) and the 2007 Supplementary Environment Effects Statement (SEES), and the two inquiries appointed under the *Environment Effects Act*. I acknowledge these efforts and thank all those who have contributed to the process, including PoMC, submitters and most recently the members of the "SEES Inquiry", including Dr Allan Hawke as the Chair, and Ms Kathryn Mitchell and Dr Mike Lisle-Williams as Members.

I particularly wish to thank the members of the Independent Expert Group (Dr Graeme Mitchell as Chair, and Dr John Parslow, Prof. Mick Keough, Dr Kerry Black and Mr Nick Bray), for their advice during both the preparation of the SEES and the SEES Inquiry process.

These various efforts have assisted in ultimately achieving a comprehensive understanding of the potential environmental effects of the CDP, in terms of magnitude and likelihood, as well as appropriate management responses. Clarity about these effects has been necessary to assess the ability of the CDP to proceed on an environmentally acceptable basis, having regard to both the important environmental assets and values of the Bay and the priority of this critical infrastructure project for the future economic prosperity of Victoria.

This Assessment concludes, having regard to the findings of the Inquiry, that the CDP can proceed on an environmentally acceptable basis:

- The design of the CDP appropriately responds to relevant legislation, policy, strategies and guidelines
- The technology selected for the CDP represents best practice in the context of the project; and moreover,
- The residual effects of the CDP can be effectively managed or offset.

The Assessment also provides clear guidance to relevant decision-makers to assist them in putting appropriate measures in place.

Overall, it is my assessment that the CDP would provide a net benefit to the State of Victoria, having regard to long-term and short-term economic, environmental, social and equity considerations.

I am satisfied that through this assessment process for the CDP the public and stakeholders have had a full and fair opportunity to express their views and provide relevant input. I note that it is necessary to bring closure to such an Assessment of environmental effects, notwithstanding the fact that monitoring and Assessment of effects will continue for the life of the CDP.

In this context, I have identified the need for refinement of the proposed Environmental Management Plan (EMP) for implementation of the CDP to ensure effective protection of

Bay assets. It will be desirable for the Independent Expert Group to provide advice in relation to the EMP. Further, to assist the transparent and successful implementation of the CDP EMP, this Assessment supports the appointment of an independent monitor to advise PoMC and relevant Government Ministers.

Acknowledging that there may be some residual effects of the CDP, this Assessment recommends that PoMC be required to make offset payments to support environmental management and that consideration also be given to the provision of an environmental performance bond or similar performance mechanism.

Finally, there are two key outcomes of the CDP that can be anticipated: one is the achievement of infrastructure vital to Victoria's future prosperity; the other is the recovery of the Bay from temporary disturbances. There is also the opportunity through this project to achieve an enduring legacy in improved environmental management of the Bay, building on the knowledge generated to date through the SEES and further developed through implementation of the EMP and related offset programs.

I look forward to the implementation of the CDP with successful environmental outcomes.

JUSTIN MADDEN MLC
Minister for Planning

LIST OF ACRONYMS

ANZECC	Australian and New Zealand Environment and Conservation Council
BPEMGD	Best Practice Environmental Management Guidelines for Dredging
BWC	Blue Wedges Coalition
CAD	Contained Aquatic Disposal
CAMBA	China – Australia Migratory Birds Agreement
CDP	Channel Deepening Project
CDP EMP	Channel Deepening Project Environmental Management Plan
CEMP	Construction Environmental Management Plan
CHMP	Cultural Heritage Management Plan
CM Act	*Coastal Management Act 1995*
DMG	Dredged Material Ground
DPCD	Department of Planning and Community Development
DSE	Department of Sustainability and Environment
EE Act	*Environment Effects Act 1978*
EES	Environment Effects Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environment Protection Act 1970*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
FFG Act	*Flora and Fauna Guarantee Act 1988*
GSC	Great Ship Channel
Ha	Hectare
IAPH	International Association of Ports and Harbours
IEG	Independent Expert Group
IGAE	Inter-Governmental Agreement on the Environment
IMO	International Maritime Organisation
JAMBA	Japan-Australia Migratory Birds Agreement
km	kilometres
LIDAR	Light Detection and Ranging
m	metres
mg/l	Milligrams per litre
MNP	Marine National Park

MPAs	marine protected areas
MRLs	maximum residual levels
MSV	Marine Safety Victoria
NODG	National Ocean Disposal Guidelines for Dredged Material
NTU	nephelometric turbidity units
OBP	Orange-bellied Parrot
PAN	Pollution Abatement Notice
PAR	Photosynthetically available radiation
PCBs	Polychlorinated biphenyls
PDS	Project Delivery Standard
PIANC	Permanent International Association of Navigation Congresses
PoMC	Port of Melbourne Corporation
PPB	Port Phillip Bay
PPB EMP	Port Phillip Bay Environmental Management Plan
PPHMNP	Port Phillip Heads Marine National Park
PSAC	Project Stakeholder Advisory Committee
SEES	Supplementary Environment Effects Statement
SEPP	State Environment Protection Policy
SEPP (WoV)	State Environment Protection Policy (Waters of Victoria)
TDP	Trial Dredging Program
TEU	Twenty-foot Equivalent Unit
TSHD	Trailer suction hopper dredge
TSS	Total Suspended Solids
VCA	Victorian Channels Authority
VCS	Victorian Coastal Strategy
VNVM	Victoria's Native Vegetation Management Framework
VSQAP	Victorian Shellfish Quality Assurance Program

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1. INTRODUCTION

1.1 Purpose of this Document

The Port Phillip Bay Channel Deepening Project (CDP) requires assessment under the *Environment Effects Act 1978* (EE Act) prior to decisions being made as to whether the project can proceed, and, if so, under what conditions.

This document is the final Assessment of the environmental effects of the CDP, made under the EE Act. It provides the Minister for Planning's findings, evaluation and advice with respect to the environmental effects of the CDP.

It also constitutes the Assessment report that is provided to the Australian Government Minister for Environment and Water Resources, as a required part of the accredited assessment process under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Origin of the Channel Deepening Project

The priority of deepening the shipping channels to the Port of Melbourne in order to provide access for deeper draught vessels emerged from a series of studies undertaken between 1999 and 2001. The *Victorian Ports Strategic Study* prepared for the Department of Infrastructure in 2000 concluded that the depth of the shipping channels leading to the Port of Melbourne would become a limiting factor.

A 2001 study by the National Institute of Economic and Industry Research[1] examined three options to accommodate the forecast increase in Victoria's container trade: deepening the Port Phillip Bay ("the Bay") shipping channels; developing the Port of Hastings; and land-bridging container freight to Sydney and Adelaide. This analysis unequivocally supported channel deepening on economic grounds.

The development of Hastings would involve significantly higher infrastructure (land reclamation, terminal infrastructure, road and rail links, dredging and worker relocation costs) costs and higher ongoing transport costs. Similarly, land-bridging to other Australian ports was found to involve increased freight transportation costs. Deepening the existing channels, however, would enable the existing infrastructure and facilities at the Port of Melbourne to be fully utilised and therefore maximise the benefits of this investment.

Options for further development of the Port of Geelong and Port of Portland have been examined but eliminated on the grounds of: higher transport costs; land restrictions and the significant landside infrastructure investment required. Additionally, in the case of Geelong, dredging of the Entrance to the Bay and other approach channels would still be required.

As the body then responsible for shipping channels to the Port of Melbourne, the Victorian Channels Authority (VCA) undertook preliminary studies in 1999-2001 on the likely costs and benefits of the deepening the channel access to the Port of Melbourne to accommodate 14 metre (m) draught vessels, as well as a preliminary

[1] NIEIR (2001). *A preliminary report on the economic impact of deepening the Port Channel* Prepared for Victorian Channels Authority

assessment of environmental, technical and operational issues. Alternative channel routes to the Port were considered, and the economic and environmental advantages of deepening the South Channel and Port of Melbourne Channel, rather than the Western or Symonds Channel were confirmed. These latter options would require much greater dredging in order to accommodate 14m draught vessels, as well as being in closer proximity to sensitive habitat areas.

Having established that deepening the Bay's shipping channels as its priority project for port development, in December 2001 the Government announced its in-principle support for the CDP, subject to three provisos:

1) The satisfactory outcomes of Victorian environmental processes, including under the EE Act;

2) The satisfactory resolution of all technical issues associated with the channel deepening; and

3) The acceptance by the Government of a sound financing strategy for the Project.

In January 2002, the VCA sought the advice of the Minister for Planning whether an Environment Effects Statement (EES) for the CDP was required under the EE Act. After the Minister confirmed the need for an EES, the VCA began its preparation in late 2002[2].

On 1 July 2003 the Port of Melbourne Corporation (PoMC) was established under the *Port Services Act 1995,* following the merger of the VCA and the Melbourne Ports Corporation. The PoMC then assumed responsibility for progressing the CDP and associated EES[3].

In April 2004, the Victorian Government identified the CDP as a critical infrastructure priority in its Economic Statement *Victoria: Leading the Way*, which set out the Government's planned actions to strengthen Victoria's performance in exports, investment and business growth. This priority confirmed the Government's earlier announcement of in-principle support for the CDP in December 2001.

In November 2004, the Victorian Government released the *Victorian Ports Strategic Framework,* which articulates a comprehensive framework for the development of Victoria's commercial ports. It recognises the need for increased shipping channel capacity and developing supporting inter-modal systems for the Port of Melbourne, if it is to maintain its status as Australia's premier container port, in order to optimise the container handling capacities of the Swanston-Dynon container precinct in the medium-term, and, in the longer-term, supporting the development of the Westgate-Webb Dock precinct. Future container development at the Port of Hastings is to occur once capacity at the Port of Melbourne is reached[4].

[2] The Stage 2 preliminary feasibility studies led to the elimination of options to deepen the West and Symonds Channels on the western side of Port Phillip Bay.

[3] Refer to Chapter 2 of this Assessment for further detail on the EES process.

[4] The metropolitan strategy *Melbourne 2030*, released in 2002, identifies the critical importance of both the Ports of Melbourne and Hastings and protects them as special activity centres with transport links to other designated industrial areas and freight terminals.

1.3 Project Description

PoMC proposes to deepen sections of the main commercial channels used to access Port Phillip Bay (i.e. "the Bay") and the Port of Melbourne. The aim of the CDP is to modify shipping channels that lead to the Port of Melbourne, to accommodate vessels with a draught of 14 m at all tides with the exception of severe metocean conditions. In comparison, the maximum all-tide draught for vessels currently using the main commercial shipping channels in the Bay is 11.6 m, and the maximum tide-assisted draught is 12.1 m.

The CDP involves dredging works at locations in the north and south of the Bay on the existing channel alignment, as well as the management of dredged material. The CDP involves dredging an estimated total of 22.9 million m^3 of material, which will bulk up to approximately 26 million m^3 as a consequence of dredging. More specifically, it comprises the following works:

- Dredging of 5.38 million m^3 of clay and silt (including approximately 2.07 million m^3 of contaminated sediment) from the Williamstown and Yarra River Channels (including dredging of berth pockets at Appleton Dock, Swanson Dock, Holden Dock and Gellibrand Pier), and structural upgrades to the berths to stabilise them at the dredged depth;
- Dredging of 2.40 million m^3 of mainly clay (including approximately 43,000 m^3 of contaminated silt) from the Port Melbourne Channel between Fawkner Beacon and Williamstown Channel;
- Dredging of 14.59 million m^3 of mainly sand from South Channel between Popes Eye and the Hovell Pile turning area;
- Dredging of 0.55 million m^3 of weak calcarenite rock from the Great Ship Channel (GSC) in the Entrance to the Bay;
- Placing and managing the dredged material (mainly sand, silt, clay and rock) at a 588 hectare (ha) extension of the existing Port of Melbourne dredged material ground (DMG) and at a new southern DMG of approximately 768 ha. Part of the Port of Melbourne DMG extension is to be bunded and capped to contain the contaminated sediments that are to be dredged;
- River works to stabilise the banks of the Yarra River and expansion of the swing basin at Swanson Dock;
- New navigation aids, including marine structures for lights adjacent to the northern channels and South Channel, and new lights between Pt Lonsdale and Queenscliff, Port Melbourne and in the Port; and
- Protection or decommissioning of infrastructure assets (service pipelines or conduits for sewage, oil, gas, telecommunications and electricity) that traverse the shipping channels proposed for dredging.

To meet marine safety standards, the declared channel depths required for access by 14 m draught vessels vary between 14.6 m in the Yarra River between Appleton Dock and Swanson Dock West and 17 m at the Entrance.

It is proposed that the majority of the dredging will be within the existing shipping channels, as well as the following areas:

- the Entrance;
- the turning area at Hovell Pile in the South Channel East;
- the southern end of the Port Melbourne channel; and
- the Swanson Dock swing basin.

The proposed constructed channel depths[5], as opposed to navigation depths, as described in the SEES are:

- 16.9 m for Port Melbourne Channel and Williamstown Channels;
- 16.3 m for the Yarra River (except downstream of Beacon 46);
- 15.8 m for South Channel East and West (except near Hovell Pile);
- 17.4 m for South Channel East in vicinity of Hovell Pile;
- 17.9 m for the fairway between the Entrance and South Channel West; and
- 19.1 m for the GSC in the Entrance.

PoMC proposes to undertake this dredging of channels with a large trailer suction hopper dredge (TSHD), the *Queen of the Netherlands,* together with a medium-sized TSHD, the *Cornelis Zanen*. In addition, a horizontal profiling grab attached to either a backhoe or grab dredge would be used for dredging berth pockets.

The CDP does not include future maintenance dredging works required to maintain the proposed depths of the channels, as that will be subject to separate approvals in the future. However, the frequency and volumes of material likely to be dredged in maintenance dredging campaigns to the year 2035 has been required to be addressed with regard to options for management of dredged material.

Figure 1 shows the location of the proposed CDP works within the Bay.

1.4 Environmental Setting

The Bay is a shallow marine embayment of about 1,930 square kilometres ($km^{2)}$ in area and with a coastline length of 264 km. It has a maximum depth of 24 m and is mostly shallower than 8 m. At Port Philip Heads, the Bay is partly closed by a shallow, rocky submarine plateau, Rip Bank and Nepean Bank, which is cut by a deep canyon. The GSC crosses this area.

In the south of the Bay, a large wedge of essentially stable sediment forms the Great Sands, extending between the Bellarine Peninsula and Dromana Bay. The South Channel extends from the Great Ship Channel in the west to Hovell Pile in the east, along the alignment of a major tidal channel.

A deeper section of the Bay from Hovell Pile north to Fawkner Beacon is known as the Fairway and does not require dredging.

In the north of the Bay, sediments discharged from the Yarra River form a fan that requires dredging for access to the Port of Melbourne, via the Port Melbourne Channel which begins at Fawkner Beacon, and then Williamstown Channel. The Yarra River Channel passes up the Yarra River up to the Appleton and Swanson Docks.

[5] Note that the constructed channel depth is the actual depth of the channel following dredging in relation to Chart Datum (Lowest Astronomical Tide).

1.5 Structure of this Assessment

Chapter 2 outlines the EES process for the CDP, while Chapter 3 describes the main considerations bearing on the Assessment, including the evaluation objectives.

The main part of this Assessment is found in Chapter 4, which provides the Minister's Assessment of the environmental effects of the CDP within the framework of an integrated set of evaluation objectives, which reflect relevant legislation and policy. Appendix B provides a summary of applicable legislation and policy.

Chapter 5 provides a response to the key recommendations of the SEES Inquiry.

A consolidated Assessment of the implications of the CDP for controlled matters under the EPBC Act is found in Appendix A. This draws heavily on the more detailed examination of relevant matters in Chapter 4.

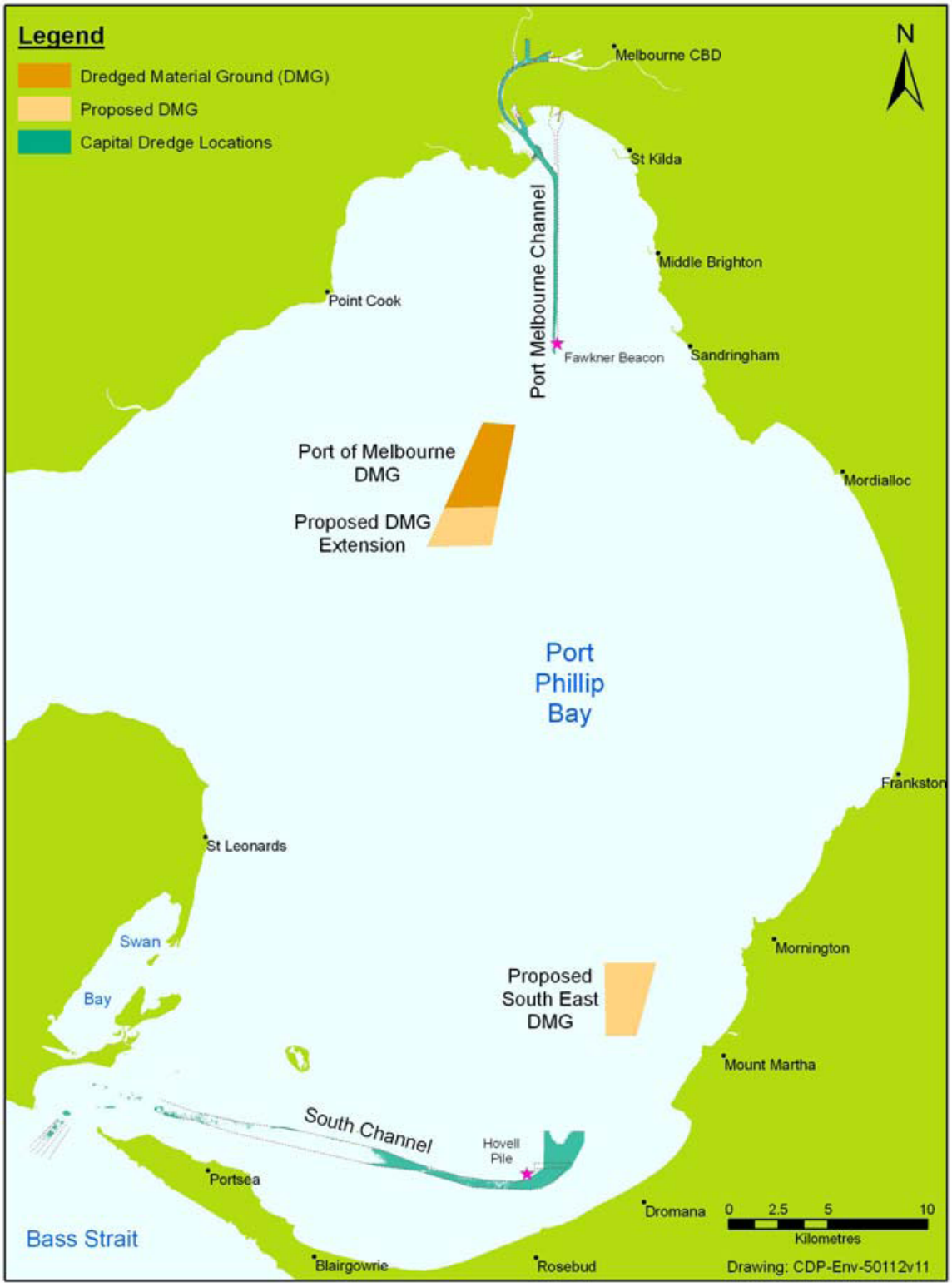

FIGURE 1 Location of the proposed CDP works within the Bay.

2. EES PROCESS

2.1 Requirement for an EES

On 30 January 2002 the Victorian Channels Authority (VCA), as the proponent for the CDP at that time, wrote to the Minister for Planning to ask if an EES was required under the EE Act for the Port Phillip Bay Channel Deepening Project.

On 9 May 2002, the Minister for Planning declared that the CDP works were public works subject to the EE Act, pursuant to s.3(1), and hence assessment through an EES process was required. The Minister's reasons were that:

- There are several significant environmental risks associated with the project, including:
  - Potential changes to hydrodynamics and coastal processes that could impact on marine ecosystems, islands and beaches;
  - Impacts on significant ecosystems and habitats from dredging and spoil disposal in the south of the Bay;
  - Mobilisation of sediments and contaminants into the water column in Hobsons Bay and the Port.
- The EES process would enable comprehensive environmental assessment of this proposal and a coordinated process to inform Victorian and Commonwealth decisions.

The provisions of the EE Act incorporate provisions: to initiate the EES process; to enable the Minister to invite public comment and to appoint an inquiry; to require the Minister to prepare an Assessment of the environmental effects of works; and to require decision-makers to consider the Assessment. The EE Act also enables the Minister to lay down guidelines for carrying out the Act. The Minister has broad discretion in administering the Act, within the framework of the guidelines[6].

In accordance with sections 4(1) and 6(2) of the EE Act, the CDP works cannot proceed until: (a) the proponent has prepared an EES; (b) the Minister has prepared an Assessment of the environmental effects of the works; and (c) the relevant Minister has considered this Assessment. The CDP is also subject to approvals under State and Commonwealth legislation, and the respective decision-makers will also consider this Assessment.

2.2 Accreditation under the EPBC Act

The delegate for the Australian Government Minister for the Environment and Heritage decided on 20 March 2002 that the project was deemed to be a controlled action under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 21 May 2002, the delegate agreed to accredit the EES process under s.87 of the EPBC Act. The controlling provisions of the EPBC Act for the CDP are the following matters of national environmental significance:

[6] The latest guidelines are the *Ministerial Guidelines for Assessing Environmental Effects under the Environment Effects Act 1978* (i.e. 'Ministerial Guidelines') issued in June 2006.

- Sections 16 and 17B (wetlands of international importance)
- Sections 18 and 18A (listed threatened species and communities)
- Sections 20 and 20A (listed migratory species)
- Sections 26 and 27A (protection of the environment of Commonwealth land).

The key features of the accredited EES process were that:

1) Assessment Guidelines be prepared for the EES to ensure it assesses all impacts that the action is likely to have on matters protected under the EPBC Act;
2) Draft Assessment Guidelines for the EES be published and public comments sought;
3) The EES be prepared in accordance with the final Assessment Guidelines and be released for public comment for at least 20 business days;
4) The proponent prepare a response to the public submissions relating to the relevant impacts of the action received during the public comment period;
5) If an inquiry is held into the environmental effects of the action, that the Inquiry prepare an Inquiry Report and submit this to the Minister for Planning;
6) The Minister for Planning prepare an Assessment Report on the proposed action and submit this to the Australian Government Minister.

2.3 The EES and "EES Inquiry"

Draft Assessment Guidelines for the EES were exhibited for 28 days for public comment in July 2002 and 30 submissions were received in response. Final EES Assessment Guidelines were provided to the proponent in October 2002.

After PoMC completed the EES, it was publicly exhibited for 30 business days between 5 July and 16 August 2004. A total of 906 submissions, including some received after 16 August, were considered by the EES Inquiry.

The Minister for Planning appointed an Inquiry pursuant to s.9(1) of the EE Act on 5 August 2004 to hold a public inquiry into the proposal, in respect of the EES and public submissions. The inquiry hearings extended over 45 days, commencing on 21 September and concluding on 17 December 2004. It submitted its report to the Minister on 11 February 2005.

The "EES Inquiry" concluded that there were fundamental issues in relation to the CDP proposal, as presented in the EES, including uncertainties regarding:

- the design of the shipping channel through The Heads;
- the ability of the proposed dredging equipment to both remove rock in the Heads and control the environmental effects of this dredging;
- the feasibility of completing an overall dredging campaign while complying with environmental performance requirements;
- the verification of the hydrodynamic and sediment transport modelling;
- the management of contaminated sediments to be dredged from the lower Yarra River;
- the risk assessment methodology used to set priorities for impact studies and

to guide management responses to environmental risks;

- the assessment of risks associated with shipping movements;
- the assessment of risks to ecological communities; and
- the effectiveness of an adaptive management approach to manage environmental effects by adjusting dredging operations in response to monitoring data.

The Inquiry made 10 primary recommendations on the forward process. In addition, it made 127 secondary recommendations, some of which addressed the need for trial dredging to confirm the feasibility of the proposed technology and program.

It further concluded that better characterisation of the project works, better calibrated modelling of physical processes, as well as a more soundly based risk assessment were needed before a final assessment of environmental effects could be completed, and the works could proceed to approval or commencement.

2.4 Response to EES Inquiry Report

After considering the EES Inquiry's report, the Minister for Planning concluded that it was premature to make an Assessment of the CDP under the EE Act. The Minister issued a statement on 31 March 2005 providing a provisional response to the report. The statement outlined an intended further assessment process, which was to involve a supplementary statement (or "Supplementary EES" (SEES)) to be prepared by the proponent in accordance with section 5 of the EE Act. Public comments on the Minister's statement were invited and 80 submissions received.

One aspect of the Minister's provisional response was to suggest that a small trial dredging program be conducted in the Heads, if practicable, together with a short program of dredging sediments in order to calibrate the turbidity and primary production models.

PoMC decided, after considering the Inquiry's Report and the Minister's response, that there was sufficient merit in the idea of testing the dredging technologies and environmental management protocols, that it sought approval to undertake a trial dredging program (TDP), in the GSC, South Channel and the Port Melbourne Channel. The Minister for Planning determined on 30 June 2005 that the trial dredging works did not require an EES. It was also determined under the EPBC Act that the TDP was not a controlled action.

2.5 The requirement for and preparation of the SEES

On 11 July 2005, the Minister for Planning confirmed that a SEES was required for the CDP and released a statement setting out aspects of the SEES process. The statement set out the objectives of the SEES, a structured approach which should be adopted by PoMC in preparing the SEES, as well as the steps in the SEES process leading to a final Assessment of the CDP. The SEES process was similar to the original EES process in key respects, including: preparation of new Assessment Guidelines, exhibition of the SEES for a six week public comment period, and

appointment of a new inquiry under the Act. Figure 2 shows the relationship between the EES and SEES processes[7].

In response to "primary" recommendations of the EES Inquiry, the Minister's Statement recommended that three advisory groups be appointed to support the SEES process:

1) An independent expert group (IEG) with expertise in shallow marine ecosystems, ecological modelling, shallow marine hydrodynamics and coastal processes, as well as dredging, to advise initially on the SEES Assessment Guidelines and then on the technical adequacy of the SEES studies as they progressed, including the exhibited SEES;

2) An inter-departmental CDP Taskforce, convened by the Department of Infrastructure, to coordinate advice and support to PoMC in advancing CDP investigations; and

3) A Project Stakeholder Advisory Committee (PSAC) to advise PoMC on its program of investigations and consultation.

The Minister also released draft Assessment Guidelines for the SEES for public comment on 11 July 2005. These draft guidelines identified matters for further assessment having regard to:

- The EES Assessment Guidelines, which were included as an appendix to the new guidelines; and
- The EES Inquiry's 127 "secondary" recommendations, having regard to the submissions on the Inquiry's recommendations and the Minister's response.

The Assessment Guidelines were finalised and issued by the Minister for Planning in October 2005 after the TDP was completed in August-September, to allow preliminary conclusions from the TDP to inform the guidelines.

[7] In relation to the accreditation of the EES process under the EPBC Act, the SEES extension of the EES process has operated within the framework of the accredited process. Indeed, the SEES process has both followed and met the requirements of the accredited EES process.

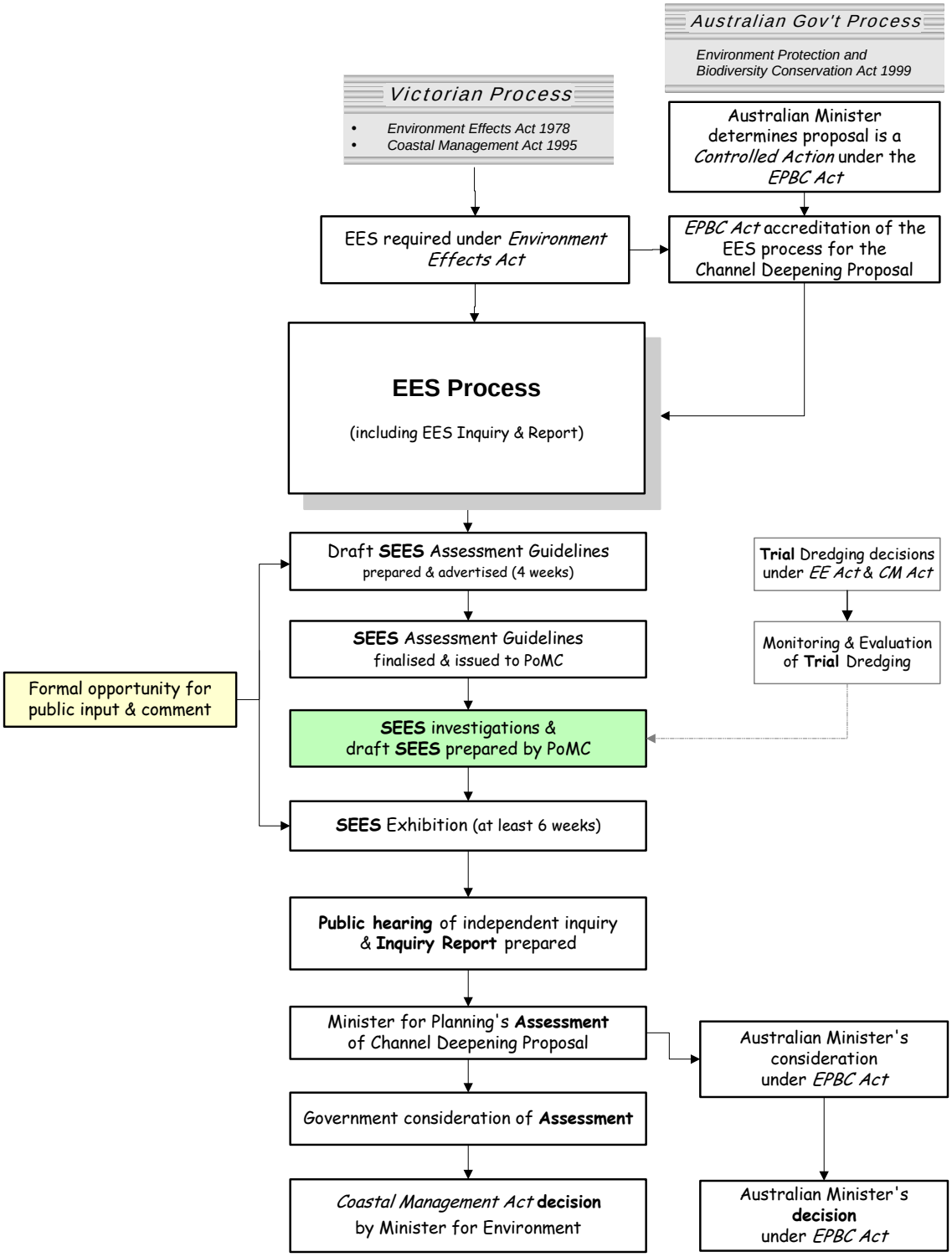

FIGURE 2: Relationship between the EES and SEES processes
(from SEES Assessment Guidelines)

The Assessment Guidelines anticipated that the SEES investigations would build upon the EES investigations and that the SEES documentation would, indeed, be supplementary to the EES. However, in the process of developing its study program, PoMC came to the early conclusion, first, that a fresh start was needed for most of its investigations, and secondly, that the SEES documentation should stand-alone from the EES. This approach was acceptable.

During the preparation of the SEES, PoMC consulted with stakeholders, including via the PSAC. It also sought advice from the IEG via the Secretary of the Department of Sustainability and Environment (DSE), to whom the IEG reported[8]. The members of the IEG (and their expertise) are:

- Dr Graham Mitchell – IEG Chair, one of the Victorian Government's Chief Scientists;
- Dr Kerry Black, ASR Consulting Pty Ltd – hydrodynamics and coastal processes;
- Mr Nick Bray, Dredging Research Ltd. UK – dredging;
- Professor Michael Keough, Melbourne University – marine ecologist; and
- Dr John Parslow, CSIRO Atmospheric and Marine Research Division – ecological modelling.

The IEG's role was to advise the DSE Secretary. In doing so, it reviewed a range of preliminary and final documents prepared by PoMC and its consultants. It was also briefed by PoMC and its specialists on several occasions and also observed several technical workshops convened by PoMC.

After the SEES was completed by PoMC, it was exhibited for public comment between 22 March and 7 May 2007. This exhibition resulted in 213 individual submissions and a further 578 pro forma responses.

During the exhibition of the SEES, the IEG was asked to review the technical adequacy of the SEES with respect to the IEG's areas of expertise. The IEG's review of the SEES was published on the DSE website.

2.6 The 'SEES' Inquiry

An Inquiry was appointed under section 9(1) of the EE Act to consider the environmental effects of the CDP. The Inquiry comprised Dr Allan Hawke (Chair), Ms Kathryn Mitchell (Member) and Dr Mike Lisle-Williams (Member). Terms of Reference for the Inquiry were issued by the Minister for Planning on 4 April 2007. The task of the Inquiry was to provide a written report to the Minister for Planning setting out information and advice in relation to the following matters only:

1) Whether the proposed design for the CDP (including for the channels, dredged material grounds and navigational aids) is safe, suitable and technically feasible to implement using the proposed dredging technologies.

2) The likely environmental effects of the proposed CDP dredging activities and the subsequent operation of the deepened shipping channels.

[8] Note that the Department of Planning and Community Development (DPCD), rather than DSE, now administers the EE Act and advises the Minister for Planning.

3) Whether the proposed project design and approach to project implementation (including technologies and work methods), with or without modification, are suitable to ensure the achievement of acceptable environmental outcomes, having regard to relevant legislation and policy, as well as costs, benefits and operational efficiency in delivering the project.

4) The considerations relevant to the Assessment that will inform decisions whether or not to approve the CDP under the *Coastal Management Act 1995* and under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

The Inquiry held a Directions Hearing on 29 May 2007, and then held a public hearing over 18 days (from 18 June to 31 July 2007) to hear submissions and supporting material in relation to the CDP. In addition to PoMC, a total of 57 parties were represented and/or heard.

Following an inspection of the bathymetry of the Great Ship Channel area dredged as part of the TDP, PoMC advised the SEES Inquiry in June 2007 that part of the area, as well as some adjacent areas, had deepened since the TDP. As a result, PoMC had commissioned further studies to assess the erosion processes involved as well as the environmental implications. On 30 July 2007, PoMC tabled the Rock Scour Supplementary Assessment reports. The Inquiry then invited submitters to make further submissions on these reports, as well as PoMC's CDP Environmental Management Plan (Revision C) tabled at the Inquiry on 31 July 2007, within 14 days.

The Inquiry submitted its report to me on 1 October 2007, to inform my Assessment of the environmental effects of the CDP.

2.7 General considerations under the EE Act

The assessment process under the EE Act does not lead to a "decision" under that Act whether or not to approve the CDP[9]. However, as indicated in section 2.1, this Assessment will inform the decision whether the CDP works should proceed. It will also inform the decisions whether to grant authorisations for the CDP works under Victorian law, as well as under Commonwealth law. Other considerations, especially financial aspects, will also be relevant to the Victorian Government's decision whether to proceed with the CDP.

The EE Act does not itself prescribe the matters that should be assessed or the form of the Minister's Assessment. However, the 2006 Ministerial Guidelines (p.27) provide useful guidance on what an Assessment is to provide, i.e.:

- findings on the potential magnitude, likelihood and significance of adverse and beneficial environmental effects of the project;
- conclusions regarding any modifications to a project or any environmental management measures that are needed to address likely adverse effects or environmental risks;
- evaluation of the overall significance of likely adverse effects and environmental risks of the project, relative to likely benefits of the project, within the context of applicable legislation, policy, strategies and guidelines.

[9] References in the EES Panel Report to the "decision" of the Minister for Planning with respect to the project are not strictly correct in this regard.

The Ministerial Guidelines further state that the preparation of an Assessment will involve consideration of:

- the EES and any supplementary statement;
- public submissions, the proponent's response to submissions, and supporting information from the proponent or submitters;
- any inquiry report;
- other information provided by the proponent at the request of an inquiry, the Department or the Minister;
- the objectives and principles of ecologically sustainable development, as well as applicable legislation, policy, strategies and guidelines.

Having regard to the foregoing, this Assessment will be informed by the SEES itself, public submissions on the SEES and the SEES Inquiry report, as well as by the EES, public submissions on the EES and the EES Inquiry report. Yet it is not constrained to consider only the outputs of the previous phases of the CDP assessment process.

An Assessment may conclude, in terms of the outcome of its evaluation, that:

- a project (with or without limited modifications) would have an acceptable level of environmental effects, having regard to overall project outcomes; or
- a project would have an unacceptable level of environmental effects; or
- a project would need major modifications and/or further investigations in order to establish that an acceptable level of environmental outcomes would be achieved.

If the Assessment concludes that a project would have an acceptable level of environmental effects, it may provide advice on project implementation and environmental management measures, including:

- opportunities for incorporating necessary measures in conditions of particular statutory approvals or in binding agreements;
- coordinating different aspects of the environmental management regime to ensure an integrated approach for achieving acceptable environmental outcomes;
- recommended approaches to environmental monitoring and management, including further public involvement.

This Assessment will conform to the above guidance in the Ministerial Guidelines.

2.8 Next steps

The final step in the assessment process under the EE Act after the preparation of an Assessment is its consideration by relevant decision-makers.

The first decision to be made once the Minister for Planning's Assessment is provided will be the decision by the Minister for Roads and Ports whether the CDP should proceed. If the Minister determines that it should, having regard to the Assessment, and also other factors including the financing of the project, several statutory decisions will be needed to authorise the works, with the primary Victorian decision being by the Minister for Environment and Climate Change under the *Coastal Management Act 1995.* Although s.8 of the EE Act has not been formally

triggered, these decisions will also be informed by the Assessment. The Australian Government's Minister for the Environment and Water Resources will also consider the Assessment before deciding whether to approve the works under the EPBC Act.

3. SPECIFIC CONSIDERATIONS FOR ASSESSMENT

3.1 Introduction

The general considerations relevant to an Assessment under the EE Act were set out in section 2.7 above. More specific considerations relevant to this Assessment need to be established in relation to the potential environmental effects[10] of the CDP. The potential environmental effects will reflect:

- environmental systems and assets of the Bay, and uses and values of these;
- hazards presented by CDP works and activities;
- potential changes to Bay systems and assets; and
- likely consequences for Bay uses and values;

The significance of these effects will need to be considered, having regard to applicable legislation, policy, strategies, guidelines and principles.

This chapter first outlines briefly and in general terms the environmental systems and assets of the Bay, as well as associated uses and values, and then the effects on these that may result from CDP hazards. A brief statement of key issues arising from the CDP, in relation to potential effects, follows. Finally, the chapter sets out 10 evaluation objectives which provide the framework for the integrated assessment of the environmental effects in chapter 4.

3.2 Bay systems and potential CDP hazards

The Bay is a shallow coastal embayment, with a narrow entrance subject to strong tidal influences and a lower-energy inner area that is more affected by wind-driven currents. The flood tide delta within the Bay is known as the Great Sands, and is composed of a partly consolidated substratum of sands and a thin veneer of mobile sands. While there are sandy beaches around much of the fringe of the Bay, bottom sediments in the inner Bay are mostly silty tending to clayey in the centre. There is an input of sand from Bass Strait, as well as from coastal erosion around the Bay. Much of the input of silt is derived from the Yarra River catchment and other inflowing streams; some of this input is chemically contaminated.

The 'aperture' or cross-section of the Bay Entrance determines the rate of tidal inflow and outflow, and hence the extent of tidal influence on sea levels and currents, as well as physico-chemical interchange between the Bay and Bass Strait. An increase in this aperture due to dredging, or erosion, will directly affect the tidal environment of

[10] For the purposes of the environment assessment process under the EE Act, the 2006 Ministerial Guidelines state that the environment "includes the physical, biological, heritage, cultural, social, health, safety and economic aspects of human surroundings, including the wider ecological and physical systems within which humans live".

the Bay and associated currents and sediment movement. Changes in the bathymetry of inner parts of the Bay due to CDP dredging or spoil disposal will affect local current patterns and power, and hence may affect sediment movement and beach profiles to some degree.

A key aspect of the Bay's ecology is the breakdown of plant and animal detritus on the surface of and within the seafloor sediments. This is important to maintain a balance between the input of nutrients (especially nitrogen) from river and drainage inflows, and the loss of nutrients from the system, by either fixing in inorganic forms in the sediments or release to the atmosphere. Nutrients are taken up in biomass, initially in the form of plankton, microphytobenthos and algae, and an excess of nutrients can lead to persistent algal blooms unless an efficient removal process can continue to operate through the biota-detritus-sediment-water-atmosphere interfaces. The CDP could potentially lead to either a temporary excess of nutrients through their release from dredged sediments or a reduction in the 'denitrification' efficiency of bottom sediments.

A range of human activities within the Bay and adjoining catchments over the past one hundred and seventy years have affected conditions within the Bay, such that habitats can mostly be characterised as semi-natural[11]. Despite the extensive input of suspended sediment, nutrients and contaminants from rivers, creeks and drains, the Bay waters, sediments and biota remain relatively unpolluted, with the exception of areas such as Corio Bay, Hobsons Bay and the mouths of waterways. More than three million people now live and work in the catchments of the Bay, and many engage in recreation activities such as swimming, diving, sailing and boating, as well as both recreational and commercial fishing, in the Bay.

There is a highly diverse benthic and pelagic flora and fauna in the Bay. The Bay supports significant fish stocks that are the target of commercial and/or recreational fishers, including well-known fish species such as King George whiting and snapper, as well as a range of other species of ecological importance (e.g. anchovy).

Much of the Bay's floor has a sparse biota of indigenous species, while extensive areas have been colonised by pest species. However, extensive areas of natural or semi-natural ecological communities remain both within and fringing the Bay. Most notably, there are dense seagrass beds in Swan Bay and the Geelong Arm, as well as smaller areas of seagrass on parts of the Great Sands. These seagrass areas provide important habitat, including 'nursery' habitat, for a range of fish species. In areas like Swan Bay and Mud Islands, and along the Western Port Phillip coastline (which are listed under the Ramsar Convention), the inter-tidal, sub-tidal and terrestrial vegetation supports diverse fauna, including large numbers of migratory birds.

Other important habitat areas include the intermediate kelp-dominated reefs and deep reef invertebrate communities in the Bay Entrance, which have high levels of biodiversity. At the other end of the Bay, the lower Yarra River estuary provides habitat for species migrating between freshwater and marine environments. Nutrient rich outflows from the Yarra River into Hobsons Bay, as well as the Western Treatment Plant, support a high level of plankton productivity, which in turn support a food chain including large numbers of anchovy and also higher-order feeders such as Little Penguins and other seabirds.

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[11] This is reflected in the level of protection for ecosystems within the "inner segment" of Bay waters provided under *State environment protection policy (Waters of Victoria) Schedule F6 - Waters of Port Philip Bay*, (i.e. SEPP (WoV) Schedule F6).

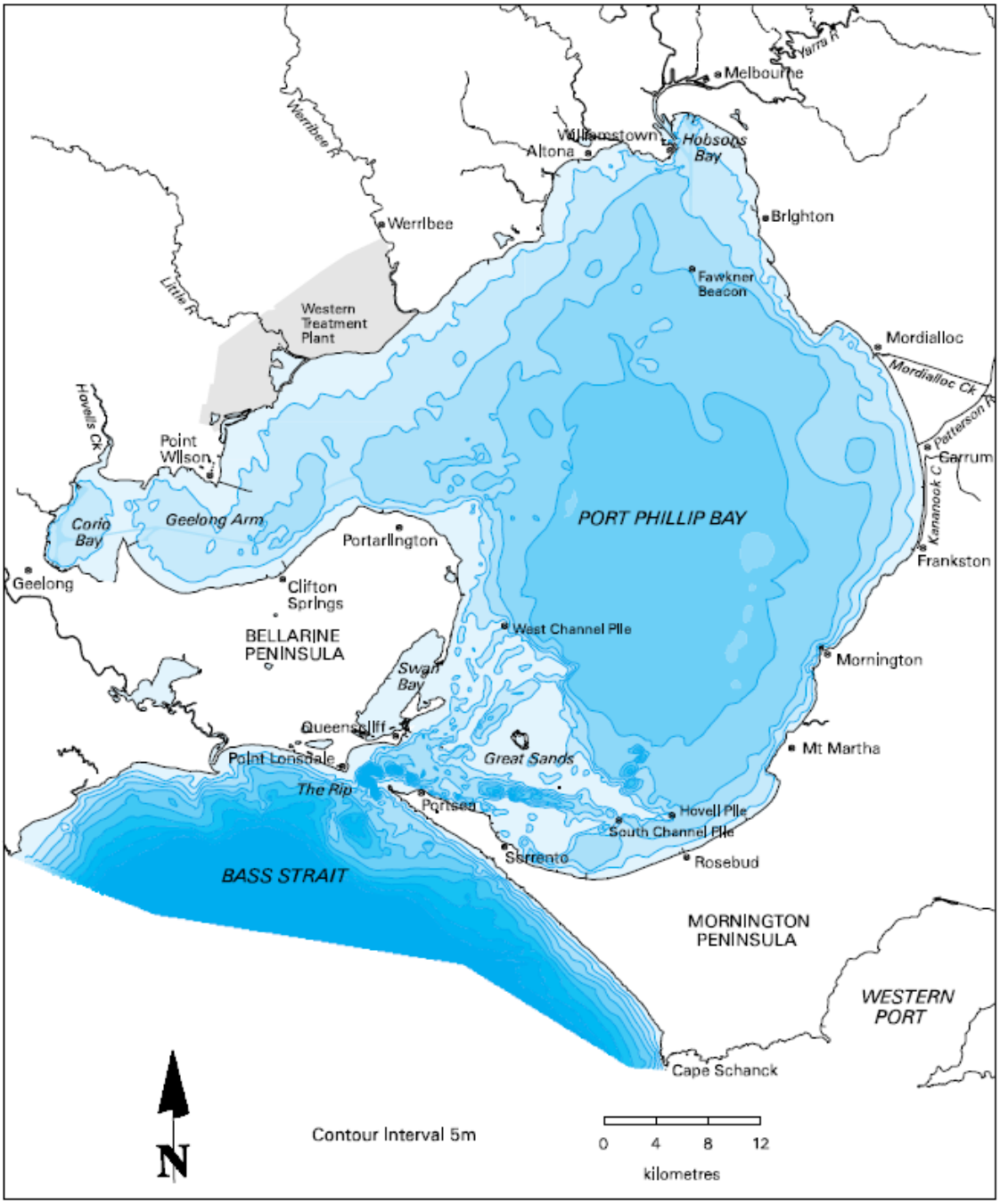

FIGURE 3: Setting and bathymetry of the Bay[12]

[12] Commonwealth Scientific & Industrial Research Organisation (CSIRO) (1996) *Port Phillip Bay Environmental Study*, CSIRO Publishing, Dickson, ACT

A key hazard of the CDP dredging will be the generation of a turbid plume, which may affect plant productivity due to reduced light availability, as well as some interference with plant and animal physiology, and also animal feeding behaviour. As a result, there is likely to be some reduction in both plant and animal productivity, and hence potentially the catch of some fish species. The turbid plume and the associated activity of the dredge could also affect environmental amenity for recreational users of local areas of the Bay where dredging is occurring, in relation to water quality, noise and the visual presence of the dredge. Further, the plume represents a potential hazard to some industrial operations dependent on water intake from the Yarra River or Bay. As a consequence of these latter effects or risks, potential economic and social consequences for Bay and Yarra River users other than PoMC need to be considered.

The CDP dredging of potentially contaminated material from the lower Yarra River and Hobsons Bay presents a potential hazard in terms of both the character of any plume from this material and the release of contaminants at the dredged material ground. There is some potential for both biota and humans to be affected. The control of these hazards, and other CDP hazards, will substantially depend on the equipment used and practices adopted.

A specific issue arising from dredging in the Yarra River is the potential for interference with third-party infrastructure crossing the river, including telecommunications, a gas pipeline and a trunk sewer.

Finally, the CDP presents potential safety hazards in terms of, first, the conduct of the dredging itself affecting normal shipping and boating movements, and, second, the future movements of larger ships in the enlarged shipping channels.

3.3 Potential CDP Effects

In light of the CDP hazards affecting Bay systems and assets, the potential environmental effects that need to be considered in this Assessment include:

- Potential for long-term changes to patterns of water and sediment movement into, out of and within the Bay;
- Potential for adverse impacts on the Bay's ecosystems, especially as a result of turbid plumes and sedimentation from suspended sediment generated by dredging;
- Potential for increased risks to human health as a result of toxic algal blooms, and mobilisation of contaminated sediments;
- Potential for reduction in recreational amenity, due to turbid plumes and the dredging activity itself,
- Potential for economic impacts on other users of the Bay and lower Yarra River waters, as a result of diminished water quality, displacement of activities or increased risks to infrastructure;
- Potential for impacts on Aboriginal and post-settlement cultural heritage, either submerged within or fringing the Bay;
- Potential changes in the risks to the Bay's environment and users from larger ships and changes to shipping movement patterns (e.g. due to increased wake, changed risk of collisions and spills).

In addition, the direct economic effects of the project itself are a relevant effect.

3.4 Evaluation objectives

In order to assist an integrated assessment of the potential effects of the CDP, the SEES Assessment Guidelines put forward a set of eight 'draft evaluation objectives' reflecting the key potential effects (pp.9-10). These objectives, which identified desired outcomes, took account of "relevant legislation and statutory policy, as well as key environmental issues identified through the EES process to date". They were intended, together with more specific evaluation ('performance') criteria to be developed by the proponent (reflecting pertinent scientific conclusions, relevant provisions of legislation and policy[13]), to help focus the SEES investigations. The criteria were also anticipated to have a useful role in evaluating the CDP project design, technology and environmental management measures.

The concluding chapter of the SEES addressed the eight draft evaluation objectives, together with a ninth identified by PoMC. In addition, the closing submission for PoMC at the SEES Inquiry addressed the nine evaluation objectives, in the context of specific evaluation criteria developed by PoMC and its advisers.

The Assessment Guidelines also anticipated that the SEES Inquiry, as well as this Assessment, might evaluate the CDP in relation to refined or equivalent evaluation objectives. However, it was a matter for the Inquiry's discretion whether to use such objectives to structure its findings.

After review of the impact and risk assessment in the SEES, as well as issues raised in submissions responding to the SEES, a set of ten evaluation objectives has been formulated to underpin an integrated assessment of the CDP. These objectives articulate the desirable outcomes, in the context of the applicable legislation and policy, including the principles of ESD. Appendix B provides a summary of legislation, policy, strategies, guidelines and principles that are applicable to the CDP in the context of either required approvals or pertinent policy guidance.

The ten objectives closely correspond to the draft objectives in the Assessment Guidelines, though some have been simplified for clarity and one draft objective has been split into two. A tenth objective which addresses the overall implications of the CDP for ecologically sustainable development has been added, to integrate the various considerations. Table 1 lists these objectives and provides a comment on their key 'policy' sources.

[13] The Assessment Guidelines further advised that the criteria should have regard to:

- Relevant provisions of State and Australian legislation, policies and strategies (e.g. SEPP (WoV) Schedule F6) especially with respect to the protection of beneficial uses;
- The application of best practice, as determined through advice from EPA;
- Feasibility of measurement and appraisal of both anticipated and actual environmental outcomes; and
- Application of principles of environment protection under the EP Act, including the waste hierarchy, the precautionary principle and the principle that measures should be cost-effective and in proportion to the significance of the environmental problems being addressed.

TABLE 1 Evaluation objectives and key policy sources.

EVALUATION OBJECTIVE	KEY POLICY SOURCES
1) To optimise the economic efficiency of deepening shipping channels to the Port of Melbourne, in terms of the economic benefits of improved opportunities for trade relative to the economic costs associated with the CDP.	• Port Services Act • Planning and Environment Act • Victorian Ports Strategic Framework • Victoria: Leading the Way • National ESD Strategy
2) To avoid changes to water levels, currents or sediment movement patterns, due to the CDP, that would be likely to give rise to unacceptable adverse effects.	• Coastal Management Act • Planning and Environment Act • Port Services Act • Victorian Coastal Strategy
3) To avoid adverse effects on ecological processes or either species or areas of conservation significance in the Bay and adjoining areas (including the Yarra River estuary) due to the CDP, such that recovery of ecological functions and biodiversity in the medium- to long-term would be uncertain.	• Coastal Management Act • Victorian Coastal Strategy • Planning and Environment Act • Flora and Fauna Guarantee Act • Victoria's Biodiversity • Fisheries Act • EPBC Act (Comm.)
4) To avoid adverse effects on human health as a result of diminished water quality or bioaccumulation of toxicants.	• Environment Protection Act • SEPP (Waters of Victoria) • Planning and Environment Act
5) To minimise adverse effects on public amenity and recreational uses, as a result of diminished water quality and other direct effects associated with the CDP.	• Environment Protection Act • SEPP (Waters of Victoria) • Coastal Management Act • Planning and Environment Act
6) To minimise adverse effects on Bay-related commercial activities, as well as industrial users of Bay and lower Yarra River waters, as a result of diminished water quality and other direct effects associated with the CDP.	• Environment Protection Act • SEPP (Waters of Victoria) • Coastal Management Act • Planning and Environment Act
7) To avoid unacceptable adverse effects of the CDP on identified sites of Aboriginal or non-Aboriginal cultural heritage.	• Aboriginal Heritage Act • Heritage Act • Coastal Management Act • Planning and Environment Act

TABLE 1: Evaluation objectives and key policy sources – continued.

8) To minimise shipping-related risks associated with the design or implementation of the CDP.	• Marine Act • PIANC/IAPH standards
9) To provide a transparent framework, with clear accountability, for managing environmental risks associated with the project to achieve acceptable outcomes.	• Environment Protection Act • Port Services Act • Coastal Management Act
10) Overall, to achieve outcomes from the CDP consistent with ecologically sustainable development.	• Environment Protection Act • Port Services Act • Coastal Management Act • Victorian Coastal Strategy • Planning and Environment Act • Flora and Fauna Guarantee Act • Victoria's Biodiversity • Fisheries Act • EPBC Act (Comm.)

4. INTEGRATED ASSESSMENT

This chapter provides an integrated assessment of the CDP within the framework of the ten evaluation objectives.

4.1 Economic Effects

Objective: To optimise the economic efficiency of deepening shipping channels to the Port of Melbourne, in terms of the economic benefits of improved opportunities for trade relative to the economic costs associated with the CDP.

As noted in section 1.2, the Victorian Government announced its in-principle support for the CDP in 2001, subject to: satisfactory outcomes of Victorian environmental assessment and approval processes, resolution of all technical issues, and a sound financing strategy. The CDP is explicitly identified as a key infrastructure priority in a number of policies and strategies including *Victoria: Leading the Way* and the *Victorian Ports Strategic Framework,* as well as in *Melbourne 2030* and *Linking Melbourne: Metropolitan Transport Plan*.

These policies and strategies recognise the economic importance of deepening the commercial shipping channels to the Port of Melbourne, in order to sustain and enhance trade through the port as the draught of the larger ships using Australian trade routes exceeds the current navigable depths through the Port Phillip Heads. The economic benefits encompass both direct reductions in costs to shipping companies through greater efficiencies, and flow-on benefits to importers and exporters and dependent businesses. At the same time, the deepening of the channels would entail a range of costs, including the capital cost of the works and external costs to both other business and to the environment. Potentially affected businesses include commercial users of the Bay (fishing and aquaculture, eco-tourism, industry, etc), and other bay-related businesses (equipment suppliers, accommodation, etc).

In the context of the strategic and economic importance of the Port of Melbourne, and the benefits and costs, there is a need to consider whether the CDP as proposed is the optimal project. Relevant aspects in this regard are:

1) The channel requirements for continued viability of the Port of Melbourne as a leading international container port for the period to 2035;
2) The need to minimise the costs of dredging while achieving effective access for deeper draught vessels;
3) The need to minimise adverse effects on other activities through the scheduling and management of the CDP dredging program; and
4) To achieve a positive net economic benefit relative to the direct and indirect costs of constructing and maintaining the deepened channels.

Channel requirements. The Port of Melbourne's position on major trade routes means that it functions as a key international trade centre for Australia. About 3,400 commercial vessels visited the port in 2004/2005. It is the busiest container port in Australia, handling about 38 percent of the nation's container trade. It is also a key driver for the Victorian economy and is vital for Melbourne and regional business.

Economic modelling studies[14] commissioned by the Victorian Government found that the Port of Melbourne generated an economic output of about $2.5 billion in 2004/2005 and supported about 13,750 full time jobs. It added value to the Victorian and Australian economies of $1.14 billion.

The growth in container trade around the world is currently about 9.6 percent a year. Container trade through the Port of Melbourne is estimated to increase from 1.5 million twenty-foot equivalent units (TEU) in 2005 to 7 million TEU in 2035. In order to accommodate this growth in trade, shipping companies are increasing the size of vessels in their container fleets and this has consequences for international ports. The SEES[15] includes examples of major ports which have deepened, or are about to deepen, their shipping channels to maintain their strategic positions in world trade.

Access to the Port of Melbourne is currently restricted to container vessels with a maximum draught of 11.6 m in all tidal conditions, or 12.1 m during high tides. As a consequence, there are increasing costs to shipping companies using the Port arising from a combination of: (a) the use of vessels smaller than the most efficient size; (b) ships not being fully laden; and (c) delays in waiting for high tide to enter the Bay. In its closing submission to the SEES Inquiry, PoMC noted that during the June 2007 quarter, 314 out of 690 vessels (i.e. 44.5 percent) visiting the Port had a maximum summer draught exceeding the existing all tides depth of 11.6 m. It also observed that as the world's shipping container fleet increases in size, an increase in trade through the Port will depend on channel access for larger ships.

At current depths, the channels to the Port of Melbourne will accommodate a decreasing proportion of ships in the world container fleet in light of international shipping trends, with container ships exceeding 9200 TEU now in operation on major international shipping routes and vessels over 12000 TEU currently being constructed. The size of container vessels coming into Australian ports has almost doubled since 1980, and whilst this rate of increase is unlikely to be sustained, the PoMC expects that the largest vessels deployed on Australian trade routes will be in the range of 6500-7000 TEU by 2035. Such ships would have draughts of up to 14 m.

The proposal to deepen the shipping channels to enable access by ships with 14m draught at all states of tide was based on analysis leading to the objective of enabling 85 percent[16] of the future fleet being able to access the Port of Melbourne up to 2035 fully loaded, and the remainder being able to access it with tidal assistance.

The selection of the 14m draught depth objective is based upon three criteria, namely vessel safety, port accessibility and commercial viability, where:

- Vessel safety is defined as having sufficient depth to prevent vessels loaded to 14 m draught touching the bottom of the channel;
- Accessibility is the minimisation of transit failure, measured as the probability of a particular vessel travelling in a particular set of wave and tide conditions without touching the bottom being at or below the prescribed level; and
- Commercial viability if secured through flexible and efficient operating

[14] Price Waterhouse Coopers 2006 *The Economic Impact of the Port of Melbourne* and Price Waterhouse Coopers 2007 *Economic contribution of the Port of Melbourne Supplemental Study,* reports prepared for the Department of Treasury and Finance.

[15] Meyrick and Associates 2007 *Channel Deepening: Strategic Economic Context* prepared for Port of Melbourne Corporation.

[16] Meyrick and Associates 2007 *Channel Deepening: Strategic Economic Context* prepared for Port of Melbourne Corporation.

arrangements which do not unduly constrain port users, particularly in comparison to alternative port destinations.

Other Australian ports have already implemented channel deepening projects in response to changing ship sizes. Port of Brisbane (14 m draught) and Port of Adelaide (14.2 m) have completed dredging projects, whilst Sydney supports ships of up to 15.2 m draught.

The SEES provides a detailed analysis of the increasing costs of trade through the Port of Melbourne in the absence of the CDP. In 2035 the additional costs borne by Victorian importers and exporters would rise to about $450 million per annum. It has also demonstrated that the consequence of not proceeding with the CDP is likely to be a reduction in the international competitiveness of the Victorian and Australian economies.

Minimising the costs of dredging. Minimising the volume of dredging while achieving a safe, navigable channel to the Port of Melbourne is critical to the success of the CDP, in both economic and environmental terms. A lower volume of dredging would reduce the direct capital costs of the CDP. A decrease in the duration and intensity of dredging would also lessen the economic impacts on business operations in the Bay, such as commercial fishing, diving and tourism. Further potential economic benefits may include lower environmental management costs for the CDP and shorter recovery times for commercial marine species.

The SEES provides a detailed description of the design process for the CDP that sets out to achieve an optimum balance between environmental and economic considerations. In selecting the final design a range of options for the alignment, extent and dimensions of shipping channels in the Bay were considered. Importantly the design was also guided by the relevant international guidelines[17].

The SEES argues that deepening to declared depths of up to 17 m is needed to provide access for 14 m draught vessels in all states of tide, whilst minimising the volume of material to be dredged and negating the need to undertake further deepening at a later stage.

The SEES also provides an multi-criteria analysis of the proposed dredging technology to be used for the CDP. The IEG concluded that the selected dredging technologies are ‘best practice’ in terms of environmental and practical outcomes.

The Inquiry concludes that the proposed changes to the shipping channel alignment and dimensions in the Bay conforms to the relevant international guidelines and minimises dredge volumes in achieving the CDP objectives.

Effects on other activities. The dredging strategy outlined in the SEES aims to schedule dredging operations in CDP project areas in a manner that would minimise the adverse effects on other activities around the Bay. These effects will be considered in more detail in section 4.4, but some reference to their economic implications is pertinent here.

The SEES proposed that there would be no dredging in the south of the Bay between 18 December and 31 January in order to reduce potential impacts on recreation and

[17] The design was guided by *Approach Channels – A Guide for Design* published by the Permanent International Association of Navigation Congresses and the International Association of Ports and Harbours, the leading world authority on the planning, design, operation and management of ports and waterways.

tourism activities in the peak holiday season. However, an economic impact on businesses related to recreation and tourism is expected to arise largely due to the fact that some key dive, fishing, and ecotourism/charter sites are located within, or in close proximity to, the dredging works in the Entrance and south of the Bay. The economic cost of the CDP to recreational diving businesses has been estimated at $4.1 million.

Commercial fishing is also likely to be affected by a reduced catch during the dredging works for the CDP and for the following three years as the commercial fish species recover to the normal population levels. The estimated cost in lost commercial fish harvesting is $1.5 million.

Other quantifiable costs associated with the CDP are vessel delays while dredging operations are under way.

The aggregate costs of impacts on other Bay activities and on shipping delays during dredging operations have been estimated to be $12.3 million (2007 dollars).

A number of potential effects and risks of the project were not costed, because mitigation is expected to reduce the impact to a very small level. However, as the SEES Inquiry observed, “the absence of any valuation of the impact of [these] negative potential externalities makes PoMC totally reliant on the impregnability of its scientific and technical studies” (p.196).

Net economic benefit. The economic aspects of the CDP have been examined in a number of technical reports supporting the SEES. In addition to modelling of the economic contribution of the Port of Melbourne to the Victorian economy, the SEES studies include a conventional benefit-cost analysis of the CDP.

The benefit-cost analysis, conducted by Meyrick and Associates, calculated benefits on the basis of projected economic growth and trends in vessel sizes up to the year 2035. The shipping costs for the Port of Melbourne were estimated for the two scenarios of: (a) maintaining current depths; and (b) achieving a 14 m draught under the CDP. The present value of benefits under the CDP scenario was found to be $1,936 million (2007 dollars) using an annual discount rate of 6 per cent.

The costs in the analysis included the direct CDP costs plus some indirect costs. The indirect costs included shipping delays while dredging is under way, plus the costs borne by recreational diving and commercial fishing. The present value of costs was found to be $590 million (2007 dollars).

The benefit-cost ratio for the CDP was calculated to be 3.3, using a 6 per cent discount rate. Sensitivity tests were used to estimate the benefit-cost ratios under different discount rates (4 to 8 per cent), capital costs (20 per cent higher and lower) and variations in the exchange rate.

Submissions raised the following concerns about the economic analysis in the SEES:

- A higher discount rate should have been used.
- The economic benefits of CDP for individuals is small.
- The time frame for predicting the economic benefits is too long.
- The SEES forecasts of the composition of the fleet of container ships exaggerates the proportion of larger ships.
- The SEES forecast in world economic growth is over-optimistic.

- The “sunk costs” should be included in the benefit/cost analysis.
- The benefit/cost analysis in the SEES does not quantify and incorporate all potential externalities from CDP.
- The flow of benefits to Victorians from CDP was questioned.

The Inquiry has considered the evidence on the above matters that was presented by economic experts commissioned by the PoMC, the Victorian Government and other submitters to the CDP. In this respect, the Inquiry’s main findings were:

- The economic modelling in the SEES is robust and has demonstrated consistently high benefit/cost ratios under a range of credible scenarios.
- While not all potential externalities were costed in the SEES, the inclusion of such costs would not significantly alter the benefit-cost ratio for the CDP.

The Inquiry has concluded that the strategic argument for CDP is compelling.

Conclusion. It is my assessment, having regard to the SEES and the Inquiry’s analysis of the relevant economic matters, that:

1) PoMC has provided a sound strategic and economic rationale for proceeding with the CDP;
2) The economic case for the CDP is sound and robust under a broad range of credible future scenarios;
3) The overall design for the CDP would result in an economically efficient outcome in terms of project costs and benefits.

4.2 Hydrodynamic and sediment transport effects

Objective: To avoid changes to water levels, currents or sediment movement patterns, due to the CDP, which would be likely to give rise to unacceptable adverse effects.

The Bay Entrance experiences severe hydrodynamic conditions, with strong tidal currents and waves. The Entrance geometry (i.e. depth and width) limits the volume of water entering and leaving the Bay on every tidal cycle, and hence regulates water levels inside the Bay. It also greatly attenuates the energy of tidal currents and ocean waves as they enter the Bay. The shallow Great Sands region inside the Bay, termed a flood-tide delta, further attenuates currents and waves entering the Bay. The combined effects of the Entrance and the Great Sands results in a smaller tidal range (e.g. lower high water levels) inside the Bay compared with outside the Bay.

The changes to the Bay’s bathymetry resulting from the CDP will lead to effects on tidal levels and currents within the Bay. Changes in the sub-marine cross-section of the Heads as a result of the CDP will affect the tidal variations at various points around the Bay’s perimeter. Similarly, the deepening of shipping channels within the bay will influence tidally driven currents, and to some degree also wind-driven currents. In the context of these hydrodynamic interactions of the CDP, three types of effects warrant attention here:

1) effects on terrestrial habitats and other coastal assets along the Bay’s edges, including islands, due to changes in water levels;

2) effects on existing patterns of sediment transport, due to changes in currents and waves; and

3) effects on the physico-chemical environment of the Bay, due to changes in water exchange with Bass Strait.

Before turning to address each of these issues, there is a need to consider both the erosion processes in the Entrance that might affect the bathymetry and hence hydrodynamics, as well as the hydrodynamic modelling that has been undertaken for PoMC.

Erosion in the Entrance. As noted in section 2.6, following a recent inspection of the bathymetry of the GSC section dredged as part of the TDP, PoMC identified that part of this area, as well as some adjacent areas, had deepened due to erosion since the TDP. Consequently, both the dredging itself and any subsequent erosion would determine the ultimate depth profile. Further studies were commissioned by PoMC as part of a Rock Scour Supplementary Assessment[18] on the dynamics of the erosion process and the hydrodynamic implications.

SKM has attributed this observed erosion to rock scour caused by hydrodynamic and related physical forces acting on the rock seabed. The removal of a hard "capping" layer of rock has exposed softer or more friable rock to the erosive impact of residual pieces of capping rock, via a mechanism similar to a mortar and pestle, progressively grinding out 'scour holes', several of which may coalesce to create a deeper profile. SKM consider that because of several factors, the rock scour process would diminish with time and a more stable condition will return. These factors include:

1) The erosion process is driven by turbulent current energy, and as a result is limited by the current speed or force;

2) A hard layer of rock at -22m depth would impede further downward erosion.

The SKM report contends that a 'worst-case' scenario for the effect of rock scour in the GSC would be deepening to -22 m depth, and that the actual depth of rock-scour is likely to be less than this. It considers that the effects of rock scour would not be laterally continuous. A peer review[19] by Dr Neville Rosengren, an experienced geomorphologist who was commissioned by PoMC, supported this conclusion. In addition, the IEG reviewed by the SKM report and the Rosengren advice. While the IEG considered that mechanisms other than that identified by SKM may contribute to the observed erosion, the net effect would be that rock scour would not exceed the worst case scenario of -22 m depth, and further, there is a distinct possibility that the extent of scour will be considerably less that the worst case scenario[20]. The IEG highlighted the need for care in the final stages of dredging in the GSC, as well as effective clean up of rock spill from dredging in order to minimise the amount of residual rubble that might contribute to the scour process.

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[18] Sinclair Knight Mertz (2007). *Port of Melbourne Corporation Channel Deepening Project Scour Assessment Report The Entrance*, by D. Raisbeck dated July 2007

PoMC (2007) Rock Scour Supplementary Assessment

[19] Rosengren, N. (2007). *Peer review of the "Sinclair Knight Mertz (SKM) report entitled Port of Melbourne Corporation Channel Deepening Project Scour Assessment Report The Entrance*, by D. Raisbeck dated July 2007*"*, La Trobe University and Environmental GeoSurveys.

[20] Independent Expert Group, 24 September 2007. *Advice to the Channel Deepening Project Inquiry on rock scour in the entrance and associated physical and ecological flow-on effect*

Hydrodynamic models. A key part of the SEES was the development of well-calibrated hydrodynamic models that were "fit-for purpose" for the Assessment of associated environmental effects of the CDP. A suite of two and three-dimensional (2D, 3D) models were developed by CLT for PoMC to assess changes in water levels, tidal currents, water exchange with Bass Strait, and waves. These models were in turn used to support 'process models' of the dispersal and intensity of suspended sediment in the water column, as well as the transport of bedload sediment on the seafloor. These models were subject to intensive peer review for PoMC and in turn were reviewed by the IEG who advised that they were sufficiently: (i) fit for purpose, (ii) well chosen, formulated and sound, and (iii) calibrated[21].

The SEES assessed impacts on the Bay's hydrodynamics by comparing hydrodynamic modelling results for (a) existing bathymetric conditions and (b) post-CDP conditions.

Effects of changes in water levels. As indicated above, the CDP changes to the Bay's bathymetry will directly affect water levels – albeit to a minor and variable degree. The key influence on changes to water levels within the Bay will be the permanent deepening of the cross-section on Rip Bank as a result of the CDP and associated rock scour.

In relation to the planned dredging scenario in the GSC (dredging to -17.3 m depth with a maximum over-dredge to -19.1 m depth), the SEES modelling predicted that the CDP would result in only small changes to sea level, with Queenscliff and the largest changes to tidal water-levels being:

- Point Wilson: 15 mm lower, and 8 mm higher.
- Williamstown: 12 mm lower, and 7 mm higher.

In relation to the worst-case rock-scour scenario of deepening to -22 m depth in the GSC, the Rock Scour Supplementary Assessment reports predicted that the largest predicted changes to tidal water-levels from the CDP would be:

- Point Wilson: 20 mm lower, and 20 mm higher.
- Mud Islands: 17.5 mm lower, and 27.5 mm higher.
- Williamstown: 20 mm lower, and 20 mm higher.
- Queenscliff: 35 mm lower, 15 mm higher.

The SEES concluded that the effects of changes to water levels, from both the CDP dredging case and rock-scour scenario, in the Bay would be "imperceptible". This is because these maximum changes will occur at high or low water, respectively, particularly during spring tides. Due to the cyclical nature of tidal variation, these maximum levels will only occur for a short time - much less than one hour. Furthermore, since the -22 m rock scour scenario is a 'worst case', it is likely that the effects will be less than the predicted maximums.

The predicted small changes in tidal ranges could potentially have the effect of causing periodic inundation of slightly larger areas where there is a very gentle

[21] Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

foreshore landward gradient[22]. Steeper gradients or natural or infrastructure barriers would prevent any increase in inundation. For the worst-case rock-scour scenario, the Rock Scour Supplementary Assessment reports predicted landward inundation to increase by 3 m at Swan Bay and 10-25 m at the southern part of the Spit Nature Conservation Reserve. No change was predicted at Jawbone Reserve. The potential increment in inundation at Mud Islands was not assessed due to lack of available surveyed elevation data.

The Inquiry concluded that the CDP is expected to have minimal net impact for low lying land, having regard to other natural forces influencing sea levels as well as the impact of climate change on rising sea levels. However, the Inquiry also recommended that given the community concern regarding the impact of the CDP on sea levels, PoMC should increase the number of sites at which sea levels are monitored.

Effects of changes in water exchange. Waters in the south of the Bay within the Great Sands area are regularly exchanged with Bass Strait waters through the tidal cycle. In contrast, the northern Bay waters (including in Geelong Arm) are sheltered from strong tidal currents, and as a result the 'flushing' time for these waters to exchange with Bass Strait waters is upwards of 12 months.

The CDP change to the Bay's bathymetry at the Entrance will affect the rate of exchange of Bay water with Bass Strait water, i.e. the "flushing rate". The SEES and Rock Scour Supplementary Assessment reports predicted that the volume of water entering and leaving the Bay between low water and high water will increase by about one percent for the planned dredging scenario and two percent for the worst-case rock-scour scenario. This equates to an average increase in flushing rate of 7 percent for the former and 14 percent for the latter scenario.

The south of the Bay experiences strong currents around the deeper natural and shipping channels, and consequently has faster flushing times than the north. These currents drive flushing, larval transport, fish recruitment, and sediment transport in the Bay.

In terms of the physico-chemical environment of the Bay, the increase in flushing rate is predicted not to affect temperature. While a slight increase in salinity is predicted, this would be well within natural variation and therefore would have a negligible effect. However, the IEG considered that the predicted change to Bay flushing times (whether 7 percent or higher on average) is potentially one of the most significant impacts the CDP will have on the Bay, because of potential ecological implications[23]. This latter aspect is addressed in Section 4.3

For the Yarra River estuary, the changed depth profile due to the CDP is predicted to cause minimal change in the water exchange between the River and the Bay.

Effects of changes in currents and waves. It is changes to tidal and wave-driven currents resulting from the CDP that will in turn determine the effect on sediment transport and any issues of coastal stability. On the basis of the expected CDP change in bathymetry, the SEES predicted that:

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[22] The ecological effects of this inundation are discussed in Section 4.3 which assesses the effects of increased water levels on Ramsar land around the Bay.

[23] Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

- Changes to tidal currents, which drive sediment movement in the south of the Bay will be confined to locations in the shipping channels where dredging will occur;
- Changes to wind-driven currents, which drive sediment transport in the northern Bay, will be mostly insignificant. At the majority of locations within the Bay, the changes will be less than one percent of the wave height. However, in the Entrance, there will be varying changes in wave height along the GSC, with an increase of around 10 percent on the ebb tide on Rip Bank.

The existing patterns of currents and waves in the south of the Bay have sustained the general form of the Great Sands for thousands of years. The same is true for Bay beaches, except that they are more subject to variability because of both seasonal factors and human intervention.

The Assessment Guidelines called for the SEES to examine the potential for medium- to long-term changes to sediment movement and the stability in southern areas of the Bay, as a result of modifying channels in or near The Heads, making appropriate use of both geomorphological expertise and computer modelling. While computer modelling of sediment transport was undertaken for the SEES using the driving hydrodynamic models, this was not successful as calibration of the sediment transport model was not practicable. Nonetheless, the analysis of net differences in current vectors across tidal cycles – using the calibrated hydrodynamic models - proved useful in identifying where accretion or erosion of sediment was likely to occur. Prof. Terry Healy, an expert coastal geomorphologist engaged by PoMC, used these results in combination with available information on the seabed and channel bathymetry to assess the likely implications for the Great Sands and adjoining beaches, including Lonsdale Bight[24].

On the basis of Prof. Healy's analysis, the SEES predicted minimal changes to sediment transport within the Great Sands, with most changes confined to the eastern end of South Channel and adjacent areas, as follows:

- Changes in sediment transport in the Sands are largely confined to South Channel, where an increase in westwards transport is predicted west of Schnapper Deep and in eastwards transport to the east of the Deep;
- A small reduction in longshore transport in Lonsdale Bight;
- No change to transport across Lonsdale Bight outside the surf zone; and
- No change to sediment transport in the vicinity of Swan Island or Mud Islands.

In relation to the 'worst case' rock scour scenario, Prof. Healy identified the potential for effects on sediment transport in Lonsdale Bight, due to changes in wave conditions, which may lead to changes in shoreline sand coverage. He therefore recommended monitoring of sediment transport in this area as well.

In the absence of robust modelling of sediment transport in the Great Sands area, Prof. Healy suggested that monitoring of long-term changes is needed. His advice was supported by the IEG, and in turn the Inquiry, which has recommended:

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[24] Healy, T (2006) *Potential Channel Deepening -Induced Morphodynamic Changes on the Flood Tidal Delta ('The Great Sands') and Adjacent Coastal Areas of Port Phillip Bay*, Department of Earth and Ocean Sciences, University of Waikato

Healy, T (2007) *Dredging-induced potential scour at the entrance to Port Phillip Bay – a review of reports on scour and modelling the potential impacts a report to Port of Melbourne Corporation*, Department of Earth and Ocean Sciences, University of Waikato

- A fit-for-purpose program, including monitoring surveys during and after the CDP, linked to scheduling of future maintenance dredging campaigns.
- Calibrating the SEES modelling against LIDAR and multi-beam surveys, maintenance dredging volumes and channel infilling rates, in order to increase the accuracy of sediment transport predictions in the Great Sands.

Conclusions. In light of studies undertaken for PoMC in relation to hydrodynamic modelling, coastal processes and rock scour in the Entrance, as well as the IEG's advice and the Inquiry's findings in this regard, it is my assessment that:

1) The CDP will cause only very small changes in sea levels, which are within the current range of natural variation, and which are unlikely to have significant effects on Bay assets, including fringing habitats, relative to the expected changes in sea level due to climate change;
2) The increased rate of exchange of Bay and Bass Strait waters due to the CDP will not have a significant effect on physico-chemical aspects of Bay waters, such as temperature and salinity.
3) Changes in tidal and wind-driven currents within the Bay are likely to have a negligible impact on Bay beaches and the Great Sands, though some changes could occur in the south of the Bay - especially Lonsdale Bight – over the longer term.

Further, it is my assessment that:

1) In order to limit consequential effects, dredging in the GSC is to minimise the deepening of the GSC beyond the depth needed for safe navigation, including by:
    i. minimising over-dredging, through specific dredging work practices;
    ii. minimising rock-spill and maximising spill recovery, during dredging in the Entrance.
2) PoMC monitor sea levels for at least one year after the completion of CDP, to allow the reporting of sea levels at locations such as Williamstown, Queenscliff, Geelong, Point Cook, Werribee and Mordialloc, with the results reported to government and made publicly available.
3) PoMC assess any future changes in seabed and beach morphology that may occur in the Great Sands region, including the southern Bay beaches and Mud Islands, as well as Lonsdale Bight, as a result of the CDP, including by:
    i. Bathymetry (LIDAR) and multi-beam surveys:
        - before dredging commences in the south,
        - two and four years after dredging commences,
        - as part of the planning of future maintenance dredging programs;
    ii. Current measurements be undertaken in South Channel and inside the Entrance after the completion of the CDP dredging, to assess whether the measured currents conform to SEES predictions;
    iii. Bedform observations and sediment grain size analyses, in conjunction with refined sediment transport numerical modelling;
    iv. Logging of all future maintenance dredging (i.e. position, volume and sediment type/size);

4) If monitoring or modelling points to long-term changes, that remedial action be considered (e.g. placement of dredged sands within the Sands region rather than at the South-Eastern DMG).

4.3 Ecological effects

Objective: To avoid significant adverse effects on ecological processes or either species or areas of conservation significance in the Bay and adjoining areas (including the Yarra River estuary) due to the CDP, such that recovery of ecological functions, productivity and biodiversity in the medium- to long-term would be uncertain.

Policy context. Having regard to the applicable policy framework[25], it will be necessary to avoid a long-term reduction in the overall biodiversity, productivity or ecological integrity of natural and semi-natural ecological communities in the Bay as a result of the CDP, i.e. outside the areas required for the shipping channels and DMGs.

A short-term reduction in the health and diversity of an ecological community in the Bay would be acceptable if a sufficiently rapid recovery could be assured to maintain pre-existing levels of biodiversity, productivity and ecological function. Similarly, a localised reduction would be acceptable if suitable offsets could be provided to compensate for any reduction in biodiversity, productivity and ecological function. An offset would need to be proportionate to the duration and significance of reduced values, in the context of associated uncertainties.

Relevant effects. Having regard to the various potential ecological impacts of the CDP, the following warrant attention here:

1) nutrient cycling and algal blooms
2) mobilisation of contaminants
3) seagrass habitats
4) Ramsar-listed wetlands
5) reef communities in the Entrance
6) other 'natural' benthic habitats
7) native fish species in the lower Yarra River
8) pelagic fauna in the Bay and migratory bird species utilising Bay habitats
9) marine protected areas.

These aspects will now be examined in turn.

[25] See Appendix 2 in relation to applicable provisions of the Flora and Fauna Guarantee Strategy, *Victoria's Biodiversity*, the *Victorian Native Vegetation Management – Framework for Action*, and SEPP (WoV) Schedules F6 and F7, as well as the EPBC Act.

4.3.1 Nutrient cycling and algal blooms

Nutrient cycling underpins the health and productivity of the Bay's ecosystem, and controls the Bay's response to natural and anthropogenic nutrient loads. Nutrient cycling is a critical environmental process of the Bay.

Nutrients are removed from the Bay through a combination of physical, chemical and biological processes, and with small quantities flushed into Bass Strait. High levels of nutrients have the potential to lead to excessive plant growth, such as algal blooms, which can have a range of consequences for the Bay's ecosystem, as well as human health. Although there are many nutrients available in the water column, nitrogen (N) is the key limiting nutrient that regulates plant growth in the Bay. Nitrogen inputs into the Bay fluctuate widely, the current annual loads are between 6000 and 9500 tonnes[26].

Algae such as phytoplankton in the water column and microphytobenthos (MPB) at the seabed play a key role in nutrient cycling processes and their growth is influenced by available nutrients, light and temperature. Infauna also plays a role in nutrient cycling.

CDP hazards
Key CDP hazards to nutrient cycling through dredging and disposal of dredged material include:

- Directly increasing nutrient loads released in dredged sediments thereby increasing algal growth and affecting water quality; and,
- Indirectly through the dredge plume and sedimentation reducing light penetration and photosynthesis of algal communities.

Analysis of Key Issues
To assess direct impacts of CDP on nutrient cycling, the SEES has used a combination of experiment and observation to estimate the direct additional loads of nutrients likely to result from CDP, and assessed their likely consequence by comparison with existing loads, and reference to historical model results. Further, the SEES assessed a range of potential indirect impacts of dredging on the nitrogen cycle, but because of the high associated uncertainties, has dealt with these through the risk assessment framework. The assessment deals with high levels of uncertainty by making conservative assumptions (i.e. assuming impacts at the upper end of potential ranges).

Submitters were concerned that modelling would be more appropriate for the assessment of nutrient cycling impacts. While there are no set methods for this type of assessment, the IEG concluded that the overall analysis and approach to assess impacts to nutrient cycling adopted in the SEES is robust and conservative. In addition, the Inquiry supported the risk assessment approach, and noted that it is commonly used to deal with impact assessment, particularly where the scope is broad and there is high uncertainty.

Assessment of direct effects of CDP on nutrient cycling. The SEES estimated that the sediments to be dredged in the Bay contain about 12,000 tonnes of nitrogen, and some of this nitrogen will be temporarily released into the water column with the

[26] Commonwealth Scientific & Industrial Research Organisation (CSIRO) (1996) *Port Phillip Bay Environmental Study*, CSIRO Publishing, Dickson, ACT

dredge plume. Laboratory experiments, however, determined that only a small fraction of this quantity of 130 +- 226 tonnes is bioavialable, i.e. able to be converted to a form of nitrogen that can be utilized by marine organisms. In this context, and considering the quantity and variability of the annual loads identified in the Bay Environmental Study (PPBES), the IEG advised that one-off temporary nutrient loads due to the CDP in the order of a few hundred tonnes would not be expected to result in major or long-lasting changes to the Bay's nutrient cycling processes. The SEES concluded that the risk of the CDP to disrupting the Bay's nutrient cycling process is low.

Assessment of indirect effects of CDP on nutrient cycling. The SEES predicted the key indirect effects on the nitrogen cycling process are suspended solids from the plume and sedimentation: (i) reducing light and photosynthesis of MPB communities, and (ii) smothering and removal of infauna assemblages. It considered that the subsequent loss in nutrient cycling efficiency could result in an increase in phytoplankton production. In all cases, the risk of indirect effects is predicted to be typically very low or at most minor because the effects of the plume and the dredging are limited in time and space. The SEES explained that the area of impact is confined either to the area under the turbidity plume, or to the area of the channel or DMG, and the plumes occupy a minor fraction, and the channels and DMG's a very small fraction of the Bay. The duration of impact is considered likely to be short, with recovery of phytoplankton and MPB expected to occur rapidly on time scales of weeks to months at most, following completion of dredging or disposal. Infauna assemblages are expected to recover in 6 to 12 months of CDP completion. On this basis, the CDP is unlikely to trigger nonlinear or threshold changes in the Bay's nutrient cycling processes.

Given that nutrient cycling underpins and is critical to the environmental health of the Bay, the SEES proposed assurance monitoring of nutrient cycling processes as part of the EMP[27], which includes denitrification monitoring be undertaken by augmenting the existing bay wide program. The assessment concluded, however, that direct risks to nitrogen cycling did not warrant specific EMP measures. However, the indirect effects will be managed through measures to control the plume area and concentration. The IEG explained that as long as the turbidity plume monitoring program informed measures to control the plume extent and concentration, it should act to control for any significant underestimation of plume extent and therefore impacts on nitrogen cycling. The Inquiry endorses the IEG recommendation to increase the number and distribution of sampling sites for the proposed nutrient flux studies.

Assessment of algal blooms. While algal blooms currently occur in the Bay under natural conditions in the absence of dredging, the release of nutrients during dredging could increase the likelihood of algal blooms. However, the nutrient quantities released during the CDP are small compared with natural loads in the Bay, and dredging activities will be restricted in space and time, as discussed above. The SEES concluded that the additional risk of algal blooms during CDP as minimal, and that algal blooms resulting from the dredging are not expected to have significant ecological impacts. In addition, dredging in the north of the Bay will take place in non-overflow mode for unconsolidated silts, and therefore reducing the release of nutrients in the plume.

The SEES predicted the risks to the Bay's ecosystem from toxic algal blooms resulting from cyst remobilization are generally judged to be very low, because if a

[27] PoMC *CDP Environmental Management Plan (Revision C)* 27 July 2007

bloom should occur, its area is likely to be small and hence the consequences will be minor. As reassurance that impacts are not greater than predicted, the SEES indicated that that the EMP will include a strategy to manage risk of algal blooms through monitoring of phytoplankton. (Refer to section 4.4.1 for assessment of effects of algal blooms on human health.)

The Bay's Nutrient Reduction Plan. In EPA's submission to the Inquiry, it advised that the State Environment Protection Policy (Waters of Victoria) (SEPP WoV) and its Schedule F6 (Waters of Port Phillip Bay) Nutrient Reduction Plan establishes the requirement for the Port Phillip Bay Environmental Management Plan's (PPB EMP) Nutrient Program. EPA noted that in response to the requirements of SEPP (WoV), a key objective of the PPB EMP is to significantly reduce nitrogen loads to the Bay, setting a target to reduce annual nitrogen inputs by 1000 tonnes. Clause 8(4) of Schedule F7 requires nutrient loads from the Yarra River catchment to the Bay to be consistent with the Nutrient Reduction Plan for the Bay required under Clause 12 of Schedule F6.

EPA advised that there has been significant investment to reduce nutrient loads from the Western Treatment Plant and the broader catchment of the Bay. The Inquiry considered this evidence, and concluded that the objective of reducing nutrient inputs to the Bay system should be applied in a consistent manner to both dredging and land-based activities in the context of the PPB EMP Nutrient Reduction Plan.

Given the critical importance of nutrient cycling to the Bay's health, and that a key objective for the management of the Bay is to reduce nutrients as part of the Bay EMP, the Inquiry concluded that the effects of CDP on nutrient cycling of increasing nutrient inputs to the Bay, should be offset by reducing nutrient loads to be Bay. The types of offsets may include upgrading or establishing wetlands to reduce nutrients entering the Bay, and/or improvements to water quality management within the Bay's catchment such as revegetation of riparian zones. Offsets should be consistent with the PPB EMP's Nutrient Program, and the EPA's SEPP WoV F6 and F7 Nutrient Reduction Plan. The details of any offsets should be endorsed by EPA and DSE, and included in the CDP EMP.

Conclusions

Having regard to the Inquiry's report and the SEES, it is my assessment that the effects from the CDP on the Bay's nutrient cycling processes are minimal and acceptable for the following reasons:

- The overall analysis and approach of the nutrient cycling assessment is robust and conservative;
- The additional nitrogen load from CDP is well within the Bay's natural variation, so it does not pose a significant risk and may not even have a detectable effect on nutrient cycling;
- Indirect effects on the nitrogen cycling are addressed effectively through the risk assessment and management measures outlined in the EMP; and
- CDP is unlikely to cause threshold or nonlinear changes in the Bay's nutrient cycling processes.

Further, it is my assessment that the EMP should include:

- A robust monitoring program as assurance against significant impacts to of nutrient cycling; and
- A strategy to manage risk of algal blooms through monitoring of phytoplankton

4.3.2 Mobilisation and bioavailability of contaminants

Context. Increased loads of sediment, together with contaminants arising from industry, agricultural and urban activities, have entered the Bay over the past 160 years through drainage and land run-off from the Bay's catchment, particularly the Yarra River system. The upper layer of unconsolidated sediments on the Yarra River bed and channels is subject to regular disturbances and resuspension during flood events, as well as from shipping propeller wash and dredging activities. Natural flood events transport sediments from the Yarra River southward along the eastern side of the Bay[28]. The Inquiry noted that these events have potential to cause impacts regardless of the CDP.

The environment of the lower Yarra River has been extensively modified by deepening and widening the channel and banks for shipping and port activities, and flood mitigation. The ecological communities and processes now associated with the lower Yarra River and Hobsons Bay have adapted to this environment – including a modified benthic habitat, increased levels of turbidity, as well as the presence of contaminants.

The key ecosystem components that may be affected by the CDP dredging and disturbance of contaminated sediments in the Yarra River and the northern Bay include[29]:

1) Phytoplankton in the water column, which is a primary food source for the marine ecosystem;
2) Fish, including Australian anchovy, Black bream, Snapper, Australian grayling and Short-finned eel; and
3) Seabirds that breed and feed in these areas, such as the Pied Cormorant (Yarra River mouth), Australasian Gannet (near Williamstown) Seabirds, as well as Little penguins from both the colony at St Kilda Pier breakwater and from Phillip Island.

SEPP (WoV) Schedules F6 and F7 provide the primary policy framework for considering and managing the impacts of dredging on the beneficial uses of the lower Yarra River and Hobsons Bay. These schedules recognise the degree of ecological change that has occurred, as well as the current uses, of these two segments by providing that water quality should be adequate to protect "highly modified ecosystems with some habitat values". Primary contact recreation such as swimming is also a beneficial use protected by these schedules, but the production of molluscs for human consumption is not protected in Hobsons Bay (or in the "Inshore segment" fringing most of the Bay).

Clause 13(d) of SEPP (WoV) requires agencies undertaking dredging or spoil disposal to ensure that[30]:

i. activities are conducted in accordance with current best practice;

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[28] Commonwealth Scientific & Industrial Research Organisation (CSIRO) (1996) *Port Phillip Bay Environmental Study*, CSIRO Publishing, Dickson, ACT

[29] Refer to section 4.3.8 for asessment of effects of contaminants on seabirds, penguins and fish and listed fish, and section 4.4.1 for assessment of contaminants on human health – much of the latter section is relevant to the present section.

[30] Refer to section 4 in Appendix B for further details.

ii. any exceedance of environmental objectives is minimised in time and space, to the extent practicable;

iii. the dredging does not impact on beneficial uses in the long term; and

iv. disposal of dredge spoil is to land where practicable and environmentally beneficial.

CDP Hazards. A total of 2.11 million m^3 (or 3.59 million m^3 bulked[31]) of sediment to be dredged during the CDP has been identified as contaminated, in accordance with the 2002 *National Ocean Disposal Guidelines for Dredged Material* (NODG). Most of these sediments occur, as a surface layer, in the Yarra River and Williamstown Channels, with small quantities also in the Port Melbourne Channel. The contaminated sediment is predominantly unconsolidated mud, with the exception of some small quantities of consolidated sediment in the batter walls and berthing pockets. Other than the above, deeper sediments in the Yarra River and Williamstown Channels and in Port Melbourne Channel, as well as sediments in the South Channel and the Great Shipping Channel in the Entrance were classified as uncontaminated and suitable for unconfined marine disposal.

The SEES identified that the potential for mobilisation and bioavailability of contaminants in the Yarra River and Hobsons Bay area during CDP could have effects on ecosystems and human health. If contaminants are bioavailable, bioaccumulation or biomagnification through successive stages of the food chain[32] may occur. Thus a key risk of bioaccumulation of contaminants to the ecosystem is to predators at the top of the food chain, e.g. flow-on effects from plankton to fish to birds.

The SEES assessed contaminant hazards by characterising the types and levels of contaminants in the dredged sediments and their potential for bioavailability, bioaccumulation, and toxicity in accordance with the framework provided under the NODG. A peer reviewer, who was expert on the content and application of the NODG, confirmed that the results of SEES sediment characterisation studies to classify the sediments were sound and in accordance with NODG[33] [34]. The EPA agreed[35].

While submitters raised some concerns about the adequacy of the sediment studies, the SEES concluded that further characterisation or analysis of the sediments, including 'hot-spots', would not change either the sediment classification under NODG or PoMC's proposed dredged material management strategy. The Inquiry supported this conclusion.

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[31] The dredging process mixes the sediment with water, temporarily increasing or bulking the volume of sediment. After a period of time, depending on the sediment type, dewatering takes place returning sediment to the un-bulked volume.

[32] Bioavailability of contaminants refers to the capacity for contaminants to be utilised or absorbed into biological systems or organisms. Bioaccumulation refers to the accumulation of a substance, such as a chemical, in various tissues of a living organism. Biomagnification (or bioamplification) refers to the increasing concentration of a substance in living organisms as it passes up the food chain.

[33] Irvine, I. (2006) *Peer Review South Channel Sediment Investigations, Port Phillip Bay, Supplementary EES and North Channel Sediment Investigations, Port Phillip Bay, Supplementary EES,* Pollution Research, SEES Technical Appendix 37

[34] Irvine, I. (2007) *Expert Witness Statement* Prepared for PoMC, Channel Deepening Project Supplementary Environment Effects Statement Inquiry

[35] EPA further advised that the NODG are the most relevant guidelines for assessment of such sediments, rather than the BPEMGD

Both inorganic compounds (metals and metaloids) and organic compounds (hydrocarbons, pesticides, TBT, and chlorinated compounds) were identified in the SEES analyses of potentially contaminated sediment[36]. It is noted that:

- Contaminants levels for nickel and arsenic were thought to be elevated (regional) background concentrations, rather than from anthropogenic sources;
- While there were elevated concentrations of DDT and DDD, their use has been banned for more than 20 years and their presence is a legacy of past activities.

An assessment of bioavailability using weak acid showed that only a small proportion of total trace metals contained in the sediment was bioavailable to organisms.

In terms of hazards arising from the CDP, there are two stages at which exposure of contaminants from dredged sediments needs to be managed:

1) During the dredging of the sediments;

2) Through the placement or management of the sediments.

There are two issues which arise in relation to these activities: first, the mobilisation of contaminants, and second, the potential bioavailability of contaminants.

Mobilisation of contaminants. The PoMC has evaluated a range of dredging technology options to minimise environmental effects during dredging, especially the mobilization of contaminants. As a first step, the quantity of sediment to be dredged has been minimised by optimising the channel design, to the extent practicable[37]. Of specific relevance for contaminated sediments, is the minimisation of the extent of the plume during dredging, PoMC proposes to achieve by using:

- A TSHD operating in non-overflow mode ;
- A horizontal profiling grab attached to either a backhoe or grab dredge for dredging adjacent to docks.

A range of disposal options for contaminated sediments were assessed by PoMC. Disposal to land was not considered to provide a net benefit compared with confined marine disposal, because of limited available suitable land to accommodate the large volume of sediments, and the implications arising from the on-shore processing and handling of these sediments. Consequently, PoMC proposes to place the sediment within an extension to the existing Port of Melbourne DMG in the form of a Confined Aquatic Disposal (CAD) facility, combining a perimeter bund and with a confining cap, to isolate the contaminated sediments from the marine environment. The bund and capping layer will provide physical barriers to prevent the lateral dispersal of contaminated sediment and its colonisation by infauna. The CAD is to be constructed using:

- A pontoon with diffuser to place the sediment; and
- A spreader pontoon to place a sand capping layer over the contaminated sediments at the DMG, to separate these sediments from infauna.

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[36] The key contaminants of potential concern identified in the SEES sediment assessment, include: Metals - nickel, arsenic, mercury and lead; Organics - Tributyltin (TBT)(marine paint), polycyclic aromatic hydrocarbons (PAH), dichlorodiphenyltrichloroethane (DDT), Dichlorodiphenyl-dichloroethane (DDD), polychlorinated biphenyls (PCB), and organophosphate pesticides.

[37] This approach has been applied to the CDP as a whole.

PoMC's peer reviewers have confirmed that the design and materials for construction of the CAD, as well as the CAD construction sequence and procedure, are appropriate[38].

PoMC proposes to allow the contaminated sediments within the bund to consolidate for a period of approximately 140 days prior to capping, in order for the sediment to gain enough strength to support the capping layer. In this context, submitters raised concerns about the elapsed time between the placement of contaminated sediments and the capping, suggesting that contaminated sediments would be released into the environment. However, the SEES indicates that the likelihood of resuspension and mobilisation of contaminated sediments is very low because the hydrodynamic forces (i.e. waves and currents) at the depth of the CAD are not sufficient to resuspend sediments.

The EPA has advised that PoMC's proposed methods for dredging and confinement of contaminated sediments represent best practice, consistent with the considerations of practicability that are to be applied. The dredging methods will minimise the dredging plume in time and space, while the CAD will prevent resuspension and dispersal of contaminants and avoid detrimental effects on the long-term protection of beneficial uses. Further, EPA advised that the assessment had demonstrated that reuse and/or disposal to land is not practicable or environmentally beneficial. In light of these features, the CDP proposal conforms with the provisions of clause 13 (1) in SEPP (WoV) Schedule F6, and is consistent with the BPEMGD[39].

In addition, the IEG has advised that the proposed dredging methods are consistent with best practice, in terms of environmental performance and practicability[40]. Specifically, both the diffuser placement method and the sand capping operation are established techniques in the dredging industry, representing best practice for managing contaminated sediments, and are likely to minimise dispersal of contaminants.

To ensure the effectiveness and structural integrity of the bund and cap in the long-term, it will be monitored as part of the EMP[41]. The IEG has advised, however, that additional monitoring is needed to both:

1) To demonstrate that the contaminated material placed in the Port of Melbourne DMG extension is behaving as predicted, in terms of its final location and surface bathymetry; and,

2) To confirm that the sand capping has been satisfactorily placed without any failures of capping occurring, without turbidity plumes beyond those predicted, and without reduction in water quality in the vicinity of the DMG extension.

Bioavailability of contaminants. Beyond the above measures to minimise the mobilisation of contaminant sediments, the necessity of any further measures requires consideration in relation to their potential bioavailability.

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[38] Palermo, M. (2006) *Peer Review of Placement and Capping of Contaminated Silt in CAD*; Desk Study, Mike Palermo Consulting 2006

[39] Environment Protection Authority (EPA) Victoria (2001), *Best Practice Environmental Management Guidelines for Dredging*, Publication 691, October 2001, EPA Victoria, Melbourne, Victoria

[40] Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

[41] PoMC *CDP Environmental Management Plan (Revision C)* 27 July 2007

The potential bioavailability of contaminants from the sediments was assessed for the SEES through laboratory tests, consistent with the NODG. Experiments confirmed that contaminants were strongly bound to the sediment particles. As noted by the Inquiry, even if the contaminated sediments are disturbed, the concentrations of contaminants in surrounding water are not likely to be affected.

Together the bund and cap will prevent benthic organisms, particularly organisms that burrow into the seabed, from exposure to the contaminated sediment. This design ensures that the contaminants will not be bioavailable in the long term. While the permeable sand capping layer will allow dissipation of pore water pressure from the contaminated sediment as it consolidates, the risk of contaminants being transported into the water column is negligible because the contaminants are bound to the sediment.

The Inquiry noted that the technique of isolating contaminated sediments in a CAD is safer for the environment than previous dredging and disposal techniques, which did not involve lateral or vertical confinement. Indeed, it is reasonable to conclude that the confinement of contaminated sediments in the proposed CAD will lead to an improved environmental outcome.

In this context, dredging and disposal of contaminated sediments during the CDP is unlikely to impact on the Bay's beneficial uses in the long term.

Conclusion. In light of the studies and peer reviews undertaken for PoMC, as well as the IEG's advice and the Inquiry's findings in this regard, it is my assessment that:

1) Appropriate methods have been used to characterise and classify sediments to be dredged as part of the CDP, consistent with the NODG;

2) The CDP proposal for dredging and placement of those classified as unsuitable for unconfined marine disposal, referred to as contaminated sediments in the text above, is consistent with best practice and conforms with the provisions of SEPP(WoV) Schedule F6, clause 13(1);

3) The risk of increased exposure of biota in the lower Yarra River and Hobsons Bay area and at the Port of Melbourne dredge material ground to bioavailable contaminants is low – the overall level of exposure may be reduced relative to the current situation. Hence, the ecological effects from mobilisation and bioavailability of contaminants, both in the water column and in the sediments, are likely to be negligible.

Further, it is my assessment that in approving the Project, specific attention be given to project delivery standards and associated work method statements for managing contaminated material, including:

i. dredging and placement of the material to be dredged from immediately beneath contaminated sediments;

ii. placement of contaminated material in the CAD facility; and

iii. monitoring the integrity of the bund and cap.

4.3.3 Seagrass habitats

Seagrass in the Bay. Extensive areas of seagrass communities occur in the south of the Bay, as well as more localised areas of seagrass in the north of the Bay. These communities are an important component of the Bay ecosystem, in part because they provide food and shelter for many marine organisms, including crustaceans and juvenile fish of various species.

According to the SEES[42], the two most common species in the Bay are from the *Zostera* group and for practical purposes may be referred to as '*Zostera'*:

> *Zostera muelleri* is predominantly found on sand or mud in the intertidal area. The other species is also predominantly found on sand or mud but below the low tide mark. The … second species is variously known as *Zostera tasmanica,* … and most recently, *Heterozostera nigricaulis.*

Seagrass areas in the Bay were mapped in 2000[43]. *Zostera* seagrass was found to occupy about 65 km^2 of seabed, or about 3.5 percent of the Bay. Of this 65 km^2, approximately 45 percent of *Zostera* is situated in Corio Bay and the Geelong Arm, and almost 28 percent occurs in Swan Bay. Of the remainder of *Zostera* seagrass in the Bay, about 3 percent occurs in the north, about 12 percent occurs west of the Great Sands, about 3 percent occurs in the vicinity of Mud Islands, and about 9 percent occurs along the coast and offshore from Portsea to Dromana.

Another bed-forming seagrass, *Amphibolis antarctica* only grows in turbulent and semi-oceanic conditions. It is found around the Heads, mostly in depths less than 5 m. About 1.25 km^2 of *Amphibolis* beds have been identified in these areas.

Dependent species. The relationship between "seagrass landscapes" and fish species assemblages in the Bay has been investigated by Anderson (2004), who found that the association of fish with seagrass habitats varied at different scales. Some species live within areas of dense seagrass (e.g. various pipefish and leatherjackets), whereas others live within areas of patchy seagrass with both 'gap' and 'refuge' habitats (e.g. goatfishes), some largely within 'gap' habitats (e.g. newly settled whiting larvae, gobies), and others again live in largely sand habitat with only sparse seagrass (e.g. flathead spp.). The implication is that loss of seagrass density and/or patch area is likely to affect the habitat capacity to support particular fish species assemblages.

The majority of seagrass associated fish are more abundant in summer, with major declines in winter, reflecting the summer recruitment of young-of-age due to larval settlement or release of brooded young (e.g. seahorses and pipefish). This pattern corresponds to the seasonal pattern of seagrass growth, as well as of epiphytes and filamentous red algae.

Causes of seagrass variation. Although the general locations of seagrass beds in the Bay have been quite persistent over several decades, monitoring of seagrass in the Bay has identified major variations in both the extent and density of seagrass beds over the short- and long-term. The causes of longer-term variations in

[42] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Seagrass*, CEE, Consultants, Richmond, Victoria

[43] Blake, S. & Ball, D. (2001). *Victorian Marine Habitat Database, Seagrass Mapping of Port Phillip Bay.* GeoSpatial Systems Section, Marine and Freshwater Resources Institute Report No. 39, MAFRI, Queenscliff

seagrass beds in the Bay are not well understood, in part because the pattern of change is not consistent across the Bay. A 70 percent decline in seagrass in the Blairgowrie area occurred between 1989 and 2000, while in the same period a similar increase occurred at Kirk Point in the Geelong Arm[44].

A key influence on seagrass viability is the availability of sunlight, though this requirement varies between species and in relation to other environmental factors[45]. Other potential influences on seagrass variation in the Bay are shading from epiphytes, temperature and hydrodynamic stress. Epiphytic flora and fauna on seagrass leaves in the Bay and Western Port have been found to reduce light availability by up to 50 percent[46], while temperature has been found to have a strong influence on seagrass light requirements[47]. A study[48] showed that seagrass beds in the Geelong Arm may expand and contract over a period of years, with fragmentation of seagrass beds resulting from "hydrodynamic stress" leading to erosion and the loss of the rhizome base or simply detritus covering seagrass shoots or rhizomes.

In the absence of research providing a multi-causal explanation of the factors driving seagrass variation in the Bay, the management of effects arising from the CDP must be predicated on the primary influence of the light climate affecting photosynthesis.

Light requirements. In terms of inter-annual patterns, the density and biomass of seagrass beds is typically higher in summer, as new growth occurs in response to higher "photosynthetically available radiation" (PAR) and temperature, than in winter when some leaf senescence occurs. Carbohydrate stored in rooting rhizomes during summer growth also helps to sustain seagrass during the lower PAR winter period. Strong seasonal variations in leaf standing crop, leaf cluster density and leaf productivity have been found for *Zostera* seagrass beds in both the Bay and Western Port[49].

Research on the ecology of various seagrass species has found that variations in the local maximum depth limit of species occurrence (i.e. the "compensation depth, denoted by the symbol Z_c) largely correspond to a combination of: (a) the light requirements of the particular species (L_c); and (b) the local coefficient or rate of diffuse light attenuation in the water column (i.e. K_d at depth d metres[50]). The established relationship then is:

$$Z_c = - \ln(L_c)/ K_d$$

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[44] Primary Industries Research (2006a) *Channel Deepening Supplementary Environment Effects Statement - Aquaculture and Fisheries*, Primary Industries Research, Queenscliff, Victoria, SEES Technical Appendix 57

[45] Bulthuis, D.A., (1983). *The effects of light reduction on density and growth of the seagrass Heterozostera tasmanica* (Martens ex Aschers) den Hertog in Westernport, Victoria, Australia. *Journal of Experimental Biology and Ecology*. 67. 91 – 103

[46] Bulthuis D.A. and Woelkerling W.J. 1983. *Seasonal variation in standing crop, density and leaf growth rate of the seagrass*. *Heterozostera tasmanica,* in Western Port and Port Phillip Bay, Victoria, Australia. *Aquatic Botany* 16: 111-136.

[47] Bulthuis, D.A., (1983). *The effects of light reduction on density and growth of the seagrass Heterozostera tasmanica* (Martens ex Aschers) den Hertog in Westernport, Victoria, Australia. *Journal of Experimental Biology and Ecology*. 67. 91 – 103

[48] Anderson, T. (2004). *The functional relationships between temperate fishes and the associated seagrass landscapes*. PhD. University of Melbourne, Melbourne.

[49] Bulthuis D.A. and Woelkerling W.J. (1983). *Seasonal variation in standing crop, density and leaf growth rate of the seagrass*. *Heterozostera tasmanica,* in Western Port and Port Phillip Bay, Victoria, Australia. *Aquatic Botany* 16: 111-136.

[50] Very clear water may have a light attenuation coefficient (K_d) of about 0.1 whereas cloudy water K_d would be near 1.0

where L_c is the ratio of I_d the irradiance at depth d and I_s is the irradiance at the surface (underwater).

Light attenuation varies around the Bay due to input of natural colour from rivers, the presence of phytoplankton pigments and the presence of suspended sediments. In the south of the bay the average K_d varies between $0.20m^{-1}$ and $0.40m^{-1}$, whereas in the north of the Bay and Yarra River the average K_d varies between $0.35m^{-1}$ and $0.45m^{-1}$.

On the basis of seagrass shading experiments on *Zostera* seagrass in Western Port, Bulthuis (1983) concluded that over a period of several months the minimum light requirement for survival of the species is between 4.7 and 13 percent of surface irradiance, with markedly lower light requirements during winter than summer. At these levels of light availability, though plants survived for up to 14 months, substantial declines in leaf cluster density were observed. Similar seagrass shading experiments by SKM (2006) found that heavily shaded areas had 80 percent declines in shoot density after 4.5 months.

A review[51] of available evidence for the SEES concluded that:

> … a light requirement of 10 percent of surface light appears to be a realistic annual light requirement for *Zostera* in the south of the Bay. For the purposes of the [ecological] assessment, and to address uncertainty, an average value of 15 percent of surface light was used as a conservative minimum annual light requirement for Zostera in the Bay.

In relation to reduced light availability, CEE (2007, p.33) state that:

> It is expected that short durations of (days to weeks) of intermittent shading followed by adequate light conditions (at least 15 percent of surface) for a long period following exposure (months), are likely to have negligible effect on seagrass habitat.

It is recognised, however, that at 15 percent of incident light,

> … there may be some short-term physiological changes (chlorophyll concentrations, changes in storage products) and possibly morphological changes (leaf density and length) to seagrasses that are usually living in average conditions higher than 15 percent of incident light.

The IEG accepted that the use of "an average value of 15 percent of surface light" as a provided a conservative threshold for assessing the risk of loss of *Zostera,* while noting the importance of a conservative threshold given that seagrasses would decline in condition at this level of light until they could no longer be sustained (IEG, May 2007, p.32).

The depth range of *Amphibolis* in the Bay is primarily limited by the habitat suitability of the substratum, where it grows to depths of 10m at Lonsdale Bay and Nepean Bay. CEE (2007, p.23) suggest, based on an estimated K_d of $0.2m^{-1}$ in these latter areas, that "an average conservative minimum light requirement value of 15 % of surface light appears to be a realistic light requirement for *Amphibolis* in the Bay".

[51] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Seagrass*, CEE, Consultants, Richmond, Victoria

CDP turbidity hazards. Since there are no seagrass beds in the shipping channels or at the proposed DMGs, the main hazards arising from the CDP that might affect seagrass in the Bay are:

- The turbid dredging plume causing a reduction in light availability; and
- The dredging plume, and resuspension of sediment, causing an increase in the rate of suspended sediment settling on seagrass.

A local change in currents or wave patterns, due to the changed bathymetry following the CDP, might conceivably lead to either erosion or smothering of local seagrass beds. However, there is no evidence arising from the SEES that this would be more than a localised event.

Following the EES Inquiry's report, the SEES Assessment Guidelines called for "refinement of the [EES] turbidity model to support a robust assessment of turbidity issues". It was to enable predictive modelling of turbidity plumes, in order to demonstrate the feasibility of the entire dredging campaign being undertaken in a manner that is protective of the environment. This modelling is particularly relevant to assessment of potential impacts on seagrass and for that reason is discussed here.

PoMC's consultants used data from the TDP to calibrate the turbidity models, which predict the dispersal and settlement of suspended sediment on the basis of the 3-D hydrodynamic models. The output data includes profiles in time and space of total suspended solids (TSS).

The IEG reviewed the turbidity models and advised that they were suitable for "screening" dredging scenarios as well as to inform studies on the potential environmental effects of turbidity. At the same time, the IEG observed that the turbidity predictions were indicative only and a robust monitoring program would be needed. Two reservations expressed by the IEG were that[52]:

1) The models do not include re-suspension of plume material after it has settled, hence there is some uncertainty about the effect of re-suspension on expected levels of turbidity and sedimentation. While wave and current action in shallow waters will resuspend fine sediments and eventually redistribute these to deeper water, the timeframe for this is unknown.

2) The predicted plume and sedimentation statistics used for impact and risk assessment were obtained by "forcing" the model with observed wind and tidal data for a "typical year". However, the variability of weather over both daily and yearly time scales means that actual dredging will inevitably deviate to some degree from that predicted. Similarly, the actual scheduling of dredging operations, in contrast to the assumed scheduling, will determine the density and extent of the plume in reality.

The IEG's conclusion that the turbidity modelling is "fit-for-purpose" for the SEES impact assessment is accepted here. It is also accepted that the uncertainties arising from limitations of this modelling will necessitate monitoring of both the turbidity plume itself and its effects on ecological assets.

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[52] Other IEG reservations regarding this modelling documented in its advice of 1 May 2007 related to:

(i) Sediment parameters, e.g. the number and settling rates of different sediment size fractions;

(ii) The accuracy of the sediment source term used, in terms of the amount of mobilised material;

(iii) The behaviour of sediments at the DMGs, including the possibility of localised density currents;

(iv) Potential sorting of sediment fractions within the dredged channels during overflow dredging.

For particular periods of dredging, PoMC's consultants prepared both spatial plots of frequency percentiles for predicted TSS and graphical time series plots of TSS for selected locations. A summary of this modelling is found in Chapter 10 of the SEES.

CDP effects on seagrass. The EES had sought to assess CDP effects on seagrass, macroalgae and microphytobenthos by modelling the impact of light reduction on their respective primary productivity. It did this by first using outputs from turbidity modelling to estimate light conditions during dredging, and then using this information to calculate the effects on seagrass productivity. Although the SEES Assessment Guidelines anticipated that the SEES would follow a similar approach, because of inherent limitations and uncertainties in this methodology, PoMC's consultants adopted a different approach, focussing on seagrass.

To assess the CDP impact on light availability to seagrass, the SEES drew upon laboratory investigations of the relationship between K_d and levels of TSS, based on sediment samples from the channels to be dredged[53]. Median attenuation values, together with the 80th percentile of predicted TSS concentrations from modelled time series for various seagrass locations, were used to provide a conservative estimate of the depth at which 15 percent of average annual surface irradiance would be received[54].

Using this approach, the SEES concluded that the CDP is likely to have:

- A negligible effect on 80 to 85 percent of the total area of *Zostera* seagrass in the Bay, including the seagrass beds at depth of 1 to 2 m in the north of the Bay, as well as in waters shallower than 3 m in the south, including within Swan Bay, in the area west of the Great Sands from Queenscliff to Portarlington, and in the vicinity of Mud Islands;
- Effects on *Zostera* seagrass at depths greater than 3 m in some areas (notably, Sorrento Bank, South Sands and Camerons Bight), as well as some seagrass deeper than 4 m from Rye to Rosebud and at Dromana), including:
    - o reduction in seagrass leaf density in areas with greatest exposure, as the depth of the seagrass increases;
    - o temporary total loss of leaves may occur in deeper areas with high exposure to turbid plumes;

  acknowledging that the recovery of some or all of the affected seagrass in water depth greater than 3 m is possible but uncertain;
- A negligible effect on most *Amphibolis* beds at Lonsdale Bay and near Portsea, as well as at depths shallower than 4 m in Nepean Bay, but more substantial effects (similar to those above) on *Amphibolis* at depths greater than 5 m in Nepean Bay.

A study on the lower depth limits of *Zostera* in the Bay and Western Port found that these lower limits of 3.8 m in Corio Bay, from 5.9 to 9.8 m around the Bay and about

[53] Though relatively strong statistical relationships emerged for sediments from the Yarra River, Williamstown and Port Melbourne Channels, a weaker relationship was found for South Channel sediments, particularly at levels of 20 mg/L, such as might be expected in the vicinity of seagrass beds in the south of the Bay (PIRVic, 2006c). Because of this variability, attenuation coefficients were calculated separate for sub-ranges of TSS in 2.5 mg/L increments up to 12.5 mg/L.

[54] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Seagrass*, CEE, Consultants, Richmond, Victoria

5.8 m in Western Port[55]. It found that in the Bay the percentage of surface light at the maximum seagrass depths ranged between 2.3 and 7. Bulthuis concluded that this species has among the lowest light requirements of bed-forming seagrasses in the world. During the SEES investigations, *Zostera* beds were found at 10 m depth in southern parts of the Bay.

The IEG noted that "small changes in light thresholds for *Zostera* may have strong effects on the area of seagrass affected", for example if a higher level of either turbidity exposure or light sensitivity were to occur[56]. In relation to *Amphibolis,* the IEG considered that the 15 percent incident light threshold "does not seem conservative", given both that *Amphibolis* mainly occurs down to 5m in The Heads, in water with relatively low background light attenuation, and because *Amphibolis* would "have a very slow recovery from any impacts". The IEG also observed that the recovery of *Zostera* is not well understood and might take longer than the "1 to 2 years" suggested by the SEES: hence this uncertainty will need to be considered in relation to the dredging schedule and post-construction monitoring.

The IEG drew attention to the potential impacts of seagrass decline on dependent species, noting that the SEES had largely focused on implications for recruitment of larval fish such as King George whiting as well species which live as adults in seagrass beds, especially pipefish. It accepted that these species could be regarded as surrogates for a range of other species that rely on seagrasses, while noting that the impact on these species will depend on both the rate of seagrass recovery and the ability of species to utilise alternate seagrass habitats, and hence be subject to corresponding uncertainties.

The SEES argues that settling of suspended sediment is unlikely to have a significant, incremental effect on seagrass viability because it will be resuspended and rapidly disperse. However, the IEG suggests that seagrass beds below 5m and in areas protected from wave action could be subject to accumulated sediment for weeks.

Environmental limits. The SEES proposed to use turbidity (as optical backscatter measured in NTU) as an indicator of light availability for seagrass, with a limit of 25 NTU being used as a proxy to ensure the receipt of 15 percent of surface light at 3 m depth, at selected points in the vicinity of seagrass beds. However, in its May 2007 advice on the SEES, the IEG expressed doubts that a 25 NTU limit would protect seagrass, having regard to: (i) the adopted factors for converting NTU to TSS; (ii) the particular statistical measures that were to be used; and (iii) uncertainties in the rate of recovery of the Bay seagrass, especially *Amphibolis*. The IEG advice on the SEES (IEG May 2007) and advice on the EMP Revision C (IEG 6 September and 24 September) suggested that the limits warrant further consideration.

Conclusion. It is my assessment that:

1) Implementation of the CDP can be managed to avoid a significant long-term reduction in the ecosystem function, productivity and biodiversity of seagrass habitats in the Bay, and to minimise short-term impacts, due to habitat removal and turbidity effects of the CDP.

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[55] Bulthuis, D.A., (1983). The effects of light reduction on density and growth of the seagrass *Heterozostera tasmanica* (Martens ex Aschers) den Hertog in Westernport, Victoria, Australia. *Journal of Experimental Biology and Ecology*. 67. 91 – 103

[56] Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

2) The goal of seagrass management in the context of the CDP be to maintain the net area of seagrass in the Bay that is present prior to commence of the CDP.

To achieve the above objective, and having particular regard to the IEG's advice, it is my further Assessment that:

1) Turbidity generated by the CDP be managed to maintain irradiance at 3 m depth (or equivalent) within seagrass habitats exceeding 15 percent of surface irradiance for 50 percent of the time in any two week period.

2) The operational limits (in NTU) to protect *Zostera* and *Amphibolis* seagrasses during CDP works, and associated response levels, be refined with assistance from independent experts (preferably the IEG), including consideration of:

   (i) the appropriate limits for *Amphibolis;* and

   (ii) an additional "moving average" limit encompassing a longer period (e.g. eight weeks) for both *Zostera* and *Amphibolis*;

   (iii) the results of further calibration of light attenuation against turbidity.

3) PAR sensors be used at least at conformance sites within Marine Protected Areas (at Nepean Bay and Mud Islands), as well as at other sites that are likely to be affected by the CDP dredge plume (including Blairgowrie), to monitor compliance with the above irradiance objective.

4) Surveys of the extent of seagrass cover within the area affected, or likely to be affected, by the CDP turbidity plume be conducted during January-February at one, two and four years after the commencement of CDP dredging, using a methodology consistent with that used by Blake and Ball (2001).

5) If a significant reduction in the aggregate area of seagrass is detected from the survey one year after the commencement of CDP dredging, or other scheduled observations, consideration be given by PoMC or Minister for Environment and Climate Change, as appropriate, to:

   (i) Adjust the Project Delivery Standard for Dredging;

   (ii) Modify the irradiance objectives for seagrass protection; and

   (iii) Modify the operational limits (cf. above).

6) As an offset for the impacts of the CDP on seagrass a minimum sum of $3 million in new funding be allocated as a CDP cost for research into seagrass ecology in the Bay, focussing on long-term variations in seagrass cover in the Bay and its causes and options to manage these;

4.3.4 Ramsar-listed wetlands

Background and Legislative context

Relevant legislation and policy applying to the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site wetlands includes:

- *Ramsar Convention (Ramsar 1971) on Wetlands*, including its listing under Article 2 – it promotes the conservation, wise use and repair of wetlands and obliges member countries to list their Wetlands of International Importance and protect their ecological character.
- *The EPBC Act*, under which Ramsar wetlands are recognised as a matter of 'national environmental significance' – any action that has, will have, or is likely to have a significant impact on the ecological character of a Ramsar wetland, needs approval from the Australian Government Minister.
- Several of the migratory waterbird species that frequent the Ramsar site are listed under the *Japan-Australia Migratory Birds Agreement* (JAMBA); the *China-Australia Migratory Birds Agreement* (CAMBA); and the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention).
- The Spit Nature Conservation Reserve (Spit Wildlife Reserve) is declared a 'Sanctuary' under the *Wildlife Act 1975*. This means that wildlife is protected from hunting and wilful disturbance.
- *State Environmental Protection Policy 'Waters of Victoria: Waters of Port Phillip Bay'* (EPA 1997).

The EPBC Act, Sections 16 and 17B (wetlands of international importance), enacts legislation for the implementation of international agreements relating to the protection of flora and fauna species and communities under the Ramsar Convention. The Australian Government Minister for Environment and Water Resources provided a Statement of Reasons for Decision and controlling provisions which outline the matters of national environmental significance that could be affected by the CDP. In relation to Ramsar wetlands, the reasons stated by the Minister for determining that the CDP is a controlled action include:

- the project would occur within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsular Ramsar site and was likely to have a significant impact on the ecological character of this declared wetland on the basis that the dredging and spoil disposal was likely to result in:
    - changes to tidal levels, tidal currents and wave refraction around Port Phillip Heads, possibly resulting in long-term, permanent impacts on the hydrology of the declared Ramsar wetland.
    - changes to waves and tides could cause shoreline instability and erosion which could affect seagrass meadows and pose a serious disruption to the lifecycle of native species dependent on the wetland seagrasses.
    - increased turbidity, nutrient and pollution loads which is likely to impact on water quality of the wetland and alter the physio-chemical status of the wetlands.
- the project would have a likely impact on a number of listed threatened species and listed migratory species.

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site contains both terrestrial and intertidal areas of international importance. These sites include:

- sections of the Western Treatment Plant.
- a coastal section from Skeleton Creek to Point Cook and another between Point Wilson and Limeburners Bay.
- Swan Bay.
- Mud Islands.
- The Spit Nature Conservation Reserve (Spit Wildlife Reserve).
- Avalon Airfield.

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site was designated primarily in recognition of its high value as habitat for avifauna, including important migratory species, although it is also of special value for maintaining the genetic and ecological diversity of the flora and fauna of the region. The site hosts 36 species under the JAMBA agreement and 40 species under the CAMBA agreement. This Ramsar site is highly representative; its components cover all eight wetlands types in Victoria's protected network, including examples of the State's most depleted wetland habitats[57].

The site has very high ecological values, providing a range of important natural functions – e.g. the saltmarsh communities and intertidal zones provide important habitat, feeding grounds and drought refuge for a number of species, even more so when inland lakes and wetlands are depleted or dry. The Ramsar site also has high conservation significance for other communities and habitats of indigenous plants and animals.

Swan Bay, Mud Islands and the Spit Wildlife Reserve are internationally significant habitats for a number of migratory birds. These three areas are the most likely components of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site to be affected by the CDP.

The *Spit Wildlife Reserve* is 300 hectares in size and is made up of a north and south spit, a lagoon and saltmarsh vegetation area. The spits are approximately four kilometres long and occur between a 300 - 500 m wide strip of sand and sea shell coast. The spits or sand bars vary in shape and size depending on the state of the tide. This environment provides an area which is an extremely important feeding ground for a great variety of birds, in particular, it is a primary wintering area for the endangered Orange-bellied Parrot. It supports breeding colonies of Pied Cormorants and has a high diversity of habitat types and high value for birds including trans-equatorial migratory shorebirds. Over 240 bird species have been recorded in this area[58]. The Spit Wildlife Reserve located at Point Wilson is declared a 'Sanctuary' under the Wildlife Act.

The *Swan Bay* ecosystem is one of the most significant in the Bay. The intertidal mudflats and surrounding fringe of salt marsh support large numbers of waderbirds including many that migrate from the Northern Hemisphere[59]. Internationally

[57] Department of Sustainability and Environment, 2003, *Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar Site Strategic Management Plan*

[58] Department of Sustainability and Environment, 2003, *Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar Site Strategic Management Plan*

[59] Parks Victoria Website, www.parkweb.vic.gov.au/1park_display.cfm?park=268).

significant populations of shorebirds that inhabit Swan Bay including, Grey Plover, Eastern Curlew, Sharp tailed Sandpiper, Rednecked Stint and Curlew Sandpiper. The critically endangered Orange Bellied Parrot uses the saltmarshes fringing Swan Bay and within Spit Wildlife Reserve as a winter refuge and feeding ground.

The *Mud Islands* provide significant habitat for many birds, including endangered and long distance migratory species. Mud Islands support the largest colonies of breeding waterbirds and seabirds in the Bay. These include over 2,000 pairs of Crested Terns, up to 5,000 Whitefaced Storm Petrels, several hundred Australian Pelicans, thousands of Straw-necked Ibis and a small colony of Yellow-billed Spoonbills.

Intertidal mudflats which occur at these Ramsar areas lie adjacent to the water's edge and are the most important feeding grounds for many wading shorebirds in the Bay. They are periodically enriched by beach-washed sea-weed and support a diverse range of marine in-fauna that are the prey of wading shorebirds birds such as herons, egrets, spoonbills and teal.

Analysis of Key Issues

The SEES assessed the effects of the CDP on Ramsar sites in the Bay by undertaking a terrestrial ecological assessment which considered review of literature, field surveys, and other relevant technical studies such as the hydrodynamic and sediment transport modelling. This together with the Inquiry's analysis is considered in terms of the key relevant effects or hazards the CDP presents for the above mentioned wetland areas.

1. Effects of tidal levels, tidal currents impacts on the hydrology of the declared Ramsar wetland.

The Ramsar areas potentially affected by CDP are Mud Islands, Swan Bay, and the Spit Nature Conservation Reserve, principally because these areas are low-lying and do not have broad natural or artificial elevation which will act as a barrier to an increase in sea level. Potential effects from changes to hydrodynamics (i.e. changes to currents, tides and waves leading to changes in sea level) as a result of the CDP include effects on vegetation and intertidal communities and habitat.

The SEES modelling predicted changes to sea level at Swan Bay, Mud Islands and the Spit Wildlife Reserve. Changes in currents at these sites are predicted to be negligible. In relation to the original dredging case of -19.1 m depth in the Great Ship Channel (GSC), the SEES predicted the following specific changes to sea level near relevant Ramsar wetlands:

- Point Wilson (Spit Wildlife Reserve): 15 mm lower, and 8 mm higher.
- Queenscliff (Swan Bay): negligible change.

In relation to the rock-scour scenario of -22 m depth in the GSC:

- Point Wilson: 20 mm lower, and 20 mm higher.
- Mud Islands: 27.5 mm lower, and 17.5 mm higher.
- Queenscliff (Swan Bay): 35 mm lower, 15 mm higher.

The SEES explained that these sea levels will occur at high or low water particularly during spring tides, and due to the nature of tidal variation will only be at these extreme levels for a short time, certainly much less than one hour.

It is anticipated that the frequency of inundation of the saltmarsh communities in Ramsar areas will increase slightly, due to the CDP, based on the predicted tides and sea level changes. However, these predictions do not account for extreme events such as storm surge or king tides which have the highest water levels due to a combination of tide, wind forcing, low atmospheric pressure and other factors. The SEES concluded that both the frequency and intensity of these extreme events are not expected to change significantly due to CDP.

The Rock Scour Supplementary Assessment reports considered the gradient of the shoreline and the predicted change in sea level under the rock scour scenario and estimated that inundation and landward migration of the coastal saltmarsh was likely:

- The Spit Wildlife Reserve – at the south of the Spit inundation and landward migration of coastal saltmarsh of 10 to 25 m, or approximately 1 to 2.5 ha per km of coastline. The north of the Spit is constrained by the artificial barriers is not expected to be affected.
- Swan Bay - landward migration of coastal saltmarsh of potentially up to 3 m, or 0.3 ha per km of coastline.
- Mud Islands - only a slight migration landward of coastal saltmarsh is predicted due to the buffering of this area by dunes. Limited survey data is available in this area, and therefore the distance of migration landward was not quantified.

This inundation of the coastal saltmarshes will expose the upper edge of the vegetation community to higher salinity, favouring the more salt tolerant plant species over the less salt tolerant species. The SEES and the Rock Scour Supplementary Assessment reports concluded that no net loss of coastal saltmarsh community is expected from the CDP. It explained that the inundation and increased salinity is likely to result in an increase in the vertical extent of these saltmarsh communities, translating into a gradual horizontal (landward) migration of the salt marsh zone. The landward migration of coastal saltmarsh vegetation will presumably replace the native and exotic grasslands vegetation. Over time saltmarsh communities in the Bay have colonised new areas of the intertidal zone changed through natural and artificial movement of sediments.

This finding is supported and it is consistent with both the increase in sea level and inundation from the CDP dredging and rock scour processes, the latter estimated to occur gradually over approximately 10 years. It should be noted that the rock scour scenario described above is a ‘worst case’ scenario, and it is possible that these effects will be less than predicted.

In relation to a decrease in sea level from CDP, the SEES and Rock Scour Supplementary Assessment report predicted that effects on intertidal mudflats are likely to result in slightly more intertidal habitat being exposed. The SEES generalised that an increase in area of intertidal habitat could benefit wading birds by increasing feeding area and opportunities.

The increase in area of intertidal habitat exposed during low sea level depends on the slope of the sea floor, but this was not quantified in the SEES due to limited information. This results in uncertainty in the prediction and assessment of effects on intertidal species including in-fauna and seagrass. Nevertheless, the gradient of the seabed in the western Bay would be similar to the gradient of the land, and it is reasonable to assume that a decrease in sea level of approximately 20 mm would result in exposure of intertidal mudflats of in the order of 10 – 20 m.

The SEES and the Rock Scour Supplementary Assessment report concluded that the impact to the Ramsar wetland areas from changes to tides and hydrology is not expected to be significant, for the following reasons:

- The SEES predicted that there will be a net increase in saltmarsh habitat in the Bay from the CDP, and this may benefit some migratory species that utilise this habitat, such as water birds and the OBP. While this proposition is plausible, it should be made clear that a net increase in saltmarsh vegetation is a result of a net decrease in grassland vegetation, due to landward migration of the saltmarsh community. Both saltmarsh and grassland vegetation types have significant ecological value. (It should be noted that other 'net' increases in saltmarsh in areas outside of the Ramsar area cannot be considered in the context of the assessment of effects on Ramsar sites.)
- The SEES explained that the effects of CDP on vegetation communities should be compared against the effects of both extreme natural events (e.g. king tides, and storm surges) and against the predicted sea level rise due to anthropogenic climate change. It is reasonable to assume that the sea level rise predicted to be caused by climate change of 2.5 mm per annum is likely to absorb the sea level effects of the CDP in a relatively short timescale – in the order of one to two decades. In this context, it will be difficult to distinguish effects on vegetation community due to the CDP from effects due to natural events and/or anthropogenic global warming. The effects of CDP on intertidal mudflats should also be compared against the effects of the predicted sea level rise due to anthropogenic climate change, as discussed above.

The Inquiry concurred with these findings, concluding that effects on Ramsar wetlands and their intertidal mudflats, due to predicted changes in tides and sea levels, are not expected to be significant in the context of natural variation and other influences.

2. Effects of waves and tides on shoreline stability and erosion on seagrasses and flow-on effects on dependent species.

The SEES explained that the hydrodynamic and sediment transport modelling did not identify measurable changes to tidal currents or waves, or changes to sediment transport in the Ramsar areas. This indicates that the CDP will not cause erosion or shoreline instability in the Ramsar areas.

However, the IEG and PoMC's peer reviewer considered the hydrodynamic and sediment transport modelling, and advised that uncertainty remains about the long-term predictions of sediment transport in the Great Sands area, including the Mud Islands. This also relates to the future maintenance dredging needed to maintain the deepened channels, which is not well established at this stage. To address this uncertainty it is recommended that PoMC should undertake monitoring of the Great Sands region as part of the EMP, both before and after CDP, including the southern bay beaches (Lonsdale Bight) and Mud Islands.

3. Effects of increased turbidity, nutrient and pollution loads on water quality in and around the wetlands.

The SEES turbidity modelling of the dredge plume predicted that the plume will not extend to the Spit Conservation Reserve, but will extend to the Swan Bay and Mud Islands. The turbidity modelling indicated that the concentration of the plume and

associated sedimentation at Swan Bay and Mud Islands will be low, and noted that the predicted concentrations of the plume in these areas will largely be within natural variation for turbidity observed in the Bay. The concentration of the turbid plume is not expected to reduce light (as it will not exceed 5 mg/L) and therefore will not effect photosynthesis of benthic plants such as seagrass in the Ramsar areas. The SEES concluded that the effects of the turbid plume and sedimentation on Ramsar sites are negligible.

In relation to contaminated sediments, the SEES sediment characterisation assessment identified that the some of the sediments to be dredged in the Yarra River and Port Melbourne channels were contaminated. The turbidity modelling predicted that the plume during dredging and disposal of contaminated sediments will not extend to the Spit, Mud Islands and Swan Bay. The sediment characterisation assessment identified that the levels of contaminants in sediment to be dredged from the South Channel are low and will not affect marine or terrestrial biota. The SEES concluded that the effects of contaminated sediments at the Spit, Mud Islands and Swan Bay Ramsar areas are negligible.

In relation to nutrient cycling, the SEES concluded that the quantity of additional nutrients released during the CDP is small in the context of total annual nutrient loads entering the Bay. On this basis, the CDP will have negligible effects on the Bay's nutrient cycling processes, and therefore it is unlikely there will be any effects to Ramsar areas from an increase in nutrients during the CDP

4. Other effects on marine and terrestrial species commonly associated with these Ramsar wetlands

As discussed above, effects of the CDP on the vegetation communities of the three relevant wetlands are not likely to be significant and are therefore predicted to have no impacts on the ecological values and character of these Ramsar habitats. It is anticipated that a net increase in saltmarsh will result in an increased area for habitat for associated flora and fauna, and potentially have some benefits to these biota. In addition, the predicted increase to exposed tidal mudflats is possibly beneficial to associated biota. Some of the possible benefits predicted within the SEES include:

- Increase in Saltmarsh habitat available (due to greater high tides) in the long term for the critically engendered (EPBC Act listed) Orange bellied Parrot (OBP). It is known to utilise current Saltmarsh habitat at the Spit Wildlife Reserve and Swan Bay.
- Slight increase the amount of exposed intertidal mudflats (at low tide), likely to result in further intertidal habitat opportunities and therefore benefits for wading birds.

Refer Section 4.3 for assessment of effects on birds.

Conclusions. Having regard to the SEES, Supplementary Rock-scour Reports and the Inquiry's Report, it is my assessment that:

1) Changes to tides, currents and hydrology from the CDP (dredging and subsequent rock scour) are unlikely to have a significant adverse effect on coastal saltmarsh or intertidal mudflat habitats, or associated listed and migratory species, within the Port Phillip Ramsar site;

2) The small change in high and low water levels predicted to result from the deepening of the GSC, may lead to a minor lateral migration of habitats within

different parts of the Port Phillip Bay Ramsar site;

3) Changes to sediment transport and coastal processes are unlikely to cause measurable changes to sediment transport or erosion/accretion around the shorelines of the Ramsar areas;

4) Any lateral movement of habitats or other effects related to the CDP are unlikely to have a detrimental effect on the Orange-bellied Parrot;

5) The CDP will not have a significant impact on the overall ecological character of the wetlands that make up the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.

Further, it is my assessment that:

1) In light of the potential for a minor lateral migration of habitats within different parts of the Port Phillip Bay Ramsar site, due to the predicted very small change in high and low water levels, it will be prudent to monitor changes in the extent and health of key coastal and intertidal vegetation communities, relative to the predicted effects of the CDP. The monitoring sites should include Swan Bay, the Spit Nature Conservation Reserve, Jawbone Reserve, and Mud Islands;

2) Although no erosion of Mud Islands, the Spit or other parts of the Ramsar site are likely, it will be prudent to undertake monitoring of any long-term changes of sediment transport in the Great Sands area to allow appropriate responses in terms of future maintenance dredging;

3) An environmental offset payment of $500,000 be made by PoMC to support habitat improvement works within the Ramsar site.

4.3.5 Reef communities in the Entrance

Ecological communities on the rocky reefs in the Entrance are a specific feature of the Bay's biodiversity. There are distinct communities developed on shallow, intermediate and deep reefs. The CDP is likely to impact mainly the intermediate and deep reefs.

Intermediate depth reef communities. Intermediate depth reefs to 17-20m depth occur in the Entrance at Point Lonsdale and Point Nepean, as well as on Nepean Bank and Rip Bank. These distinctive reefs, exposed as they are to oceanic conditions, are dominated below about 5 m by kelps which are common on the Victorian coast from Cape Otway to Cape Schanck, especially *Ecklonia radiata* and *Phyllospora comosa*. Both the green alga *Caulerpa* and diverse red algae are also present in the Entrance. In addition to numerous fish that eat the reef invertebrates, there are herbivorous fish that eat kelp or algae, including pipefish, seahorses and weedy and leafy seadragons.

CDP effects on intermediate reef communities. Dredging in the Great Ship Channel will remove 9.5 ha of intermediate depth reef habitat from Rip Bank and the western section of Nepean Bank. Following the TDP, juvenile *Ecklonia* was observed to recolonise bare rock after six months. The SEES acknowledges, however, that the re-establishment of a mature *Ecklonia* community with other locally common

seaweeds and invertebrates may take considerably longer[60]. The process of recovery is likely to be inhibited locally in areas of mobile rubble, which is mobilised by the turbulent conditions. Consequently, recolonisation may be patchy.

The impact of mobile rubble on the Entrance plateau on the *Ecklonia* community is likely to be significantly exacerbated by the process of rock scour that may occur to varying degrees after dredging is complete (refer section 4.3.2 for further details). A greater effect would result from a wider area of impact as rock is eroded and mobile rubble move beyond the dredged zone, as well as from the impeded and delayed recovery as the scour processes diminish and the seafloor restabilises.

The IEG has advised that[61]:

> In the SEES and its technical appendices, recovery was predicted to take more than two years. The scenarios presented in the supplementary rock scour reports could result in recovery being delayed by up to 30 years, in the worst case. There is considerable uncertainty associated with the predictions of recovery, although the argument that recovery will be pushed well beyond 5 years seems sound.

It is relevant to note here that blasting between 1901 and 1986 extensively modified the area within the Great Ship Channel. The existing *Ecklonia* community within this area is indicative of the potential for substantial recovery over the longer term.

Deep reef communities in the Entrance. Deep reef communities, those more than 20m deep occur within the three kilometre long marine canyon that winds through the Entrance. The reef of sculpted calcarenite rock within the canyon is extensively covered with a diverse sessile invertebrate fauna, including sponges (65 percent cover overall), as well as hydroids, anemones and bryozoans - fauna that are able to flourish in areas with strong currents, and low light conditions, and are able to attach to rock or other firm substrate.

Dr Matt Edmunds advised the Inquiry that Port Phillip Heads is a place of high biodiversity, including many species of sponges, hydroids and bryozoans known only from this location that were recorded during the nineteenth century. He also noted that the sessile invertebrate assemblage is distinct from other deep reef systems in Victoria, at The Arches, Twelve Apostles, Point Addis and Wilsons Promontory[62].

It is noted, however, that all of the sessile invertebrate fauna identified to species level as part of the SEES study comprises a suite of species that occurs extensively off the Victorian coast and elsewhere in southern Australia[63]. According to the SEES, no threatened or listed species of diverse sessile invertebrates were found in the canyon.

Dr Edmunds noted that most sessile invertebrate species can only be identified by laboratory examination, and hence ecological studies of associated communities cannot be carried out at the species level. While some species can be identified in

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[60] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Deep Canyon*, CEE Consultants, Richmond, Victoria, SEES Technical Appendix 51

[61] Independent Expert Group, 24 September 2007. *Advice to SEES Inquiry on rock scour in The Entrance and associated physical and ecological flow-on effects*

[62] Edmunds, M (2007) *Expert Witness Statement* Prepared for PoMC, Channel Deepening Project Supplementary Environment Effects Statement Inquiry, p.11

[63] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Deep Canyon*, CEE Consultants, Richmond, Victoria, SEES Technical Appendix 51

the field, studies of abundance and distribution are largely limited to morphological types. The SEES studies of deep reef communities at the Entrance therefore relied on the statistical identification of species/morphotype faunal assemblages, which could then be mapped.

The IEG supported the adopted approach to sampling of deep reef biota, stating both that the SEES provided "the first comprehensive snapshot of organisms living in this environment", and that further sampling effort to identify species was not warranted for the impact assessment. The IEG also noted that the statistical analyses of ecological assemblages did not identify discrete communities. This view was consistent with PoMC's consultant[64], who concluded that the ecosystem in the canyon "is fundamentally a sponge community with small scale patchiness and larger scale gradients in character".

Rockfall into deep canyon. The experience of the TDP showed that, as a result of dredging in the Entrance, some rock is likely to fall into the deep canyon, causing damage to deep reef biota as it moves down slope. PoMC has estimated that between 10 and 20 percent of the 30,000 m^3 of rock dredged during the TDP fell into the canyon. In light of the hazard that rock fall represents to the reef biota, since the TDP PoMC has developed dredging methods that would greatly reduce the level of rock fall during the CDP. The proposed methods include the use of a specialised draghead to reduce the amount of residual rock, as well as regular "clean up" of loose rock by the TSHD. Also, a 5m high ridge of rock is to be retained along the edge of Nepean Bank for as long as possible to minimise rockfall, including into the adjoining Marine National Park (MNP). Up to 0.35 ha of the MNP could be affected by rockfall, which is only 0.01% of the its total area of 3580 ha.

Modelling undertaken for the SEES predicts that 4,300 m^3 of rock will fall into the canyon, compared to 3000-6000 m^3 from the TDP. The resulting amount of damage to biota will depend on the amount of loose rock, the slope of the seabed and the small-scale topography. The SEES estimates that rockfall into the canyon will affect a total area of 18 ha as it rolls across the surface, though with rock permanently accumulating in an area of only 2.4 ha. As a result, the physical change to the canyon slopes is likely to be quite minor.

CDP effects on deep reef communities. The significance of the rockfall impacts on the deep reef biota will depend on:

- The spatial extent, severity and duration of physical impact;
- The diversity, rarity and ecological function of the affected biota; and
- The likely rate of ecological recovery.

The SEES estimated a total area of 13.5 ha of affected habitat, with varying levels of impact severity in terms of removal of biota. Dr Edmunds' study determined that the impact of CDP-induced rockfall on different sessile invertebrate faunal assemblages would be quite variable, depending on the extent and duration of their exposure. About 6 ha may be subject to temporary cover by small rubble, with little resultant effect on biota. Partial to total removal of biota by rockfall scouring may occur over an area of 7.5 ha.

As these assemblages do not represent discrete communities, the significance of impacts on particular assemblages needs to be considered. Dr Edmunds was of the

[64] CEE Consultants (2007) *Port Phillip Bay Channel Deepening Project, Overview Impact Assessment Deep Canyon*, CEE Consultants, Richmond, Victoria, SEES Technical Appendix 51

view that there might be "major" consequences for particular assemblages and sponge types. In contrast, Scott Chidgey, another expert witness for PoMC, considered the immediate effect of rockfall on the invertebrate community to be "moderate". As well as noting that the identified species were common, Mr Chidgey considered that "none of the species are major habitat forming species or have an ecological or community functional significance". (p.50)

While the diversity of faunal types and assemblages in the Entrance is acknowledged, since intensive survey efforts for the SEES did not identify either rare species or distinctive ecological communities, it can be concluded that biodiversity and ecological values will *not* be greatly impacted by the CDP. In particular, the available evidence does not indicate that rare endemic species will be affected by the CDP dredging in the Entrance, assuming that some number of these are still present. It is possible that blasting in the period 1901-1986, as well as collecting of specimens, may have had a major impact on the occurrence of these rarer species.

The ultimate impact of the CDP on ecosystems in the Entrance will depend on the extent of recovery. The IEG has observed that recovery of areas impacted by rocks will occur by two mechanisms:

> "first through regeneration of damaged parts of animals like sponges, which in shallow waters would be quite rapid; and, second through the arrival, establishment, and growth of planktonic larvae of species that can live in the Entrance region" (IEG, May 2007, p.35).

In the context of evidence from initial post-TDP recovery, the report by CEE (2007, p.63) states that:

> Regrowth of biota in scoured or permanently covered areas is likely to commence within weeks of stabilisation of the rockfall. The consequent growth and succession of the encrusting community over these areas is likely to range from:
>
> - Weeks for establishment of first colonisers or commencement of regrowth from adjacent areas;
> - Months for total coverage of stabilised areas with biological growth;
> - Two years for recovery of general community functionality (identifiable filter biota);
> - Five years for recovery of general diversity.

The IEG noted the uncertainty in relation to rates of recovery. This arises largely from the limited scientific evidence available on rates of recovery, particularly in relation to limited knowledge on rates of arrival of larval stages and their rates of successful establishment[65].

Further mitigation of CDP effects on reefs. The IEG has identified opportunities to further reduce the extent of rock spill, in addition to the measures proposed by PoMC. These further measures have the potential to reduce the amount of rock fall affecting deep reef biota, as well as the extent and duration of rock scour affecting the recovery of the *Ecklonia* community on the plateau (strategies to address rockfall are covered in section 4.2).

[65] The IEG commented that the terms used to describe recovery ("functional recovery" and "general diversity") are not recognized scientific terms and hence their implications are unclear.

Conclusions regarding Entrance reefs. It is my assessment that:

1) No known listed or protected species have been identified from the reef habitats that are likely to be directly affected by the CDP, i.e. through the intensive studies undertaken for the SEES, and hence any such species occurring in the Entrance are unlikely to be significantly affected by the CDP;

2) The CDP will have a significant temporary impact on the deep reef community, in particular. A full recovery will occur, though over a period in excess of five years;

3) The CDP dredging can be managed to effectively minimise short-term impacts and enable the progressive recovery of habitat as post-dredging erosion stabilises, so as to avoid a significant long-term reduction in ecosystem function, productivity and biodiversity of reef communities in the Entrance, including within the MNP.

It is further my assessment that:

1) In finalising the EMP, the definition of the canyon edge, in order that the "draghead lift-off distance" and the 5 m wide ridge on Nepean Bank can be geographically specified for audit purposes;

2) In addition, in finalising the EMP, the following be incorporated:

   - The video survey nominated in the EMP to occur within 4 to 6 weeks of completing dredging be used to assess the effectiveness of clean-up operations;
   - Assessment of the results of the video survey be timed to effectively inform the proposed schedule of dredging operations in the Entrance; and
   - If necessary, surveys be repeated so that the effectiveness of clean-up operations is confirmed;
   - The mooted further clean-up operation be scheduled just prior to the completion of CDP dredging in the Bay, and that this clean-up be to the satisfaction of the Minister for Environment and Climate Change or delegate;

3) Post-construction monitoring of the recovery of the reef habitats affected by the CDP dredging include surveys four and ten years after dredging;

4) To offset the CDP impact on the reef community, PoMC make a $2.5 million contribution to research on the reef ecology of temperate Australian waters, preferably in Victorian waters.

4.3.6 Other 'natural' benthic habitats

1. Effects on ecosystem function, productivity and biodiversity of other 'natural' benthic habitats.

The Bay has a diverse range of marine habitats which are shaped by physical factors such as water depth, substrate type (sand, silt or mud) and the level of shelter or exposure to hydrodynamic forces (i.e. currents and waves). The Bay's habitats provide food and shelter to a rich biodiversity of flora and fauna. Invertebrate and vertebrate fauna are preyed upon by larger invertebrates and fish, which in turn are preyed upon by sharks and rays, as well as seabirds, dolphins and seals. The Bay's habitats can be broadly defined as follows:

- water column;
- bare sediments (soft seabed);
- macroalgae (seaweed beds);
- seagrass meadows;
- pyura (seasquirt) beds;
- intertidal and shallow reef; and
- deep canyon.

Both the seagrass and the deep reef habitats are covered in section 4.3.3 and section 4.3.5 respectively of this Assessment.

Analysis of Key Issues
The SEES assessed the affects of the CDP on the Bay's marine habitats by considering a review of literature, some field surveys (e.g. reefs in the Entrance), and the findings of other relevant SEES assessments of hydrodynamic and turbidity modelling, and sediment characterisation.

***Water column*.** In the water column, phytoplankton drives the productivity of the Bay's ecosystem. Phytoplankton are microscopic plants which require light for photosynthesis. Phytoplankton are preyed upon by zooplankton, which are a key food source for anchovy, which in turn are preyed upon by fish, penguins, and birds.

The SEES explained that the turbid dredge plume during the CDP has potential to affect the water column habitat by reducing visibility and light penetration. The SEES predicted that effects on phytoplankton due to reduced light during the CDP is likely to be negligible, as it can move vertically in the water column to compensate for decreased light, and the area of the plume is small compared with the area of the Bay. Recovery of phytoplankton is predicted to be within months of completion of the CDP.

Bare sediments (soft seabed). Eighty percent of the Bay's seabed is soft sediments, comprised of fine sand, silt and clay. The bare sediment habitat supports a diverse infauna invertebrate community (i.e. mobile and sessile benthic animals that live and burrow in the substrate such as worms and crustaceans), which in turn are preyed upon by fish.

The SEES explained that the CDP will remove the bare sediment habitat in the channels to be dredged, and smother the habitats during disposal of dredged sediments at the proposed southern and extended northern DMG's. It concluded

that the total area of bare sediment habitat affected is minimal in the context of the total area of bare sediment habitat in the Bay. In this context, the SEES predicted that recovery of bare sediment habitats will be within 12 months following completion of the CDP.

Pyura (seasquirt) beds. Pyura (*Pyura stolonifera*) is a filter-feeding invertebrate, with each individual anchoring itself to the seabed with a large root. Aggregations of pyura in the south and north of the Bay provide important habitat and substrate for attachment of a range of flora and fauna such as seaweeds, sponges, crabs and echinoderms. Pyura are thought to be long-lived (> 5 years).

The SEES assessment explained that the turbid dredge plume and sedimentation during the CDP could potentially smother pyura habitat, particularly in the areas near the south channel. However, pyura can withstand periods of high suspended sediments because of physiological mechanisms such as closing siphons during heavy suspended sediments loads including burial, and back squirting to remove accumulated silt[66]. On this basis, Pyura are not expected to be significantly affected by the dredge plume or sedimentation, with recovery within 6 to 12 months following completion of the CDP.

Macroalgae (seaweed beds). Macroalgae requires light for photosynthesis. Macroalgae are important habitats as they provide food and shelter to a range of vertebrate and invertebrate species, such as crustaceans, bivalves, gastropods, and juvenile fish such as snapper. Macroalgae may be either attached to a substrate on the seabed such as kelp forests in the south of the Bay, or unattached at the seabed as 'drift algae' such as red (rhodophyta) algal beds in the north of the Bay. The distribution of unattached macroalgae is highly spatially and temporally variable. Macroalgae plays a minor role in nutrient cycling compared to phytoplankton and MPB[67].

The SEES explained that the turbid dredge plume during the CDP has potential to reduce light penetrating into the water column, thereby affecting the productivity of macroalgae habitats in the Bay, and possibly cause some change in community composition toward species that are more tolerant of lower light conditions. The SEES concluded that, for example, based on the localised extent of the plume from the Port Melbourne Channel and the PoM DMG, the effect of reduced light on attached and unattached macroalgae habitats, in the immediate vicinity is considered to be minor. Recovery is predicted within one year of completion of the CDP. Effects on kelp habitat are discussed below under shallow reefs.

Intertidal rock platform and shallow reef. The Bay's intertidal rock platforms are often associated with shallow rocky reefs. The most expansive intertidal rock platforms in the Bay are in the Entrance area, which is characterised by a covering of the alga (*Hormosira banksii*) and associated invertebrates.

The Bay's shallow rocky reef habitats predominantly occur nearshore. Shallow rocky reefs in the south of the Bay and the Entrance are exposed to strong hydrodynamic forces, and are dominated by large kelps with an understorey of red algae. Reefs in

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[66] CEE (2007). *Port Phillip Bay Channel Deepening Project Marine Ecology Head Report Impact Assessment*. SEES Technical Appendix 49

[67] Commonwealth Scientific & Industrial Research Organisation (CSIRO) (1996) *Port Phillip Bay Environmental Study*, CSIRO Publishing, Dickson, ACT

the north of the Bay are more sheltered and have a more delicate flora. Rocky reef habitats support a diverse invertebrate and vertebrate community.

The SEES explained that dredging in the Entrance will have a significant affect by removing 9.5 ha of shallow reef and kelp habitat in the Great Ship Channel, with on-going effects in this area predicted due to rock scour processes mobilising rock material following completion of the CDP. Recovery of the kelp community is expected to be within 1 to 5 years; however, rock scour creates uncertainty about this prediction (refer to section 4.3.5 for further details on rock scour and its effects at the Entrance). The SEES highlighted that these shallow reef habitats and associated communities are relatively common along the Victorian coastline. The CDP is not expected to have significant ecological effects on other shallow rocky reefs and intertidal platforms in the Bay, including those in the Bay's Marine National Parks and Marine Sanctuaries (refer to section 4.3.9 for my assessment of Marine National Parks.

Other matters. It should be noted that introduction or proliferation of marine pests during placement of rock dredged in the Entrance is considered to be minor and a low risk, because the rock will be covered with a 0.5 m layer of sand.

Conclusion
Having regard to the SEES and the Inquiry's report, it is my assessment that:

1) Effects of the CDP on the Bay's natural marine habitats will be minimal and are acceptable;

2) Recovery of affected benthic habitats (e.g. bare sediment habitats, pyura beds, seawed beds) is generally predicted to occur within one year following completion of CDP, with the major exception being shallow reef communities in the Great Ship Channel which may take from one to five years to recover; and

3) No specific measures are required to address CDP effects on these habitats, though EMP measures that are proposed for other reasons will assist to mitigate effects.

4.3.7 Native fish species in the lower Yarra River

Bream and eels. A range of native fish species occur in the lower Yarra River, some of which reside there and others that migrate through or temporarily reside during part their lifecycle. Two species are black bream (*Acanthopagrus butcheri*) and short-fined eel (*Anguilla australis* Richardson), both of which are found in river estuaries around the Bay.

Black bream spawn many times between September and December, probably in the upper reaches of the estuaries. Larvae remain in the water column for about a month before juveniles settle into shallow algae or seagrass beds, such as those located along the coast near St Kilda.

Dredging in the lower Yarra River will temporarily remove the seabed community used by benthic feeding fish species, such as bream. Until a new layer of silt is deposited and benthic invertebrate communities can then re-establish themselves, the area of estuarine feeding habitat suitable for bream will be reduced and a proportion of the local bream population is likely to move to other areas, including the upper Yarra River estuary and the Maribyrnong River, until suitable conditions return in the lower Yarra River[68]. A recovery period of one year has been estimated.

The short-fined eel is common in coastal streams in south eastern Australia. Adult and juvenile eels migrate through the Bay to the sea from about November to May, and juvenile eels return to estuaries from July to September. Migrations of adult and juvenile eels through estuaries occur mainly at night.

The main CDP impact on eels is likely to arise from turbidity affecting their upstream migration. While a temporary reduction of the eel population in the Yarra River catchment may result from the CDP, recovery is likely to occur in one to two years. There are no implications for wider eel populations in Victoria.

Listed fish species. Three fish species listed under the FFG Act have been recorded in the lower reaches of the Yarra River, viz. Yarra pygmy perch (*Nannaperca obscura*), Australian grayling (*Prototroctes mareena*) and Australian mudfish (*Neochanna cleaveri*). The first and third of these species are also listed as vulnerable under the EPBC Act.

Yarra pygmy perch. While the Yarra pygmy perch was first recorded from lagoons along the Yarra River near central Melbourne in 1870, no specimens have been recorded since the early 1870s and this freshwater species is believed to be extinct in the Yarra River river basin[69]. It is, however, found in the Maribyrnong basin and elsewhere in south-western Victoria, in slow-flowing or still water with abundant aquatic vegetation.

Australian grayling. No surveys of Yarra River fish populations were undertaken as part of the SEES, although the Assessment Guidelines indicated that further baseline studies might be needed for listed indigenous fish in the lower Yarra River. In the absence of survey information which might have indicated its presence or absence, it is assumed here that a viable population of Australian grayling continues to utilise the

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[68] Primary Industries Research (2006a) *Channel Deepening Supplementary Environment Effects Statement - Aquaculture and Fisheries*, Primary Industries Research, Queenscliff, Victoria, SEES Technical Appendix 57

[69] Department of Sustainability and Environment (2003) Action Statement for Yarra pygmy perch, Edelia obscura, under *Flora and Fauna Guarantee Act 1988*

lower Yarra River, as part of its diadromous lifestyle migrating between fresh and brackish or salt waters. While the grayling has recently been recorded from the Yarra River at Dights Falls[70], the Yarra River does not appear to be a stronghold for the species. In Victoria it has been most frequently collected from the Tambo, Barwon, Mitchell and Tarwin River systems. It also occurs in coastal streams in NSW and Tasmania. It is absent from the Murray-Darling system.

Grayling in the Yarra River spawn in their 'adult' upstream habitat at various times from about late March to mid June with the larvae then drifting passively to estuaries or the sea[71]. Spawning in this species is short and synchronised, with most fish having completed their spawning in a period of two to three weeks. Larvae would then transit the lower Yarra River in the period between about mid April and mid July and spend their juvenile period in the Yarra River estuary or in the Bay itself.

Upstream migration of juvenile grayling in Victorian rivers has been observed to occur between October and December. As the grayling is a schooling fish, the return migration may occur within a short period.

Grayling are highly fertile (e.g. about 50,000 eggs in mature females) and can breed after one year. Further, since they typically have a breeding span of two to three years, they have a strong capacity to recover from the loss of local cohorts.

Australian mudfish. Only one record of Australian mudfish exists from the Yarra River out of a total of 29 records in Victoria, a single specimen from a sample of about 3000 galaxiid 'whitebait' taken at Dights Falls on the Yarra River in 1992. It is quite possible, though uncertain, that a viable population of mudfish, another diadromous species, continues to utilise the lower Yarra River[72].

Other Victorian occurrences are in the Otway Ranges, in the Barwon River near Geelong and at Wilsons Promontory. The mudfish is relatively common in Tasmania. This difference in its abundance in Victoria and Tasmania is reflected in its listing under the FFG Act but not the EPBC Act.

The mudfish is thought to spawn in late winter to early spring, though there are no recognised spawning sites in Victoria. While spawning occurs in freshwater, it is likely that larvae drift passively to the sea, where juveniles then spend part of their early life stages before dispersing into waterways and migrating upstream in spring at about two months of age[73]. Adult Australian mudfish are found in low, lying swampy areas in and just above the estuarine areas of coastal streams – which have been lost in the Yarra River.

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[70] McDowall (1976), Zampatti, B. et al (2003) *Assessment of the rock-ramp fishway at Dights Falls, Lower Yarra, Melbourne.* Unpublished report Arthur Rylah Institute for Environmental Research, DSE, Mebourrne.

[71] Hall, D.N. and Harrington, D.J. 1989. Studies on the spawning and early life history of Australian grayling Prototroctes maraena Günther in the Barwon River, Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 84. Department of Conservation, Forests and Lands, Melbourne.

O'Connor J. P. and Mahoney J. C. (2004). Observations of ovarian involution in the Australian grayling (Prototroctes mareana) Ecology of Freshwater Fish. 13(1)

[72] The SEES Inquiry's observation that "it would be reasonable to assume that the mudfish was extinct from the [Yarra] river system" (p.74) was not sufficiently supported to accept here. The precautionary assumption should be, at this point, that the mudfish is still present.

[73] Fulton W and Pavuk N 1988. The Tasmanian whitebait fishery: Summary of present knowledge and outline of future management plans. Unpublished report, Inland Fisheries Commission, Hobart, Australia, 22 pp.

It is noted that the SEES identified the period for migration to the Bay for the grayling and mudfish to be March-May and June-July respectively, and for their upstream migration to both occur in September-November.

CDP hazards for listed fish. As the Yarra pygmy perch is extinct within the Yarra River, the CDP does not present a hazard to it. The key hazards to grayling and mudfish posed by the CDP are:

- Reduced visibility due to turbidity from dredging affecting the migration of fish in the lower Yarra River, particularly the upstream migration of juveniles;
- Suspended sediments clogging the gills of migrating fish, particularly at the most sensitive larval stage;
- Underwater noise from dredging by the TSHD and berthworks in the Yarra River port area affecting upstream migration of juveniles.

The periods in which grayling is most vulnerable to dredging are when grayling larvae drift downstream and during the upstream migration of grayling juveniles.

A combination of elevated turbidity and elevated noise are likely to present at least a partial barrier to upstream migration of fish, if dredging (or berthworks) coincide with the migration period. Clogging of larval gills is likely to exacerbate the overall level of impact. However, the latter effect is likely to be less significant in itself as the level of suspended sediments generated by CDP dredging in the lower Yarra River is predicted to be slightly below the level of 100 mg/L found to cause mortality of larvae of some fish species (PIRVic, 2006). Nevertheless, there is no specific information available on the sensitivity of the grayling and mudfish to suspended sediments.

The SEES proposed an indicative dredging schedule with TSHD dredging in the Yarra River occurring from December 2008 to February 2009, and in the Williamstown Channel from June to August in both 2008 and 2009. Use of a backhoe or grab dredge in the Yarra River was proposed in June-July 2008 and December to May 2009. This schedule was based on the availability of a jumbo-size TSHD and was designed to avoid TSHD dredging in the Yarra River and Williamstown Channels during the period of upstream migration by the grayling and mudfish. However, a modified schedule tabled by PoMC at the SEES Inquiry following negotiations with Ecogen, and adjusted for the size of the TSHD likely to be used, proposed dredging in the Yarra River from mid July to early August 2008, and from early September to early October 2008, as well as from mid December 2008 to late March 2009. Dredging in Hobsons Bay is now proposed from May to mid July 2008, and from late march to mid July 2009.

Several sources of uncertainty need to be taken into account in assessing potential CDP impacts on the grayling and mudfish. These include uncertainty regarding:

1) Whether the mudfish is actually present in the lower Yarra and, if it is, whether the population is viable;
2) Whether grayling spend their juvenile period in the Yarra estuary or in the Bay itself; and
3) The level of suspended sediments causing both lethal and sub-lethal effects in the two species.

Conclusions regarding listed fish. It is my assessment with respect to the Australian grayling that:

1) It is likely to be still present in the lower Yarra, though in relatively small numbers;

2) Its downstream larval drift is unlikely to be significantly affected if dredging in the lower Yarra during the period April-July is limited to an overlap of less than two months

3) Its upstream migration is unlikely to be significantly affected if dredging in the lower Yarra avoids the period October-early December.

Having regard to (a) the extensive occurrence of the grayling elsewhere in south-eastern Australia, (b) the likelihood that the migration of the grayling in the Yarra would not be significantly affected by the proposed dredging schedule, and (c) the ability of grayling populations to recover from a poor migration season, it is further my assessment that:

1) A temporary and limited reduction in habitat suitability for Australian grayling in the lower Yarra due to the proposed CDP dredging program is acceptable, since population recovery within one to two years can be reasonably assured;

2) The environmental limits for grayling be reviewed to take account of the seasonal factors for the revised dredging schedule;

3) To offset the CDP impact on the Australian grayling in the lower Yarra, PoMC make a $300,000 contribution to a grayling recovery program in Victoria, with the specific priorities to be guided by advice from the Arthur Rylah Institute.

It is my assessment with respect to the Australian mudfish that:

1) If it is still present in the lower Yarra, its population is likely to be quite small and non-viable;

2) Consequently, while there is a potential for some impact on both the downstream larval drift and upstream migration of any mudfish present if dredging in the lower Yarra proceeds according to the revised schedule, any impact on overall mudfish numbers would be very small;

3) No mitigation or offset measures are warranted specifically to address potential impacts on the mudfish.

Having regard to the scheduled maintenance shutdown of the Newport power station in September/October 2008, it is my assessment that the scheduling of dredging in this period would provide a suitable accommodation of both ecological protection and avoiding interference with the operations of the power station. Further, the additional three weeks dredging proposed in the Yarra for July-August and 14 weeks in December-March would not have an unacceptable impact on either the grayling or mudfish.

4.3.8 Pelagic fauna in the Bay and migratory bird species utilising Bay habitats

Context. Mobile fauna relying on Bay include a variety of fish inhabiting the water column and a range of birds that are either shore-based (shorebirds) or marine in habit (seabirds). While complex ecological relationships link various bay species, attention here focus on species that are of particular conservation or social interest, viz.:

- Fish that are ecologically important (e.g. Australian anchovy) in supporting predator species higher in the food chain;
- Fish that are listed aquatic biota under the *Fisheries Act 1995,* including seahorses and pipefishes (Syngnathids);
- Fish that are important for recreational or commercial fisheries, including snapper, King George whiting, southern calamari and pilchards;
- Little penguins, including from the colony at St Kilda breakwater and those from Phillip Island that feed within the Bay;
- Listed migratory birds, that are listed under international treaties including JAMBA and CAMBA, as well as being protected under the EPBC Act;
- Cetaceans, including resident dolphins and whales that visit the Bay.

These different groups of fauna are addressed in the sections to follow.

Anchovy and other ecologically important fish. Anchovy are expected to be affected both directly and indirectly by the CDP. A direct impact on a small proportion of the anchovy population, particularly larvae, is predicted in the SEES, as a result of clogging of the gills during dredging in the Yarra River and northern Bay in summer. Recovery of breeding success is predicted to occur within one to two years of completion of the CDP. A indirect impact will result from reduction in phytoplankton biomass due to the dredging plume, which will affect the biomass of zooplankton on which anchovy feed upon phytoplankton. Recovery of phytoplankton is predicted to be within months of completion of CDP, with recovery of anchovy with one year.

Listed aquatic biota. While Syngnathids are listed under the Fisheries Act, the species within PPB are not listed under either the FFG Act or the EPBC Act and are mostly common species in southern Australian waters. Syngnathids mainly inhabit seagrass beds within the bay, where they tend to stay. They may be affected by the CDP through reduction in seagrass, clogging of gills and possibly by noise impacts.

Recovery of seagrass in the South of the Bay is predicted to take 1 to 2 years following completion of CDP, with recovery of fish species such as syngnathids within the same period. On this point, the IEG advised that there is considerable scientific uncertainty associated with making these predictions, which reflects our current level of understanding of natural variation of seagrass and fish recruitment[74].

Fish that are important for fisheries. Key PPB species for fisheries include Snapper, anchovy, pilchards, King George whiting and Australian salmon. These species are known migrate in and out of the Bay, but there is high uncertainty about the timing and potential effect of dredge plumes on their migration. The SEES predicted recovery within 1 to 2 years of completion of the CDP.

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[74] Independent Expert Group, 1 May 2007. Advice on the Channel Deepening Project Supplementary Environment Effects Statement

Smothering of seabed habitat and benthic invertebrates during disposal of dredged sediment at the proposed South Eastern DMG is predicted to affect fish such as snapper which feed and spawn in this area. The area of the South Eastern DMG, and the plume during disposal of dredged sediments is small, however, relative to the range of snapper within the Bay. Recovery of the seabed habitat is predicted within one year of completion of the CDP, with recovery of snapper within the same period.

Juvenile snapper rely on macroalgae in the north of the bay for habitat and food. The SEES predicted that recovery of macroalgae would occur within one year, with recovery of snapper in the same period. Snapper spawning is predicted to be affected by suspended sediments by through clogging of gills of larvae. Snapper spawn in the north of the bay from November to March which, as with anchovy spawning, overlaps with the period of dredging in the Port Melbourne Channel[75]. The SEES predicted recovery of snapper within one year of completion of the CDP.

Mobile fish such as snapper and salmon are able to avoid noise sources such as the hydrohammer, although the parts of the Entrance used for migration under normal conditions are unknown. It is therefore possible that noise may deter the entry of some salmon and snapper to the Bay and one year of juvenile recruitment may be affected, with a 5 to 10 percent reduction of their population[76].

In relation to effects on fish, PoMC's expert witness indicated that the assessment of risk would change if dredging took place throughout a second spring. This would also change the assessment of flow-on effects to penguins, cetaceans and seabirds. Hence, a change to the dredging schedule may increase the effects on fish, and other flora and fauna, from the CDP.

Little penguins. Little penguins in the Bay originate from two populations: the St Kilda Breakwater population (1,000 penguins) is resident to, and feeds exclusively in the Bay, and the Phillip Island population (60,000 penguins) of which 60 percent enter the Bay to feed mainly during winter and spring. The predicted reduction in the anchovy populations is expected to have flow-on effects to penguins. While penguins can travel up to 20 km per day, the St. Kilda population forage mostly within Hobson's Bay. The SEES explained that the penguin's ecology and behaviour indicated that they are able to swim through both natural and dredge plumes. This was supported by observations during the TDP.

The SEES predicted that significant effects from the CDP on penguins (and cetaceans) are unlikely given that:

- Underwater noise from dredging, pile driving and hydrohammering are predicted to affect only small areas of the Bay and has a the small noise impact radius,
- A period of sustained exposure would be needed to cause an effect, and
- Animals would be expected to move away from noise source[77].

Cetaceans. While cetaceans such as whales are regular visitors to the Bay they are not dependent on it for survival. Migratory cetacean species that occur the Bay, but are not resident to the Bay, and are protected under the EPBC Act and FFG Act

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[75] Primary Industries Research (2006a) *Channel Deepening Supplementary Environment Effects Statement - Aquaculture and Fisheries*, Primary Industries Research, Queenscliff, Victoria, SEES Technical Appendix 57

[76] ditto

[77] ditto

In relation to dolphins, while the SEES predicted that effects on fish could affect dolphins, other food sources such as squid, octopus and crustaceans will not be affected by CDP. Further, dolphins are observed to forage widely in the Bay, and during CDP it is likely that dolphins will change their feeding behaviour to feed in areas unaffected by turbidity. Recovery of dolphin feeding behaviour would be expected within 1 to 2 years after completion of the CDP.

The CDP EMP (Revision C) includes mitigation measures that ensure the use of the hydrohammer will be immediately suspended if cetaceans are observed within 600 m of the dredger, and, at the commencement of hydrohammering, a 'soft start' will be used which comprises either the intermittent use or gradual increase in the hydrohammer energy during the initial 10 minutes of use. The Inquiry recommended that PoMC deploy alternative noise producing devices to deter marine fauna from approaching the hydrohammer prior to its use in the Entrance, if it cannot be used at lower power for this purpose.

Listed migratory birds. A range of migratory birds depend on the Bay for breeding and food. Key species include: White-faced storm-petrel, Australasian Gannet, Pied cormorants, Crested tern and Orange-bellied Parrot.

Seabirds. The bird species most likely to be affected by the CDP are those seabirds which occur in large numbers and regularly breed in the Bay. The most important species are the Australasian Gannet, Pied Cormorant, Crested Tern and White-faced Storm-Petrel. The main effect of the CDP on these key seabird species would be through a reduction in fish, particularly anchovy, in the Bay.

The Pied Cormorant would be affected by the dredging of the Yarra River, Williamstown and Port Melbourne Channels through impacts on feeding and breeding patterns. The SEES notes that cormorants have been found to feed successfully in high levels of turbidity ranging from 15 to 25 mg/L suspended sediments. Because of the cormorant's wide distribution throughout the Bay and its long breeding season, it is concluded that any effects from the CDP are likely to be short-term and localised.

Although the White-faced Storm-Petrel breeds on Mud Islands and South Channel Fort, it feeds mostly outside the Bay in Bass Strait. The main effect of the CDP on this species is potential disturbance during the breeding period from September to March. The SEES concludes that this is unlikely to be a significant effect.

The SEES has given particular attention to the effects of the CDP on the breeding colonies of the Australasian Gannet and Crested Tern in the south of the Bay. Under the dredging schedule in the SEES, 13 weeks of dredging is proposed for the South Channel East during the breeding seasons for both these seabird species. The SEES predicts that the extent of the plume from dredging the South Channel East from September to November 2008 would occupy one-third of the seasonal feeding area of the Australasian Gannet and is expected to exceed 5 mg/L for 10 weeks. This is likely to reduce the gannet's breeding success, because of decreased foraging efficiency and ability to catch prey.

In respect to the Crested Tern, the SEES predicted that the turbidity levels near the Mud Islands would be well below 5 mg/L. The plume at higher turbidity levels would occupy a proportion of the tern's foraging range for two consecutive seasons, thereby affecting foraging efficiency and breeding success. This may reduce the local population of the species for up to two years following the CDP.

The SEES noted that the dredge plume will not cover the entire distribution of the foraging range for either the Crested Terns (3-20 km radius) or for Australasian Gannets (> 10 km radius). On this point, the Inquiry concurred by noting that effects

on seabirds from increased turbidity will be minimal due to their ability to forage widely within the Bay.

As with penguins, the SEES considered that the key effect from the CDP on the terns and gannets is likely to be the reduction in fish supply, particularly anchovy, as prey. On this basis, the SEES concluded that recovery of seabirds will be generally within one year (e.g. for the gannet and pied cormorant populations), and within two years for the crested tern population, following completion of CDP, with no long-term effects on seabird population viability.

It should be noted that the EMP includes measures to minimise the effects of the turbidity plume on gannets and crested terns.

Shorebirds. Shorebirds are numerically one of the largest bird groups using the bay. They have a widespread distribution and use a variety of habitats. However, most migratory shorebirds in the bay inhabit coastal habitat in the west and south where they forage over intertidal mudflats at low tide. At high tide, they fly to roost on sandy beaches and spits, coastal lagoons and/or saltmarshes. The majority of the shorebird species that occur in Port Phillip Bay are migratory (44 identified species), breeding in the northern hemisphere and spending their non-breeding season in the southern hemisphere, and are recognised by international treaties.

Conclusion. Having regard to the SEES and the Inquiry's report, it is my assessment that:

1) The effects of the CDP on fish, listed fish, penguins, cetaceans and birds are short term, and will not affect long term population viability, and are acceptable. Recovery is predicted within one to two years following completion of CDP,

2) Some disruption of the feeding behaviour of listed seabirds and shorebirds may occur, with a potential temporary impact on the reproduction of the Crested Tern and Australasian Gannet. there is some uncertainty in relation to the period of recovery of Crested Tern and Australasian Gannet, in terms of breeding rates.

Further, it is my assessment that:

1) PoMC minimise the use of the hydrohammer in order to minimise impacts on fish and cetaceans;

2) PoMC deploy alternative noise producing devices to deter marine fauna from approaching the hydrohammer prior to its use in the Entrance, if it cannot be used at lower power for this purpose.

3) In view of the uncertain impact, PoMC should provide support (including a financial contribution) to community-based monitoring of listed seabirds and shorebirds at Mud Islands and in the Rye-Dromana foreshore area.

4.3.9 Marine Protected Areas

Context. The *National Parks (Marine National Parks and Marine Sanctuaries) Act 2002* established a system of marine national parks and marine sanctuaries to protect representative examples of Victoria's unique marine environment. The Bay includes the following marine national parks and marine sanctuaries, which collectively are referred to as marine protected areas (MPAs):

- Port Phillip Heads Marine National Park (PPHMNP) (encompassing the areas of Mud Islands, Swan Bay, Portsea Hole, Popes Eye, Point Lonsdale and Point Nepean) [78];
- Ricketts Point Marine Sanctuary;
- Point Cooke Marine Sanctuary; and Jawbone Marine Sanctuary.

These marine protected areas largely correspond with the aquatic reserves segment of SEPP Schedule F6 (Waters of Port Phillip Bay), which provides a further legislative framework for their protection. The most sensitive beneficial use or value protected within the aquatic reserves or MPAs through the SEPP is the "maintenance of aquatic ecosystems and associated wildlife (natural ecosystems and substantially natural ecosystems)". Fishing (commercial and recreational) is not permitted within MPAs (i.e. no-take zones)[79]. (South Channel Fort and its immediately surrounding waters is also part of the Point Nepean National Park.)

Refer to section 4.3.4 and the Appendix A for an assessment of effects on the Mud Islands and Swan Bay Ramsar areas.

CDP effects on Marine Protected Areas. The PPHMNP is of particular relevance to the assessment of CDP effects due to its proximity to the capital dredging areas at the Entrance and in the South of the Bay. The SEES assessed the potential effects on MPAs, focussing especially on the PPHMNP.

Point Lonsdale. This MPA area is around the Point Lonsdale headland directly adjacent to the western side of the GSC to be dredged at the Entrance. It consists of rocky intertidal platforms, sub-litorral reefs and deep reefs, including deep reef walls (Lonsdale Wall) that form parts of the deep canyon at the Entrance. This SEES predicted than a small area of the Point Lonsdale segment of the MNP will be affected by rock-fall into the deep reefs in the canyon. Refer to section 4.3.5 for assessment of effects on deep reef habitat in the Entrance.

Point Nepean. This area is also adjacent to the GSC, on its eastern side. It also includes rocky intertidal platforms and sub-litorral reefs, as well as more sheltered shallow reefs and dense beds of seagrass and algae within Nepean Bay.

The turbidity plumes from dredging will extend to Nepean Bay and its seagrass and algal beds, with the deeper seagrass (*Amphibolis*) possibly losing some leaf density and productivity in the short term. The overall effect is predicted to be minor,

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[78] The Swan Bay and Mud Island components of the PPHMNP are also listed on the Register of the National Estate in recognition of their outstanding values and heritage importance. A number of significant natural, cultural, historical, scientific, tourism and recreational values are protected within the park's components, which are outlined in the Management Plan for the PPHMNP. See Parks Victoria, July 2006, *Port Phillip Heads Marine National Park Management Plan.*

[79] Whereas access for recreation (e.g. boating, SCUBA diving, snorkelling, swimming, passive), tourism, education and research is generally permitted.

although there may be some flow-on effects to other dependent biota in this area (e.g. Syngnathids).

Portsea Hole. This area is a unique depression or hole with depths to 30 m, left from the old Yarra River bed, with an extensive rock and wall reef areas that support a number of fish and other marine fauna and flora. The SEES predicted that ecological effects would not be significant.

Popes Eye. Popes Eye is an artificial marine environment formed from a semi-circle of bluestone boulders, which were to form the base of a fort similar to South Channel Fort. The structure now provides important habitat for marine birds (e.g. Australian Gannet). Effects from the CDP are not considered to be significant.

Effects from the CDP on the Ricketts Point Marine Sanctuary, Jawbone Marine Sanctuary and Point Cooke Marine Sanctuary, are considered to be negligible.

Conclusion. It is my assessment that potential effects on the MPAs will be minor and acceptable, including the likely impact on a small area of on deep reef habitat within the Point Lonsdale section of the PPHMNP due to rockfall.

4.4 Other Effects

4.4.1 Human health

Objective: To avoid adverse effects on human health as a result of diminished water quality or bioaccumulation of toxicants.

Sources of risk to human health were examined as part of the SEES through considering the direct or indirect effects of exposure to contaminated sediments, and the possibility of increased occurrence of toxic algal blooms:

Risk from contaminated sediments. In addition to the potential for risk to biota posed by the proposed CDP dredging of contaminated sediments, the potential for risks to humans that need to be considered are:

- potential effects on human health through bioaccumulation in fish of contaminants from dredged sediments; and
- exposure to and ingestion of contaminated seawater by swimmers or beach users.

As discussed in section 4.3.2, as the contaminants have been found to be tightly bound to the sediment particles, there is limited potential for bioaccumulation through take-up by biota from the water column.

Many submitters were concerned about the risk to human health from bioaccumulation of contaminants in fish. A key consideration here is the potential risks to recreational fishers and their families from consuming fish taken from the lower Yarra River, including the popular ‘Warmies’ area near the Newport Power Station cooling water outlet.

In early 2007, EPA concluded a fish study in the lower Yarra and Maribyrnong Rivers, where fish are caught by recreational fishers[80]. The study investigated a broad range of contaminants in fish and eels, including heavy metals, pesticides, hydrocarbons, and other compounds in fish and eels that had been sampled in 2005 and 2006. It found that none of the contaminants in the fish tested were above the relevant standards, including the Australia and New Zealand Food Standard maximum residual levels (MRLs). Polychlorinated biphenyls (PCBs) were found in all fish including eels. However, none sampled in the 2006 study were above the MRLs.

Two eels sampled in 2005, did exceed the MRLs, which led to the initial health advice being issued. Human health advice continues to be in place [81].

The SEES human health risk assessment investigated the potential for bioaccumulation in fish by modelling concentrations of contaminants in snapper, yellow-eye mullet and sand flathead fish from the suspension of contaminated sediments during dredging. The model assumptions were conservative and would therefore tend to overestimate impacts. Predicted fish tissue concentrations were compared with the Australian and New Zealand Food Standards Code 'maximum residual limits' for a range of contaminants, or an equivalent standard. The SEES concluded that the potential for unacceptable health risks to recreational fishers associated with the consumption of fish was not found in any of the project areas, including areas potentially affected by the turbid plume during and immediately after dredging of contaminated sediments.

Submitters were particularly concerned that dioxins and radionuclides had not been characterised in the sediments, and that risks to human health from these contaminants may have been underestimated. PoMC Expert witness at the Inquiry indicated that while it would have been preferable to test for dioxins and radionuclides for completeness, it would change neither the sediment classification under NODG nor the proposed dredged material management strategy[82]. Previous studies have confirmed that radionuclide contaminants do not occur in the Bay area. PoMC commissioned modelling of dioxin bioaccumulation pathways in fish, which concluded that while some bioaccumulation is evident, risks for human health through contamination of fish were negligible at both the dredge areas and the Port Melbourne DMG.

EPA has advised that it would be appropriate to monitor contaminant concentrations in fish in areas potentially affected by turbidity plumes from dredging of contaminated sediments, following completion of the dredging of contaminated sediments. This monitoring would provide assurance regarding the SEES conclusions and a basis for enhanced community information, including any fishing advisories, taking into account both existing conditions and any effects of dredging. I note that the monitoring proposed as part of Annexure 8 of the CDP EMP (Revision C) includes programs for both water quality and contaminants in fish.

While the Inquiry recommended a 'mussel watch program' to monitor bioaccumulation at the Port Melbourne DMG, before and after the capping is put in

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[80] EPA Victoria, (2007) *Yarra and Maribyrnong estuaries: Investigation of contaminants in fish*. Technical Report 1094.

[81] The study report and details of the advice from the Chief Health Officer are available from EPA's website (www.epa.vic.gov.au).

[82] Irvine, I. (2006) Peer Review South Channel Sediment Investigations, Port Phillip Bay, Supplementary EES and North Channel Sediment Investigations, Port Phillip Bay, Supplementary EES, Pollution Research.

place, EPA advised that, “the use of mussels or other filter feeding biota as an early warning indicator is unlikely to provide sufficiently timely information that would be informative in managing any risk that may emerge from dredging of contaminated material.” Further, as noted elsewhere in this assessment other controls are proposed that would provide a more informative and timely means of assessing and controlling the residual risk.

In relation to risks to swimmers, the SEES assessment explained that the distribution of the plume during the dredging of contaminated sediments will be largely confined to the area of the channels, and consequently, exposure to and ingestion of seawater containing contaminated sediments by swimmers is unlikely. Again it is relevant that contaminants are tightly bound to sediment particles, and not released into the water column in quantities exceeding screening levels. PoMC’s peer reviewer concluded that the risk to recreational swimmers is low. Further, the Inquiry concluded that as contaminants are not available for uptake via contact with the skin, and that swimmers in relatively calm seas don’t consume significant quantities of salt water, contaminant concentrations would not pose unacceptable risks to recreational swimmers. The concentrations will not exceed relevant water quality guidelines of the World Health Organization (WHO, 2003), the ANZECC and ARMCANZ (2000) recreational water quality guidelines, or the objectives of SEPP(WoV) Schedule F6.

Risk from algal blooms. Algal blooms occur in the Bay under natural conditions and are generally related to the physico-chemical factors, including light, temperature and the availability of nutrients which drive plant life, or primary productivity. High nutrient levels entering the Bay during a natural flood event are utilized by phytoplankton and are associated with algal blooms. Additional nutrients not utilized exist in sediments at the seabed. Algal blooms are highly variable in space and time – both patchy and spasmodic.

Submitters were concerned about the potential human health risks from algal blooms, particularly toxin bioaccumulation from toxic algae in filter feeding organisms such as mussels. Submitters noted that the CDP would resuspend sediments that may contain cysts of toxic dinoflagellates which could result in cyst germination leading to toxic algal blooms, and that the dredging and disposal will release nutrients in sediments which could trigger or enhance algal blooms.

The SEES nutrient cycling assessment concluded that any increase in algal biomass (toxic or otherwise) from the CDP is likely to range from small to undetectable from background conditions in the Bay. The SEES explained that the quantities of nutrients released from CDP are small compared with natural loads in the Bay (see section 4.3.1). While the CDP could potentially resuspend dormant algal cysts in bottom sediments, viable cysts are already present in shallow sediments in the Bay and these sediments are subject to natural resuspension. Moreover, toxic blooms have occurred under natural conditions in the Bay in the recent past.

The SEES human health assessment concluded that the risk from toxic algal blooms triggered by the CDP for human health is low because: any bloom is expected to have a short duration, blooms occur naturally in Bay, and any increase in blooms from CDP will be small to undetectable from background. The IEG and the Inquiry concurred.

PoMC proposes that phytoplankton biomass will be monitored as an indicator of algal blooms, as part of Annexure 8 of the CDP EMP (Revision C). Continuous monitoring in Hobsons Bay is to be assessed fortnightly during dredging by the TSHD in the Yarra River, Williamstown and Port Melbourne Channels. In relation to toxic algal

blooms, the Victorian Shellfish Quality Assurance Program (VSQAP) routinely monitors mussels for phytoplankton and bacteria, ensuring that there are no risks to humans from the consumption of aquaculture mussels.

Conclusions. In light of the studies and peer reviews undertaken for PoMC, as well as the IEG's advice and the Inquiry's findings in this regard, it is my assessment that:

1) The CDP is unlikely to lead to a significant or unacceptable increase in the rate of bioaccumulation of contaminants in fauna residing or feeding in the lower Yarra River or Hobsons Bay;

2) The CDP is unlikely to lead to a significant or unacceptable increase in the frequency of algal blooms, including of toxic species,

3) The impacts on human health via consumption of fish and swimming from bioavailability and bioaccumulation of contaminants in the Bay are generally low and additional risks due to the CDP will be minimal.

Further, it is my assessment that assurance monitoring of contaminant levels in fish be conducted immediately following dredging of contaminated sediments.

4.4.2 Public Amenity and Recreation

Objective: To minimise adverse effects on public amenity and recreational uses, as a result of diminished water quality and other direct effects of the CDP .

Context. The Bay is a significant area for tourism and recreation in Victoria. It is particularly important for recreational fishing, recreational diving and the public enjoyment of beaches, foreshores and marine-waters (e.g. swimming, sailing, dolphin watching). About 70 percent of Victorians visit the Bay at least once a year.

The SEPP (WoV) - *Schedule F6 (Waters of PPB*) designates an "Inshore segment", extending 600 m seaward from the low water mark around most of the perimeter of the Bay. Within this segment, water quality objectives are set for beneficial uses including:

- Water based recreation (primary contact, secondary contact and aesthetic enjoyment);
- Maintenance of substantially natural ecosystems with some modification; and
- Commercial and recreational use of edible fish and crustacea.

A higher level of protection applies to aquatic reserves ("natural ecosystems"), and a lower level within Hobsons Bay ("highly modified ecosystem with some natural values").

CDP hazards. The SEES identified a range of sources of CDP impact on the public amenity and recreational uses and values of the Bay. Some sources of impact have the potential to reduce the quality of recreational experiences and public amenity in certain foreshore areas, at least while dredging operations are occurring, e.g.:

- Airborne noise;
- Turbidity plumes and associated reduced underwater visibility;
- Ship generated waves from larger vessels;

- Changes in the ecology, particularly reduced fish abundance and animals of special interest (e.g. dolphins); and
- Loss of habitat and removal of specific dive sites.

Other impacts could preclude certain recreational activities for a time, e.g.:

- Underwater noise;
- Dredging of the proposed channels;
- Toxic algal blooms.

The SEES concluded that the CDP would have significant effects on certain tourism and recreational activities, in particular recreational diving, as well as recreational fishing (e.g. at the 'Warmies' and charter fishing) [83]. These effects are largely due to the fact that some key dive, fishing, and ecotourism/charter sites are located within, or in close proximity to, the dredging works in the Entrance and southern Bay.

Diving. Diving in the south of the Bay, particularly near the Entrance will be affected during a 11 to 15 month period, due to turbidity and underwater noise from dredging. Due to safety concerns, an exclusion zone is proposed to operate during dredging. In addition, the SEES indicated that there will be the permanent loss of some diving sites within the dredged areas. The SEES explained that there is limited opportunity for divers to relocate to comparable diving locations in similar proximity to Melbourne.

The SEES also predicted a moderate effect on public perceptions of the environmental values of the Bay, e.g. in terms of rock-fall impacts on deep reefs near the Entrance. The significance of the general Entrance area for recreational diving, together with the public perception that now exists regarding the importance and sensitivity of this marine environment, are likely to influence how these effects are perceived within the wider community.

Recreational fishing. A range of effects on fish are predicted to have minor, short-term effects on fish stocks of species such as snapper and King George whiting, as well as affecting the local occurrence of fish[84]. Nevertheless, these effects are not expected to have substantial flow-on effects to recreational fishing due to the ability for fishers/boats to move to different locations in order to find fish and continue with their recreation. The SEES predicted that the effects on recreational fishing would be significant but short term, and largely manageable through the provision of information to fishers about alternative locations and the timing of dredging operations to enable planning of fishing trips[85].

Effects on recreational fishing at the 'Warmies' is predicted to be greater due to increases in turbidity, removal of seabed and underwater noise from pile-driving, which may cause fish to move away and reduce stocks in the short term. Further, a significant proportion of fishers at the 'Warmies' may not be able to readily relocate, and therefore, effects on these fishers are predicted to be higher. The remainder of

[83] Sinclair Knight Merz, (2007), *Channel Deepening Project – Supplementary Environment Effects Statement: Social Impact Assessment*, Sinclair Knight Merz, Armadale, Victoria, SEES Technical Appendix 59

[84] Primary Industries Research (2006a) *Channel Deepening Supplementary Environment Effects Statement - Aquaculture and Fisheries*, Primary Industries Research, Queenscliff, Victoria, SEES Technical Appendix 57

[85] Sinclair Knight Merz, (2007), *Channel Deepening Project – Supplementary Environment Effects Statement: Social Impact Assessment*, Sinclair Knight Merz, Armadale, Victoria, SEES Technical Appendix 59

recreational fishers in this area should be able to continue fishing during the CDP, and effects on other recreational fishing in the Bay are predicted to be minor and localised.

The SEES concluded that there is some potential for less significant effects on other recreational and tourism boating activities (e.g. yacht racing), due to the presence of the dredger and restrictions on yachting and boating movement at times. As these could be managed through the usual protocols and procedures, the SEES concludes that there should be no reduction in boating activity.

Amenity. The SEES did not consider the use of the Bay's beaches for swimming and general recreation to be at risk from the dredging, primarily because the turbidity plume will be predominantly in the channels. However, as noted by the Inquiry, the proposed extension to the dredging schedule (due to the use of different dredge size combinations), increases the risk of effects on recreational users, especially while dredging in the Williamstown and Port Melbourne Channels. The resultant plumes would be of a greater duration, and potentially occur during peak beach use in this area.

The SEES predicted an impact on the community's amenity and perception due to short-term effects on the aesthetics of the areas in the South during and after the CDP, including the possible visual amenity effect of the proposed new navigation aids near Queenscliff. I note that no submissions raised concerns with respect to either the latter navigation aids or that proposed for Pt Gellibrand.

The SEES concluded that effective communication and environmental management will ensure that no long-term social effects, in terms of how people feel about or use the Bay passively, will occur. However, it is predicted that there will be short-term effects on amenity due to: the presence of dredger, associated noise and the visible turbidity plume, as well as the perceived impact on seafloor habitats and perceived risks of contamination of the water column.

Conclusion. Having regard to the SEES, public submissions and the Inquiry's analysis, it is my assessment that:

1) The effects of the CDP on public amenity and recreational uses of the Bay are mostly minor and acceptable, and can be appropriately managed through scheduling and refinement of relevant aspects of the EMP;

2) The CDP effects on recreational diving are potentially significant, though temporary and variable.

To further minimise effects on public amenity and recreational uses of the Bay, it is my assessment that:

1) PoMC maintain regular and effective communication with key Bay user groups, including dive groups, especially in relation to the scheduling of dredging operations and the likely area of the dredging plume (to the extent practicable); and

2) Any practicable refinements to the dredging schedule be made by PoMC in consultation with affected community interest groups, to reduce effects on recreational activities.

Finally, it is my assessment that a fair and reasonable opportunity for public comment and review of the proposed new navigation aids near Queenscliff and at Pt

Gellibrand has been provided through the SEES process, and these works may now proceed to approval.

4.4.3 Marine-based Tourism and Commerce

***Objective: To minimise adverse effects on the Bay's marine-related tourism and other commercial activities/industries, as well as industrial users of lower Yarra River waters, as a result of diminished water quality and other direct impacts of the CDP*.**

Context. The SEES considered the importance of the Bay for the tourism sector, commercial fisheries, aquaculture, diving industry and local commercial activities related to marine-based recreation. Key aspects of Bay-dependent commercial activities include:

- The Bay is a significant area for tourism, attracting around six million day trippers and 2.7 million overnight visitors per year, including about 130,000 tourists from overseas;
- The State's recreational diving industry is strongly focussed on the south of the Bay; it has an annual turnover of about $45 million; and
- The Bay is productive for commercial fisheries and aquaculture, and important for the commercial industries, including recreational fishing, dependent on this.

The potential effects of the CDP on recreation activities were considered in the previous section 4.4.2. Attention here focuses on the flow-on impacts for the related commercial industries, including eco-tourism (e.g. dolphin/seal tours, penguin parade), aquaculture, commercial fishing, diving businesses and other local businesses reliant upon tourism and marine recreational activities.

The beneficial uses of marine waters that are protected under SEPP (WoV) - *Schedule F6 (Waters of PPB*) and *Schedule F7 (Waters of the Yarra Catchment*) that are particularly relevant here include:

- Commercial and recreation use of edible fish and crustacea;
- Production of molluscs for human consumption (natural populations and aquaculture);
- Water based recreation; and
- Industrial water use.

The SEPP beneficial use "maintenance of aquatic ecosystems and associated wildlife" underpins the first three of these other uses.

***Effects on commercial fishing and aquaculture*.** The SEES indicated that that the CDP will have unavoidable short-term effects on commercial as well as recreational fisheries, due to the ecological effects on fish species in the Bay.

Larval and juvenile King George whiting, snapper and southern calamari inhabit the seagrass beds in southern parts of the Bay. Therefore the effects on seagrass, including any loss or degradation of seagrass habitat, would be likely to flow on to these species and reduce some larval recruitment and affect stock numbers, particularly for King George whiting. Consequently, a flow-on effect on associated

commercial and recreational fisheries for these species could occur. The potential consequences of these and related effects on fish are addressed in section 4.3.8.

The SEES uses King George whiting and snapper as indicator species to assess the CDP impact on the Bay's fisheries. On this basis, it concludes that the effects on the Bay's commercial fin-fisheries would be significant but short-term. PoMC's economic assessment provided estimates of the costs for commercial fisheries overall, rather than for individual fisheries. It estimated that the total cost impact of a reduction in the Bay's fisheries would be $1.5 million over four years. However, the economic recovery for commercial fisheries could extend over two to 10 years[86].

Commercial abalone diving, particularly outside the Port Phillip Heads, is predicted to be moderately impacted by increased turbidity and reduced underwater visibility (a minimum of 6 m is required to work effectively). The SEES predicted that a reduction of five to 30 percent in productivity is likely to occur, with recovery within two years following completion of the CDP.

Marine aquaculture in the Bay primarily consists of mussel farming. Dependent on the farm's location, it may be affected by turbidity plumes generated during dredging. The Mount Martha mussel aquaculture zone is particularly susceptible to increased levels of turbidity near the South Eastern DMG. The SEES concluded that while continuous dredging (3 to 6 months) could reduce growth rates and possibly productivity in this area, the effects would be short-term. There is some uncertainty regarding the likely extent of reduction in growth rates due to prolonged exposure to elevated turbidity. However, the CDP turbidity levels are predicted to be lower than actual mussel tolerances. Further, the scheduling and duration of dredging in the key southern areas of the Bay is likely to reduce the effects to a minor and acceptable level. Recovery from short-term and localised impacts on mussel growth is predicted within a year of the project's completion.

Effects on diving and related businesses. The Inquiry agreed with the SEES[87] that the most significant economic effect is likely to be on businesses associated with recreational diving, especially in the short-term and potentially extending into the medium-term if the recruitment of new/entrant divers is disrupted. The SEES predicted the loss of up to 147 direct employees across the sector (25 to 30 percent of the current workforce) and some minor flow-on effects for other related sectors in the south of the Bay (e.g. accommodation and ecotourism charters). It also concluded that some diving businesses may need to close[88] during the period that CDP dredging occurs within the south of the Bay.

The significant short-term and potential medium-term impacts on recreational SCUBA diving in the Bay could have consequences for the Victorian diving industry. Some potential diving areas near the channels will be impacted, in addition to not being accessible for periods of time due to operational constraints. The SEES estimates that the possible loss of total income to the dive industry could be as high as 25 to 35 percent ($10.3 to $14.6 million). It is considered very likely that some businesses will close and that the industry may alter structurally in response to the

[86] Primary Industries Research (2006a) *Channel Deepening Supplementary Environment Effects Statement - Aquaculture and Fisheries*, Primary Industries Research, Queenscliff, Victoria, SEES Technical Appendix 57

[87] Sinclair Knight Merz, (2007), *Channel Deepening Project – Supplementary Environment Effects Statement: Social Impact Assessment*, Sinclair Knight Merz, Armadale, Victoria, SEES Technical Appendix 59

[88] ditto

influence of the project on the Bay's environment and its use by recreational divers[89]. The possible economic losses during the dredging (in the south of Bay and the Entrance) are estimated to be approximately $3.2 to $4.1 million.

The SEES considered that the potentially significant CDP effects on recreational fishing and ecotourism charters would be short-term and largely manageable through the provision of information to fishers and businesses about alternative locations and the timing of dredging operations to enable good planning. No economic or commercial impacts of significance were therefore quantified within the SEES for these activities.

Flow-effects of amenity impacts. The potential effects on the recreational uses and tourist visitation of some of the Bay's beaches and foreshore areas may flow-on to associated businesses such as cafes and accommodation. But the overall effect on tourism and related businesses is predicted in the SEES to be localised, short-term and minor, particularly in economic terms. This is in large part on the basis of the dredging schedule that excludes dredging in the south of the Bay from 18 December to 31 January, the peak holiday period.

Newport Power Station. Ecogen Pty Ltd owns and operates the Newport Power Station located on the western bank of the Yarra River. The power station is a gas-fired electricity generator with a capacity of 510 MW (6 per cent of the installed generating capacity in Victoria). As an intermediate load generator, it plays an important role in the national electricity market by responding in a timely manner when electricity demand exceeds the output of the base load generators.

While operating the NPS draws in 17,500 litres of water per second of cooling water from the Yarra River. Ecogen claims that the suspended material from the CDP dredging has the potential to cause destabilisation or collapse of the cooling inlet system[90]. According to Ecogen, this could lead to a major interruption to its operations, affecting its ability to meet its undertakings in the national electricity market as well as a shortfall of power in the State. Because of the potential safety and financial ramifications, Ecogen have called for dredging within the "exclusion zone" around its power station (300 metres upstream and 300 metres downstream of the cooling water intake point) to be undertaken during its planned maintenance shutdown in September/early October 2008. Alternatively, Ecogen has suggested a commercial settlement with PoMC.

The risks of the CDP to the Newport Power Station were the subject of a specific report[91] which forms part of the technical appendices to the SEES. The risk assessment found that the risk of damage to the power station's inlet and outlet structures is negligible and manageable. The report concluded that "the likelihood of an inability to operate or a large reduction in output capacity due to Channel Deepening is extremely low". There was disagreement between Ecogen and the PoMC's consultants on the findings of this report.

The potential financial implications of the CDP on the Newport Power Station were the subject of an *in camera* session of the Inquiry hearings.

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[89] Sinclair Knight Merz, (2007), *Channel Deepening Project – Supplementary Environment Effects Statement: Social Impact Assessment*, Sinclair Knight Merz, Armadale, Victoria, SEES Technical Appendix 59

[90] The use of river water for such industrial purposes is a protected beneficial use in this segment of the Yarra, under the SEPP (WoV) Schedule F7.

[91] Arup 2006 *Risk Assessment of Potential Impacts of Dredging on Newport Power Station* prepared for Port of Melbourne Corporation

The Inquiry asked PoMC to prepare a new schedule to accommodate Ecogen's concerns. Following its review of this schedule, the Inquiry has recommended that the revised schedule that includes Yarra River dredging in Spring 2008 be adopted, on the basis that an offset be required for the potential impact on the Australian grayling, i.e. if dredging in the Yarra River were to occur during Spring.

Conclusion. Having regard to the SEES, submissions and the Inquiry's report, it is my assessment that:

1) Any effects of the CDP on the Bay's marine-based tourism industry and other industries and commercial activities will mostly be short-term, though there are some uncertainties in relation to the extent of impact and the period of recovery;

2) It has not been demonstrated that the CDP dredging operations in the Yarra River would be likely to affect the operations of the Newport Power Station, though this possibility is not excluded.

Further, to minimise effects on commercial users of the Bay, it is my assessment that:

1) PoMC maintain regular and effective communication with key Bay user groups, including commercial fishers, ecotourism and dive school operators, especially in relation to the scheduling of dredging operations and the likely area of the dredging plume (to the extent practicable);

2) Any practicable refinements to the dredging schedule be made by PoMC in consultation with affected key Bay user groups, to further reduce short term and minimise any extended effects on commercial activities;

3) The monitoring of fish stocks and recruitment that is to be undertaken as part of the CDP EMP "Baywide" monitoring programs (see section 4.5.3) during and for two years after completion of dredging, will provide a satisfactory response to potential CDP effects on fish stocks, in the first instance;

4) Government determine an appropriate response to enhance fish stocks and address related issues, if (a) a significant decline in fish stocks and recruitment occurs during or after the CDP and (b) is determined to be attributable to the CDP;

5) Government monitor any impacts that the CDP may have on commercial operators that rely either directly or indirectly on access to Bay resources.

4.4.4 Cultural heritage

Objective: To avoid unacceptable adverse effects from the CDP on identified sites of Aboriginal or post-settlement cultural heritage.

Aboriginal Cultural Heritage. Under the provisions of the *Aboriginal Heritage Act* 2006, a Cultural Heritage Management Plan (CHMP) must be prepared for the CDP. Having regard to the criteria against which the CHMP will be evaluated, it will be necessary for the PoMC to demonstrate that construction activities will be undertaken in a way that avoids harm to Aboriginal cultural heritage, or where this is not possible, in a manner which minimises harm.

The SEES describes the history of indigenous people in the Melbourne region over 35,000 years, including their use of what is now the sea floor of the Bay at times of lower sea level. Modelling undertaken to inform the SEES suggests that the excavation of the sea floor required for the CDP will be within recent marine sediments which are unlikely to contain archaeological sites. The likelihood of excavation intruding into older terrestrial land surfaces which contain submerged archaeological sites has been assessed as very unlikely to implausible.

The PoMC's consultants identified almost 600 Aboriginal archaeological sites and places within 300m of the existing coastline. Although there will be small changes to hydrodynamic processes within the Bay, the SEES concludes that these will not exacerbate existing coastal processes affecting coastal Aboriginal archaeological sites. In particular, the small, short-term increase in vessel wake in the vicinity of the DMGs during construction is considered unlikely to result in increased erosion of heritage sites.

I note that the Inquiry was satisfied that there will not be any significant impacts upon Aboriginal cultural heritage.

Cultural Heritage. Under the provisions of the *Heritage Act* 1995, permits or consents will be required to remove, demolish or excavate any part of a site on the Victorian Heritage Register or Victorian Heritage Inventory, including historic shipwrecks or relics. Having regard to this, it is necessary to consider the extent to which the CDP would affect the cultural heritage significance of registered or inventoried heritage places or objects.

The SEES identifies 307 marine heritage sites and 176 coastal heritage sites within the broader study area. Of these, the HMVS *Cerberus* is listed as nationally significant, but is not expected to be impacted upon.

The SEES predicts that known/certain impacts will occur to the following sites on the Victorian Heritage Inventory:

- Two marine sites in the Yarra River area;
- Four marine sites in the Bay
- One land-based site on the coast at Queenscliff[92].

One other site on the Victorian Heritage Register in the south of the Bay is predicted to be impacted.

These impacts relate both directly to dredging activities and associated works and indirectly through disturbance from turbulence associated with larger ships passing through the channel. The impact on each site has been assessed as ranging from minor to moderate. The SEES outlines a range of mitigation and management measures to ensure that heritage objects will be avoided, recorded or retrieved where possible.

There is a small possibility that dredging and/or berthworks may result in the disturbance of unknown sites, although the SEES concludes that these are likely to be fragmentary and not attributable to any particular site, and would therefore be of

[92] TerraCulture (2007) *Channel Deepening Project Supplementary Environmental Effects Statement Non-Aboriginal Heritage*, TerraCulture, Fairfield, Victoria, *SEES Technical Appendix 62*

limited cultural value. In the unlikely event that a previously unknown but a cohesive site is located during dredging, prompt action by both PoMC and Heritage Victoria will be needed to resolve the necessary response.

Conclusions. It is my assessment that the overall impacts of the CDP on cultural heritage assets are minor, and can be appropriately managed. Further, it is my assessment that:

1) Aboriginal cultural heritage issues will be effectively managed through the CHMP process, which allows for refinements to proposed management and mitigation measures to made in discussion with affected Aboriginal parties;

2) PoMC consider contributing to a program to be lead by the relevant indigenous groups for the protection and improved management of Aboriginal heritage sites on the Bay coastline; and

3) The proposed provisions within the SEES environmental management framework relating to non-Aboriginal cultural heritage represents an appropriate response to managing potential impacts to known assets.

4.4.5 Shipping-related risks

Objective - To minimise shipping-related risks associated with the design or implementation of the CDP.

Channel design for navigational safety. The CDP 'project description' is to modify the shipping channels to enable access for 14 m draught vessels to the Port of Melbourne at all states of the tide. Once constructed, the proposed channels in the Entrance to the Bay, and within the Bay to the Port of Melbourne, will have the same accessibility for 14 m draught vessels as at present for 11.6 m draught vessels. This accessibility is described as:

- 100 percent access with respect to tide; and
- 95 percent access with respect to metocean conditions.

Complete accessibility with respect to metocean conditions is not practicable due to the potential effects of high and medium swells from the southern sector on vessels' motion when passing over Rip and Nepean Banks. The Port Operating Guidelines therefore specify that a delayed transit of the Entrance may be necessary.

Guided by the project description, the channel design process established the necessary channel parameters for navigation[93] (i.e. route, declared depth and width) required for the vessel to travel between the Entrance and the berths in the Port of Melbourne. A range of safety, economic and environmental factors were considered in the channel design process, including:

- Selection of an appropriate 'design vessel' fleet in 2035, in terms of length, beam (width) and maximum operational draught, vessel speed and handling

[93] Note that the 'declared channel depth for navigation' is different to the 'constructed channel depth'. The constructed channel depth is the actual depth of the channel following dredging in relation to Chart Datum (Lowest Astronomical Tide). It is deeper, compared with the navigation channel depth, as it takes into account the navigation channel design as well as operational and construction allowances such as survey tolerance, dredge tolerance and siltation.

characteristics[94];

- A marine safety risk assessment of the proposed channel options for the 'design vessel' fleet in 2035;
- Analysis of variable metocean conditions (e.g. tide, current and wind);
- Computer based analyses to verify design and safety aspects, including: simulations of the navigation by various types and size of ships; computation of the vertical response of ships in various wave and wind conditions; channel capacity simulations[95]. This included consultation and simulation testing with the Port Phillip Sea Pilots;
- 'Designing out' unacceptable environmental impacts and risks, where possible and practicable.

Through the channel design process, a range of channel options and configurations were considered, such as one-way versus two-ways options in the South Channel and Port Melbourne Channel. Based on the analysis of dredge volumes, marine safety and operational efficiency (vessel delays due to channel constraints) for each option, the existing channel widths (but not depths) were determined to be optimal in the South Channel and Port Melbourne Channel. It further concluded that it is not possible to change the channel width and operation of the Yarra River, Williamstown Channel, South Channel West or the Great Ship Channel due to physical, safety and operational limitations. The optimal channel design, and declared channel depth guaranteed to be available to 14 m draught vessels at all states of the tide, was determined to be[96]:

- 14.6 m for the Yarra River upstream of Beacon 46 (one-way channel);
- 15.2 m for the Yarra River Channel between the services and Beacon 46 (one-way channel);
- 15.5 m for Port Melbourne Channel (one-way channel) and Williamstown Channel (one-way channel);
- 15.5 m for South Channel East and West (except Hovell Pile vicinity) (two-way channel);
- 16.0 m for the vicinity of Hovell Pile (two-way channel);
- 16.5 m for the fairway between the Entrance and South Channel West (two-way channel); and
- 17.0 m for the GSC in the Entrance (one-way channel for vessels with draught greater than 11.6 m, two-way channel for all other vessels

During its hearing, the Inquiry received submissions and evidence challenging the safety of the channel design, particularly in relation to the additional safety risks of larger ships entering the Bay through the GSC.

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[94] The 'design vessel' fleet was determined by analysing trends in the historical increases in the size of ships (i.e. tanker and container ships), and then using this information to estimate the fleet in 2035. The dimensions of design vessels included in the simulations ranged from approximately 190 m to 320 m in length, 29 m to 50 m beam and 11.6 m to 14 m draught. This ensures that all vessels which are forecast to use the port have been considered in the channel design process.

[95] Maunsell Australia (2007) *Port of Melbourne Corporation Channel Deepening Project Channel Design Report* Maunsell Australia, Melbourne, Victoria, Technical Appendix 8),

[96] Compare with construction depths on page 4 of this Assessment.

To assess the safety of ships transiting the channel network through the Entrance and the Bay, the SEES conducted a marine risk assessment[97] based on the proposed channel design and the design vessel fleet, i.e. of larger vessels of 14 m draught. It found that a 14 m draught vessel was limited to use the GSC, and would not be able to use the shallower eastern and western channels on each side of the GSC when transiting the Entrance. Currently ships of lesser draught are able to use the eastern and western channels. The Inquiry noted that PoMC had acknowledged that this would result in greater constraints for navigators transiting the Entrance. On this basis, the SEES concluded that there will be a small increase in risk of shipping incidents to 2035 because of changes to channel configuration, traffic volumes and patterns, but operational factors determined by metocean conditions will remain unchanged (as discussed above). The SEES explained, however, that the increase in risk from these changes would be negated by: (i) improving navigation aids, by installing navigation lights to define the channel edges (at present only the centre line for the GSC is defined), to assist ships transiting the Entrance via the GSC, and (ii) proposed changes to Port Operating Guidelines which will require larger vessels to use the GSC when transiting the Entrance to the Bay.

The Inquiry considered the SEES and expert witness statements, and noted that:

1) The peer review of PoMC's channel design concluded that the channel design for navigation of the channels hahad been carried out in accordance with joint Permanent International Association of Navigation Congresses and International Association of Ports and Harbours (PIANC & IAPH) publication "*Approach Channels – A Guide for Design*"[98];

2) The Director for Marine Safety, who has a statutory responsibility for marine safety in Victoria, has advised that the deepened channel can be constructed safely, and changes to sea floor shape will not affect navigational risk;

3) The Port Phillip Sea Pilots, who are responsible for navigating ships into and out of the Bay, advised the Inquiry that they were satisfied with both the channel simulation work and the proposal to define channel edges with navigation lights – which will provide information to enable them to take corrective action respond if a vessel starts to veer off course.

The Inquiry concluded that:

1) The proposed CDP design, including the channels, dredged material grounds and navigational aids, are safe and technically feasible to implement using the proposed dredging technologies, and would achieve the objectives of the CDP project description (see section 1.3);

2) The proposed deepened channels can be constructed safely, to guarantee access by 14m deep draught vessels and will not result in a risk to navigation, including at the Entrance.

It also recommended that the channel design and implementation details be incorporated into the required consent under the *Coastal Management Act 1995*[99].

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[97] Royal Haskoning (2006a) *Port of Melbourne*, *Preliminary Marine Safety Report*, Royal Haskoning, Peterborough, United Kingdom

Royal Haskoning (2006b) *Port of Melbourne Marine Risk Assessment*, Royal Haskoning, Peterborough, United Kingdom

[98] PoMC's channel design was peer reviewed; it concluded that the channel design for navigation of the channels has been carried out in accordance with the PIANC/IPAH guidelines.

[99] In addition, the Inquiry concluded that proposed construction design, including selection of channel routes, minimises dredging volumes, and therefore the potential generation of suspended sediment.

Rock Scour and channel navigation. In its closing submission, PoMC explained that ongoing scour at the Entrance could possibly produce accretion mounds of up to 2 m height, potentially affecting the declared navigation depth in the GSC, and presenting a possible hazard to shipping transiting the Entrance. PoMC explained that the CDP Environmental Management Plan (EMP) will address this issue through:

- Post-construction bathymetric surveys, as part of the Entrance Dredging PDS (project delivery standard), including a requirement for the report to include confirmation of declared depth; and
- Additional clean-up of accretion mounds if needed during major maintenance dredging campaigns.

The Inquiry supported this approach, but noted that further advice may be needed from the Director for Marine Safety.

Conclusions. Having regard to the SEES and the Inquiry's report, it is my assessment that:

1) The proposed channel design is in accordance with relevant international standards and guidelines for navigational safety;
2) The proposed channel design achieves the objectives of the CDP project description, to enable access for 14 m draught vessels to the Port of Melbourne at all states of the tide;
3) The channels in the Entrance and the Bay, navigation aids, and dredge material grounds, can be constructed safely to guarantee access by 14 m deep draught vessels and will not result in a risk to navigation;
4) PoMC seek further advice from the Director of Marine Safety in relation to the formation of accretion mounds in the GSC in the Entrance and address this advice in finalising its EMP.

4.5 Environmental risk management

Objective: To provide a transparent framework, with clear accountability, for managing environmental risks associated with the CDP to achieve acceptable outcomes.

The necessity for a transparent, accountable framework for managing environmental risks associated with the CDP is self-evident. The management of environmental risks is directed towards achieving acceptable outcomes, in the context of applicable legislation, public policy - and often also corporate policy.

Key considerations in relation to this objective are the need for:

1) A sound basis in risk assessment;
2) Clear environmental goals, consistent with the applicable legislative and policy framework;
3) A sound framework specifying requirements for performance of the CDP works and program to protect environmental assets and values in the Bay;
4) A sound framework for accountability and system for decision-making, both during and following dredging.

4.5.1 Risk assessment

From the outset of the environmental effects assessment process for the CDP, a key priority has been to provide a transparent and proportionate assessment of risks of adverse environmental outcomes[100]. A broad view of risk has been adopted to encompass all potential adverse environmental effects, in relation to the likelihood of potential effects.

One of the key tasks for the SEES in addressing the weaknesses of the EES was to provide a more transparent and robust approach to the assessment of risks arising from the CDP. In summary, the Assessment Guidelines called for the SEES to:

1) Characterise the environmental assets, values and dependent uses that might be affected by the CDP, based on a sound understanding of the Bay system;

2) Characterise potential hazards arising from the CDP;

3) Identify and justify proposed performance criteria to protect the environmental assets and dependent uses of the Bay;

4) Assess the environmental effects and associated consequences, as well as their likelihood, and the associated level of risk for CDP project design, technology and environmental management options. Following an initial assessment, a more detailed analysis of higher risks and potential responses was to occur;

5) Evaluate residual risks against the proposed performance criteria; and

6) Confirm strategies for monitoring and management (avoidance, mitigation or control) of residual environmental risks.

These steps were intended to enable a rigorous approach to the assessment of CDP risks to Bay assets and systems, as well as an appropriate focussing of study efforts and effective and proportionate responses to risks. The guidelines further stated that:

> "Potentially significant risks need to be addressed in the SEES, by demonstrating that the risk would be acceptably low either without special measures being implemented (i.e. the project is unlikely to have a significant effect) or with special measures being implemented (i.e. through proposed risk avoidance or mitigation or other management measures)."

The SEES adopted a structured approach[101] to risk assessment and treatment, generally in accordance with the Assessment Guidelines, in order to inform project development, such that major risks were progressively "designed out" or otherwise reduced to a level "as low as reasonably practicable".

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[100] The principles of best practice for environmental assessment articulated in the 2006 Ministerial Guidelines include:

- a *systems* approach to identifying, assessing and managing potential environmental effects to ensure that relevant effects and responses are considered
- a *risk-based* approach to ensure that required assessment, including the extent of investigations, is proportionate to the risk of adverse effects
- an *integrated* perspective of the relationship between and significance of different effects to inform decision-making

[101] This approach confirmed with the of risk management framework with the *Australian/New Zealand Standard: Risk Management (AS/NZ 4360:2004).* Risk was defined as a combination of: (i) the likelihood of an event and its associated consequences occurring; and (ii) the magnitude of potential consequences of the event.

A systems perspective was implemented through the comprehensive development of cause-effect pathways in the form of linear "event trees", to provide a transparent analysis of both "predicted effects" of the CDP that were (almost) certain and "risk events" which were uncertain effects. After identifying predicted effects and risk events, the consequences arising from these effects/events, as well as their likelihood, were assessed through multi-disciplinary workshops of the SEES specialists and project team. A consequence table was developed to enable a consistent rating, within a five-level sequence of: negligible, minor, moderate, major and extreme. An iterative approach to risk assessment and treatment was followed, as investigations and project development proceeded in conjunction.

The environmental management plan (EMP) developed as part of the SEES to manage the residual impact of the CDP, specifically addresses "significant" predicted effects and risk events, which have respectively been defined as:

- a predicted effect on an asset of "moderate" or greater consequence; and
- a risk event of "medium" or greater risk level.

The SEES risk assessment/management approach was distinctly superior to that in the EES. The IEG considered that it provided a consistent methodology for assessing different categories of effects and risks, noting that "a risk assessment approach is commonly used to deal with impact assessment, particularly where the scope is broad and there is high and variable uncertainty". Further, the IEG considered the overall approach to have "resulted in an assessment of impact and risk which the IEG regards as exceptionally comprehensive for projects of this type, nationally or internationally"[102].

One reservation of the IEG regarding the risk assessment was the limited range of expert opinion involved in the risk workshops that produced the SEES risk ratings. Related to this, the treatment of uncertainty through the expert workshops was not wholly transparent, though a conservative approach was followed by adopting "worst case" estimates of consequence or likelihood. Two other weaknesses can be noted:

1) An early integration of available understanding of Bay systems might have allowed a better focussing of efforts;

2) The adopted consequence criteria did not derive from the legislative/policy framework, resulting in some ambiguity in the evaluation of risk acceptability.

Importantly, the above weaknesses are matters of clarity and efficiency, rather than being of fundamental concern.

Conclusion. It is my assessment that the risk assessment undertaken as part of the SEES has adopted a satisfactory approach to assessing cause-effect pathways and generating estimates of the consequences and likelihood of potential adverse effects, on a consistent basis.

[102] Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

4.5.2 Environmental Management Plan

The SEES Assessment Guidelines called for the SEES to demonstrate a best practice approach for minimising and managing environmental impacts and risks, supported by scientific knowledge, verified predictive modelling or proven technical concepts, as relevant. A combination of 'upfront' project design and technology choices and a responsive EMP to guide project implementation were needed:

- "Best practice design, technology and approaches that minimise and manage environmental risks and protect key environmental assets;
- A practicable, adaptive management approach … able to meet environmental protection objectives, taking into account scientific uncertainty".

While both of these aspects are encompassed within the EMP, attention here focuses on the efficacy of the CDP EMP with respect to the later aspect.

PoMC has adopted an environmental management system (EMS) for the CDP which has been audited for compliance with the international standard ISO140001:2004[103]. The EMS comprises a set of policies, plans, procedures and activities that together form a systematic method of managing the predicted effects and risk events arising from the CDP. The EMP is a key component of the EMS. It incorporates a series of project delivery standards (PDS) which are intended to guide the actual work method undertaken. Other key components are system procedures (e.g. risk management, training, auditing and management review) and operational procedures, plans and technical documentation. Contractors, including Boskalis as the dredging contractor, will be required to incorporate EMP requirements into specific Construction EMPs. PoMC intends that it will be responsible for preparation and implementation of the EMP, while contractors will prepare, execute and achieve compliance with CEMPs.

The PDS within the CDP EMP have been developed by PoMC:

> "to ensure that the project is delivered with no greater than the level of residual predicted effects and risk events set out in the SEES, and to enable the management and mitigation measures to be delivered in accordance with applicable legislation and policy[104]".

Eight PDS are proposed, including for Construction management (all activities), marine-based works (all areas), land-based works, dredging and plume, dredging schedule, Entrance dredging, dredged material management and hydrohammer use and marine-based pile driving. Each PDS includes an objective or performance goal, environmental controls in the form of required management and mitigation measures, environmental limits in the form of numerical performance standards, as well as references to associated monitoring programs and contingency plans.

Environmental limits have been developed to manage potentially significant impacts of project activities on environmental assets, where the impact pathway is well characterised and a suitable indicator is available for the activity (e.g. dredging), the asset (e.g. seagrass) or a surrogate (e.g. turbidity)[105]. Indicators need to be both

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[103] *ISO140001:2004 Environmental Management Systems – Requirements with guidance for use*

[104] SEES, p.17-13

[105] In its advice of 4 September 2007 on the EMP, the IEG strongly commends the approach adopted by PoMC's consultants in setting environmental limits for seagrass, which it regards as a model for other aspects of the EMP. The approach was seen to have a number of positive features:

- Limits are related to a clearly-stated ecological objective;

practicable and able to inform operations in a timely manner, in some circumstances in real time. For this reason PoMC has selected a suite of indicators that are close to the source of effects as possible, i.e. turbidity[106], airborne noise and underwater noise. For a given indicator, where more than one asset may occur in an area, the operative environmental limit is set for the most sensitive asset.

To complement each limit, 'responses levels' are to be set below the limit, to trigger corrective actions, such as measures to reduce the intensity or duration of the effect or additional monitoring. Contingency plans describe the process to be followed in the event that either responses levels or environmental limits are reached.

Environmental performance monitoring is needed to facilitate management and mitigation of project effects and risks, as well as to measure conformance with established environmental limits, controls and processes. In addition, monitoring and evaluation of the effectiveness of environmental limits, controls and processes is needed to identify opportunities to improve performance.

In CDP EMP (Revision C) tabled at the SEES Inquiry, PoMC proposes to undertake four forms of monitoring:

1) *Environmental monitoring* of environmental conditions to inform operations;
2) *Process monitoring, inspections and surveys* of operational activities, physical conditions and post-construction environmental conditions, to inform any additional management actions that may be needed;
3) *Management performance monitoring* of the implementation and effectiveness of the EMS, to inform the management review process; and
4) *Baywide monitoring* to provide information on the long-term status of or health of key species, habitats and ecological processes in the Bay, again to inform the management review process.

PoMC proposes that internal audits of conformance with the EMS and EMP will be undertaken at the commencement of key activities, and on a six monthly basis while the activity occurs. The CDP EMP (Revision C) also acknowledges that external audits will be done by external agencies as part of the project implementation.

Because CDP effects on the Bay assets need to be considered in a ecosystem context – in most instances this is the Bay - and will also be combined with other influences on the same assets, PoMC proposes to utilise or augment existing the Bay monitoring programs undertaken by State agencies[107]. Some new programs are planned. The programs are for: seagrass, plume intensity and extent, water quality, nutrient cycling, contaminants in fish, algal blooms, fish stock and little penguins.

EMP (Revision C) proposes that management reviews of environmental monitoring will be conducted to confirm whether environmental performance conforms with SEES predictions, and to identify any changes to assets outside expectations or with

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- There has been a rigorous statistical analysis of experimental data and observations, to relate the ecological objective to statistical limits for turbidity;
- Historical background data and model predictions have been used to assess the likelihood of both Type 1 and Type II errors for proposed environmental limits.

[106] As optical backscatter measured in NTU, which can be readily measured in the field, rather than as mass per volume of total suspended sediments (TSS) measured in grams/litre, which requires laboratory measurement.

[107] The eight programs are described in Annexure 8 Baywide Monitoring, in CDP EMP (Revision C).

implications for beneficial uses of the Bay. PoMC propose that it will coordinate these reviews, but also involve representatives from relevant agencies and specialists as required. These reviews would be conducted approximately six monthly over the four years from project commencement, with flexibility in timing in relation to project milestones and monitoring reports.

The reviews would consider significant changes beyond expected natural variation or background conditions, in terms of the causes and appropriate corrective actions or other measures (such as further investigations), having regard to ecological objectives of environmental limits and the principles of environment protection. Where if applicable to the CDP, operational measures could include modification to response levels, the dredging schedule or dredging methods. Non-operational measures could include modification to baywide monitoring programs and post-construction responses, including further investigations, offsets or rehabilitation.

The IEG's review of the EMP (Revision C) focussed on the Baywide monitoring component (Annexure 8), which had been developed partly in response to the IEG's review of the draft EMP included with the SEES. It considered that:

> [T]he EMP, particularly Annexure 8, does not yet provide the necessary detail for its effective implementation. Generally, the justification for the levels of augmentation proposed for existing programs needs to be strengthened. Further, for many of the augmentation monitoring programs, the link between the proposed locations to be sampled and information needs to effectively inform management of the CDP require clarification.

Key aspects of concern to the IEG were the need for:

1) clarity regarding the purpose of particular monitoring programs[108], and
2) a clear justification for the monitoring design, in terms of the spatial and temporal data, as well as statistical methods, needed to detect CDP effects and separate these from those of other events in the Bay.

The IEG distinguished between several purposes and strategies for environmental monitoring:

1) Short-term monitoring during project implementation, designed to allow quick responses;
2) Medium- to long-term monitoring, including post-construction, particularly to assess CDP impacts on assets. The attribution of effects to either the CDP or other causes would need to involve comparing the state of assets in areas putatively affected by the CDP to the state of assets in areas outside this influence. Accurate measurement of physical changes (e.g. dredging plume extent and intensity) is needed in order to test the influence of these changes on environmental assets;
3) Monitoring of 'recovery of assets', which needs to be designed in the context of observed impacts - and hence cannot be fully designed in advance.

[108] The IEG observed in its review of the SEES that: "Monitoring and adaptive management represent a standard and widely-adopted method of dealing with residual uncertainty in major projects." Independent Expert Group, 1 May 2007. *Advice on the Channel Deepening Project Supplementary Environment Effects Statement*

Conclusion. Having regard to the IEG's advice, it is my assessment that the CDP EMP (Revision C) prepared by PoMC is sound and suitable for adoption, subject to amendment and refinements to:

1) Reflect the role of the independent monitor in the environmental management of the CDP (as set out on page # here);
2) Document specific contingencies for responding to greater than expected changes to assets or delayed recovery;
3) Finalise the eight programs described in Annexure 8 Baywide Monitoring, to establish a clear rationale, statistical design and evaluation strategy for each program, such that they are useful for informing management responses; and
4) Incorporate any other matters relevant to the EMP that arise from this Assessment.

It is further my assessment that:

1) the EMP, once (a) refined as above by PoMC, (b) peer reviewed by a person nominated by the Secretary DSE, and (c) considered by the IEG, be endorsed by the Minister for Environment and Climate Change or delegate prior to the commencement of dredging;
2) Some staging of the finalisation and endorsement of elements of the EMP would be acceptable so long as the relevant elements are concluded and endorsed before dredging commences in the relevant area (e.g north and south of the Bay).

4.5.3 Decision-making and accountability for the CDP

To enable the effective and transparent implementation of the CDP requires:

1) A suitable framework for authorisation and regulation of the CDP, to establish effective accountability, particularly for PoMC; and,
2) A suitable framework for administering implementation of the CDP, to ensure that this is both efficient and transparent.

Project authorisation and regulation. Key considerations in structuring the framework for authorisation and regulation of the CDP are the need for:

1) A broadly framed legislative base that can integrate the spectrum of relevant considerations;
2) A legal ability to set a broad range of environmental conditions, including performance requirements and offsets;
3) A transparent framework establishing the accountability of PoMC to implement the project in accordance with environmental conditions;
4) An ability to enforce the conditions, including stopping/re-starting dredging works, and to apply commensurate sanctions for non-compliance with environmental conditions.

With respect to the first attribute, the Ministerial decision whether to grant consent for the CDP under the CM Act has a sufficient ability to consider a broad range of matters, including the protection of significant environmental features as well as

economic and social aspects of sustainable use and development of coastal resources.

However, in relation to the second and fourth attributes, the approval of the CDP under the CM Act is not sufficient in itself for authorising and regulating the project. There are limitations relating to both the scope of conditions that may be applied and the enforcement of the conditions that are applied. The SEES Inquiry considered that "this mechanism alone does not cater adequately for the continuing implications of CDP, as the consent authorises the principal activity only" (p.234). The CM Act also only provides for relatively small penalties in the event of a breach of approval conditions.

While other mandatory Victorian approvals, for example under the *Fisheries Act 1995, Heritage Act 1995* and *Aboriginal Heritage Act 2006,* complement the function of the CM Act consent, they do not compensate for the limitations of the latter. Two options for an effective framework for authorisation and environmental regulation of the CDP are, first, to introduce special legislation, and second, to extend planning scheme controls over the relevant part of the Bay. The former option is not considered necessary. The EES Panel suggested the latter option. The SEES Inquiry also recognized its potential as an appropriate governance framework, but it did "not consider that this option alone is adequate for the CDP" (p.235).

As a further option, scheduling dredging as an activity under the Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 could enable the works approval procedures under s.19A of the *Environment Protection Act 1970* (EP Act) to be applied. However, this option is neither immediately practicable nor would it provide a comprehensive regulatory solution.

The EP Act provides several other mechanisms for establishing accountability for environmental performance, including the use of a pollution abatement notice (PAN) under s.31A and the 'stop notice' direction-making power of s.62B. The SEES Inquiry comments that:

> While the EES Panel considered that advance preparation of a PAN appeared to be one tool [under the Environment Protection Act] to enable the construction of a detailed regulatory framework for the project, the Inquiry concludes that it would be difficult to use a PAN, as pollution needs to be demonstrated before a PAN can be acted upon.

The use of these reactive mechanism under the EP Act does not provide a suitable basis for regulating the CDP, both because a more proactive framework is needed and because other instruments are also available. Nonetheless, the PAN and s.62B provisions of the EP Act, are in-principle available even if they are not needed.

The third required attribute, i.e. a transparent framework for accountability, can be achieved through a suitable EMP that "internalises" both relevant environmental conditions and best practice for the project. Preparation and implementation of an EMP is likely to be a condition of CDP approval (if granted) under both the CM Act and the EPBC Act, to address relevant matters under the respective legislation. It is also pertinent that the *Port Services Act 1995* contains a strong set of provisions for the development, certification, implementation, review and auditing of EMPs for ports that could be applied to the CDP.

Through consultation with "relevant Ministers", including the Minister administering the *Environment Protection Act,* the EMP provisions under the *Port Services Act* enable effective coordination with other statutory procedures.

There is a need to consider other statutory and administrative mechanisms that might be used to coordinate the regulation of the CDP. In relation to the coordination of EPA's statutory interests with consents under other legislation, s.66A of the EP Act may offer a useful mechanism. This section enables the EPA to designate any protection agency[109] or agencies to have jurisdiction and control over part of the environment - and to be responsible - where the Authority considers that "a condition of pollution is occurring or is likely to occur" contrary to the provisions of the Act or State environment protection policy. As a dredging plume could qualify as "pollution", there is potential for PoMC and DSE to assume specific responsibilities in their capacities as protection agencies under the EP Act.

In addition to the authorisation and regulatory powers that are either mandatory or available under the various legislation that applies to the CDP, there is also the option of making binding agreements under one or more heads of power. Legally binding agreements might be used for three main purposes:

- to establish an obligation to implement measures that cannot be adequately encompassed as a statutory condition;
- to establish an agreed framework for implementation of the EMP and related measures; and
- to establish a performance bond, or similar performance mechanisms.

Under s.14 of the *Port Services Act,* PoMC is able to enter into contracts, agreements, leases or licences. Also, under s.18 of the *Conservation, Forests and Lands Act 1989,* the Secretary of DSE is able to enter into contracts and agreements in relation to his/her responsibilities. In addition, under s.25 of the FFG Act, the Secretary "may enter into an agreement with one or more public authorities to provide for the management of any taxon or community of flora or fauna or potentially threatening process". The latter are not limited to taxa or processes listed under the Act.

Conclusions. In light of the foregoing, it is my assessment that the relevant Ministers, agencies and parties consider the suitability of the following combination of statutory and legal instruments to be used as the framework for authorising and regulating the CDP:

1) The consent under the CM Act to provide for various conditions to be set, including for an EMP to address relevant matters under that Act. The EMP might be endorsed by the Minister for Environment and Climate Change following consultation with the Minister for Roads and Ports and the Australian Minister for the Environment and Water Resources, to facilitate coordination;

2) The EPA to designate the Secretary DSE under s.66A of the EP Act as the responsible protection agency for oversight of the turbidity, suspended sediment and nutrient effects of the CDP dredging and dredged material management activities to be undertaken by PoMC and its contractors. The Secretary DSE might be given jurisdiction to exercise control over the conduct of these operations, including an ability to direct that dredging cease if unacceptable conditions of environmental quality are observed or expected to be imminent, as well as an ability to direct that dredging may recommence. In

[109] Under the EP Act, 'protection agency' means any person or body having powers or duties under any other Act with respect to the environment.

exercising this function, the Secretary DSE might be advised by an independent monitor. EPA would, however, retain responsibility for control over the dredging and placement of contaminated material.

3) Tenure be granted to PoMC under the *Lands Act 1958* by the Minister for Environment and Climate Change for use of the relevant areas for the Port of Melbourne and South Eastern DMGs, subject to relevant conditions;

4) A legally binding agreement between PoMC and the Secretary DSE to be made under s.25 of the FFG Act, recognising the CDP dredging as a potentially threatening process as well as the need to protect specified taxa and communities, and:

   (i) commit PoMC to comply with various EMP provisions that may or may not be included as statutory conditions, including provision of offsets and (potentially) performance bond(s);

   (ii) commit DSE to cooperate with PoMC in the evaluation of data from environmental monitoring during and after the CDP dredging, that may point to the need for some form of intervention or other response.

   This agreement could also be made as a common law contract or under the *Conservation, Forests and Lands Act 1989.* Other parties to the agreement could include the Minister for Environment and Climate Change, the Minister for Roads and Ports, and the EPA. The making of this agreement under complementary heads of power would facilitate a coordinated approach to different environmental aspects of the project, including the central role of the Secretary DSE; and

5) The PoMC to adopt the CDP EMP, as authorised under the CM Act and EPBC Act, as a new part of the EMP for the Port of Melbourne made in accordance with s.91C of the *Port Services Act 1995*.

6) If necessary, a direction to be issued by the Minister for Roads and Ports under s.91H of the *Port Services Act,* for PoMC to implement specified measures in accordance with the EMP.

The two key elements above are the CM Act consent and the binding agreement. The designation of the Secretary DSE under s.66A of the EP Act would assist his/her role in coordinating the environmental management regulatory regime for the CDP, under Victorian statutes.

I note that the Inquiry recommended that the Government consider whether the Alliance should deposit an environmental performance bond. It is my assessment that the Minister for Environment and Climate Change, in consultation with the Minster for Roads and Ports, consider whether a performance bond or similar mechanism, linked to safe and effective CDP delivery and post-construction recovery.

i. If a performance bond or similar performance mechanism is applied to the CDP of this Assessment and Recommendation 4 below), one relevant consideration would be the CDP impact on fish stocks and recruitment.

While the approval decision under the EPBC Act will be made separately under Commonwealth law, it could play a complementary role in setting of conditions.

Administration of the EMP. As indicated above, the key mechanism to ensure the efficient and transparent implementation of the CDP will be a sound EMP that is effectively coordinated across the different approvals. In view of the portfolio responsibilities of the Minister for Environment and Climate Change encompassing several Acts that apply to the CDP – including the CM Act, EP Act, FFG Act, *National Parks Act 1975* – it will be appropriate for DSE to act as the coordinating agency for monitoring implementation of the EMP.

At the same time, the responsibility of PoMC to implement the EMP in accordance with the approved EMP needs to be recognised. Auditing of its compliance will be needed, but enforcement action should not be required if PoMC's accountability is supported through effective arrangements for monitoring and reporting the environmental performance of the CDP.

The SEES Inquiry has recommended that an "independent monitor" be appointed to provide assurance to the public regarding the implementation of the EMP.

Conclusion. It is my assessment that a person of suitable authority and experience be administratively appointed as an independent monitor to advise on the delivery of the CDP in accordance with the EMP, and that the role of the independent monitor be to:

1) Review EMP management reports prepared by PoMC and examine any other reports related to the EMP that may be requested by Government Ministers;
2) Monitor and evaluate the environmental performance of the CDP;
3) Advise PoMC and relevant Ministers on the above matters, and any other matters referred to him/her by a relevant Minister, as appropriate;
4) Provide an annual report to relevant Ministers, and for public release, on implementation of the EMP, for the five years after commencement of the CDP.

It is further my assessment that the independent monitor be:

- able to access technical support as required;
- administratively supported by DSE;
- funded as a direct cost of the CDP by PoMC.

It is also my assessment that the forward role of the IEG in providing advice on the refinement of the EMP, and potentially in relation to implementation of the EMP, be funded as a direct cost of the CDP by PoMC.

4.6 Overall Environmental Acceptability

Objective: Overall, to achieve outcomes from the CDP consistent with ecologically sustainable development.

As indicated in section 2.7, the overall evaluation of the CDP for this Assessment needs to consider both: (a) its consistency with applicable legislation, policy, strategies and guidelines; and (b) its consistency with the principles and objectives of ecologically sustainable development (ESD)[110]. The ten evaluation objectives have

[110] Section B.1 in Appendix B summarises the expression of ESD within relevant national agreements, Victorian legislation and the EPBC Act.

been used in this Assessment to synthesise these two aspects. The outcomes will initially be considered in relation to the first nine evaluation objectives, before turning to explicitly consider the CDP's consistency with legislation, policy etc., and then its consistency with the principles and objectives of ESD.

4.6.1 Key environmental outcomes

With respect to the first nine evaluation objectives, in summary this Assessment has concluded that the following outcomes can be expected or achieved:

1) ***Economic efficiency.*** The proposed route, design and strategy for implementing the CDP optimise the economic efficiency of deepening shipping channels to the Port of Melbourne, in terms of the economic benefits of improved opportunities for trade through the Port relative to the economic costs associated with the CDP. The deepening of the channels to accommodate 14m draught vessels at all states of tide will enable the Port of Melbourne to sustain its competitiveness as Australia's leading container port through to 2035;

2) ***Water levels, currents and sediment movement.*** The proposed design and likely depth outcome of the CDP would cause only very small changes to water levels, currents and sediment movement patterns within the Bay, even in the event that some erosion occurs in the Entrance when dredging is complete. Because minor changes in sediment movement in Lonsdale Bight and the Great Sands could cause changes in beach or seafloor morphology over the long-term, monitoring of these areas will allow a management response if necessary – in particular to place some material from maintenance dredging within the Great Sands rather than the South-eastern DMG in order to maintain the sediment supply within the area;

3) ***Ecology.*** The goal for ecological outcomes following the CDP should be to avoid a long-term reduction in the overall biodiversity, productivity or ecological integrity of natural and semi-natural ecological communities in the Bay as a result of the CDP, i.e. "no net loss", outside the areas required for the shipping channels and DMGs. In terms of the potential for adverse effects on ecological processes or either species or areas of conservation significance, two main environmental risks will need a strong and focussed management response:

    i. The impact of the dredging plume on the health of seagrass beds in the south of the Bay, which are likely to be temporarily affected with an expected though uncertain recovery within two years. Clearly justified environmental limits to guide dredging operations as part of the EMP are needed, together with an environmental offset payment of $2.5 million to support seagrass research in the Bay;

    ii. The impact of rock spill from dredging in the Great Ship Channel on both intermediate and deep reef communities, which are likely to take in excess of five years to recover substantially. Careful control of dredging in this area, especially in the final stages of dredging, as well as careful clean-up of residual rubble will be needed to minimise the extent and duration of impacts on the reef communities. Refinement of the performance delivery standards for dredging operations (as part of the EMP), together with an environmental offset payment of $3 million by PoMC will be appropriate;

Other ecological issues, which pose a lower risk of a residual impact but nonetheless need an effective management response, are:

iii. Dredging of contaminated sediments from the lower Yarra, which will require effective containment within a bunded and capped structure in an extension of the Port of Melbourne dredged material ground;

iv. The impact on the Australian grayling due to dredging during its seasonal lifecycle migration down and then up the lower Yarra, which will require some limitation of the period in which dredging can occur. However, dredging to coincide with Ecogen's planned shutdown of the Newport power station for a major maintenance overhaul should not have a major impact on the grayling. An environmental offset payment of $300,000 by PoMC is proposed to support grayling recovery efforts in areas with greater potential for long-term population viability;

v. The potential for a minor lateral migration of habitats within different parts of the Port Phillip Bay Ramsar site, due to the predicted very small change in high and low water levels, will warrant a monitoring response in the first instance. An environmental offset payment of $500,000 by PoMC to habitat improvement works within the Ramsar site is proposed;

vi. Some disruption of the feeding behaviour of listed seabirds and shorebirds may occur, with a potential temporary impact on the reproduction of the Crested Tern and Australasian Gannet. In view of the uncertain impact, PoMC should provide support (including a financial contribution) to community-based monitoring of listed seabirds and shorebirds at Mud Islands and in the Rye-Dromana foreshore area.

4) ***Human health.*** Sources of risk to human health were examined, including the mobilisation of contaminated sediments and the possibility of increased occurrence of toxic algal blooms:

i. Contaminated sediments currently occur in the upper layer of soft sediments within the lower Yarra, exposed to biota inhabiting the area. Past maintenance dredging of these sediments has placed them in the Port Melbourne DMG, without bunding and capping to prevent their dispersal. The use of a bunded and capped design for the CDP DMG extension has been confirmed to be a secure, best practice solution for management of dredged contaminated sediments, leading to an improvement over past practice, consistent with the NODG and BPEMGD. Further, the dredging of these sediments by either a TSHD in non-overflow mode or a horizontal profiling grab will minimise the dispersal of these sediments and exposure of biota;

ii. Laboratory tests have established that the contaminants are strongly bound to sediment particles and therefore only weakly available to biota to which they come in contact. Nonetheless, as there is an existing issue of bioaccumulation of PCBs in fish in the lower Yarra and Maribyrnong Rivers, monitoring of any change in contaminant levels in fish following the dredging of contaminated sediments;

iii. The release of nutrient-rich pore water from dredged sediments could lead to algal blooms – potentially of a toxic variety. The same effect could result from a reduced rate of denitrification by benthic biota affected by the dredge plume leading to a nutrient excess in local waters. Such blooms are not uncommon under normal conditions in the Bay, usually involving elevated temperature and raised nutrient influxes.

However, it is unlikely that the CDP will significantly exacerbate toxic blooms.

In summary, adverse effects on human health are most unlikely as a result of the CDP, through diminished water quality or bioaccumulation of toxicants.

5) ***Public amenity and recreation.*** The physical activity of dredging, as well as the associated turbidity plume and noise, will inevitably affect the amenity of Bay waters and adjoining areas to some degree – depending strongly on the season, proximity, number of people affected and their expectations. Through PoMC's commitment to avoid dredging in the south of the Bay between 18 December and 31 January, the potential exposure of holiday-makers will be substantially reduced. However, there is likely to be some impact on the amenity of beach users at Port Melbourne and to a lesser degree other beaches during the summer months while dredging occurs in the Williamstown or Port Melbourne Channels.

   Dredging in the south of the Bay and Entrance may also discourage recreational divers and fishers from using these areas for a large part of the dredging program. While recreational fishers will have the option of shifting to alternate locations, there is more limited scope and less likelihood for recreational divers to travel to alternate locations.

6) ***Bay-related commercial activities.*** Some degree of conflict between the CDP dredging program and other commercial uses of the bay is unavoidable, and so too is some degree of impact:

   i. A reduction in the productivity and recruitment of fisheries including snapper and King George whiting is expected, due to a range of direct and indirect ecological effects of dredging. Although recovery of fish stocks is expected within two years, recovery of productivity may take longer. Because of the uncertainty involved, the monitoring of fish stocks and recruitment rates during and following dredging will be a priority to guide any necessary action;

   ii. The other sectors which may be impacted are the marine-based eco-tourism and diving businesses that are strongly focussed on the Bay. These activities will be disrupted when either dredging or its associated plume occurs in sites of interest, and there is likely to be an impact on the income stream of these businesses;

   iii. The Assessment has identified the need both for PoMC to effectively communicate its dredging schedule so that Bay users can adjust their plans, and for Government to monitor any impacts that the CDP may have on commercial operators that rely either directly or indirectly on access to Bay resources;

   iv. Although Ecogen as the operator of the Newport Power Station made submissions regarding the impact of dredging in the lower Yarra on its operations, the potential for such an impact is uncertain. Notwithstanding this, the revised dredging schedule should overcome any risk.

7) ***Cultural heritage.*** Impacts on some known marine heritage sites are expected as a result of the CDP. In the unlikely event that a previously unknown but cohesive site is located during dredging, prompt action by both PoMC and Heritage Victoria will be needed to resolve the necessary response.

   No impacts on known sites of Aboriginal heritage are expected, while impacts on submerged sites predating the inundation of PPB around 8,000 years ago

are unlikely. Nonetheless, it may be appropriate for PoMC to consider contributing to a program to be lead by the relevant indigenous groups for the protection and improved management of Aboriginal heritage sites on the Bay coastline.

8) ***Shipping-related risks.*** The channel design investigations in conjunction with the SEES, supported by peer review, have established that the proposed channel design is in accordance with relevant international standards and guidelines for navigational safety, and is to the satisfaction of the Director Marine Safety Victoria.

9) ***Environmental risk management.*** A key priority for the implementation of the CDP is to establish a transparent, accountable framework for managing environmental risks associated with the CDP:

   i. The key instrument to guide the achievement of desired environmental outcomes is the EMP. The CDP EMP (Revision C) prepared by PoMC has been found to be sound and suitable for adoption, subject to some amendment and refinements, including in relation to Baywide monitoring of environmental assets and responses to changes in these. It will be important for PoMC to address further advice from the IEG in finalising the EMP;

   ii. The CDP requires approval under a number of statues, and so coordination of relevant requirements during project implementation will be important. Moreover, other instruments could be applied to assist good outcomes. The Assessment suggests that a combination of instruments be applied including the required CM Act consent and a binding legal agreement, together with the use of powers and procedures under the EP Act and the *Port Services Act;*

   iii. To support effective implementation of the CDP, it is proposed that a person of suitable authority and experience be appointed as an independent monitor to advise both PoMC and relevant Ministers on the project's delivery in accordance with the EMP;

   iv. Finally, the Assessment suggests that the Government consider whether an environmental performance bond or a similar performance mechanism be applied, linked to safe and effective CDP delivery and post-construction recovery.

4.6.2 Consistency with specific legislation and policy

The CDP is consistent with the objectives and responsibilities of PoMC under the *Port Services Act 1995*, as well as giving effect to the policy commitment of the Victorian Government to deepen the shipping channels to the Port of Melbourne, as articulated in both *Victoria: Leading the Way* and the *Victorian Pots Strategic Framework* in 2004.

In addition, the following environmental legislation and associated policy are of particular relevance to the CDP:

- The EP Act and SEPP(WoV);

- The CM Act and Victorian Coastal Strategy;
- The FFG Act and the associated strategy Victoria's Biodiversity; and
- The EPBC Act.

Environment Protection Act and SEPP. It is my assessment that the investigations and dredging strategy put forward by PoMC are consistent with the requirements under Clause 13(1) of SEPP(WoV) Schedule F6 (Waters of Port Phillip Bay) and the equivalent clause in Schedule F7 for the Yarra River catchment, in terms of:

1) The application of best practice, having regard to relevant considerations of practicability;
2) The planned implementation of CDP dredging and management of dredged material to ensure that levels of suspended sediments and optical turbidity will exceed the relevant SEPP environmental objectives over the smallest practicable area and over the smallest practicable time;
3) The proposed project delivery standards and adoption of a CAD design for the extension of the Port Melbourne DMG will ensure that the CDP dredging and management of dredged material will not re-suspend and/or disperse sediments or accumulated contaminants so as to be detrimental to the long-term protection of beneficial uses in the north of the Bay and lower Yarra River;
4) Although some refinement to the environmental limits applying to seagrass in the south of the Bay may be needed, the relevant project delivery standards will ensure that beneficial uses are protected over the long-term.

It is also my assessment that the waste hierarchy has been appropriately applied through the design and proposed dredging strategy of the CDP, including the proposed placement and availability for re-use of dredged material, to minimise the generation of dredging "waste" that has the potential for adverse effects.

Coastal Management Act and Victorian Coastal Strategy. The proposed design and environmental management framework for the CDP provide for a high measure of protection of significant environmental features and sustainable management of coastal and marine environments within and adjoining the Bay, consistent with the principles underpinning the *Victorian Coastal Strategy*[111]*.* Relevant aspects include the response to:

Some additional measures have been recommended as part of this Assessment to provide a further, necessary level of protection to coastal and marine ecosystems, biodiversity, and dynamic physical processes in the Bay. The CDP development has been addressed in the context of ESD principles and objectives, as discussed in the next section.

Flora and Fauna Guarantee Act* and *Victoria's Biodiversity. The CDP is not expected to have an enduring impact on any threatened species or ecological community listed under the FFG Act. While temporary impact on the Australian Grayling, and possibly also the Australian mudfish, may occur as a result of dredging in the lower Yarra River and Hobsons Bay, recovery of population numbers is expected in one to two years after dredging.

[111] See section 5 in Appendix B for further detail of relevant considerations.

Victoria's Biodiversity has a goal of maintaining and, where necessary, restoring ecological processes and the biodiversity dependent upon terrestrial, freshwater and *marine environments.* In this context, this Assessment considers that the goal for ecological outcomes following the CDP should be to avoid a long-term reduction in the overall biodiversity, productivity or ecological integrity of natural and semi-natural ecological communities in the Bay as a result of the CDP, i.e. "no net loss", outside the areas required for the shipping channels and DMGs.

The Assessment also responds to priorities identified in *Victoria's Biodiversity,* including to:

- To increase understanding, *protection and monitoring* of vulnerable habitats, particularly *seagrass,* mangroves and saltmarsh;
- increase understanding, *protection and monitoring* of vulnerable habitats, particularly kelp and epibenthic communities affected by trawling or *dredging*[112].

Further, this Assessment applies the principle of three-step decision approach prescribed by *Victoria's Native Vegetation Management* with respect to the loss of native vegetation, i.e. avoid, minimise and offset, though not on the basis of the "net gain" offset approach that is applied to terrestrial but not marine or aquatic vegetation. Since, direct offsets are not practicable in relation to the potential impacts on seagrass and reef communities, indirect "scientific" offsets are proposed[113].

EPBC Act. The implications of the CDP with respect to the controlling provisions under the EPBC Act are summarised at some length in Appendix A. The key conclusion is that the CDP is unlikely to have a significant impact on controlled matters under the Act, with the possible exception of a significant temporary impact on a local population of the Australian grayling (a listed threatened species). Significant impacts on the Port Philip Bay Ramsar site, listed migratory species and Commonwealth land are unlikely.

4.6.3 Consistency with ESD principles and objectives

Through the assessment process under the EE Act, including this Assessment, careful consideration has been given to "ESD" principles an objectives as variously defined under the Inter-Governmental Agreement on the Environment (IGAE) and the National Strategy for Ecologically Sustainable Development[114], as well as the EPBC Act, EP Act and *Commissioner for Environmental Sustainability Act 2003.* In particular, this Assessment has:

1) effectively integrated both long-term and short-term economic, environmental, social and equitable implications of the CDP, having regard to the need to improve net community well-being;
2) recognised the importance of the CDP to maintain and enhance the international competitiveness of the Port of Melbourne, and support a strong, growing and diversified economy;

[112] *Victoria's Biodiversity, 1997, note* - italics inserted above
[113] This approach is consistent with the principles set out in the *Draft Policy Statement: Use of environmental offsets under the EPBC Act,* DEWR, August 2007.
[114] See section 1 in Appendix B.

3) addressed potential threats of environmental degradation, having regard to sources of scientific uncertainty, in terms of the need for measures to prevent serious or irreversible environmental damage;

4) considered the interests of both the present generation and future generations in terms of ensuring that the CDP would not diminish the health, diversity and productivity of the Bay over the long-term;

5) recognised the priority of managing the implementation of the CDP so as to conserve biological diversity and ecological integrity within the Bay;

6) recognised the responsibility of PoMC to apply sound environmental practices and procedures mitigate, manage or offset the environmental effects of the CDP that cannot be avoided, potentially with the incentive of a performance bond;

7) recognised the need for environmental management measures to be cost-effective and in proportion to the significance of the problems involved, having regard to the risk-weighted consequences of various options; and

8) built upon extensive community involvement in the assessment process under the EE Act.

I also consider that the CDP is consistent with sustainability considerations under Victorian legislation, including the EP Act, CM Act, Port Services Act, FFG Act, *National Parks Act 1975,* and the *Planning and Environment Act 1987.*

Overall, it is my assessment that the CDP would provide a net benefit to the State of Victoria, having regard to long-term and short-term economic, environmental, social and equity considerations.

4.6.4 CDP and the future environmental management of the Bay

One of the objectives of the EES process as set out in the 2006 Ministerial Guidelines is “to provide a basis for monitoring and evaluating the effects of works to inform environmental management of the works and improve environmental knowledge”.

Looking to the future, the following priorities can be identified for implementation of the CDP and beyond:

1) Strong scientific oversight and integration of the results of the CDP monitoring programs is needed to ensure that full advantage of them is made in developing scientific understanding and predictive capacities with respect to environmental processes in the Bay, to evaluate the predictions made in the SEES, and to inform implementation of both the CDP and future marine projects;

2) More specifically, it will be desirable to scientifically evaluate and integrate the results of following programs, to the extent practicable and relevant:

    i. Monitoring of the changing morphology of the Great Sands;

    ii. The Baywide monitoring programs, including for seagrass, plume intensity and extent, nutrients, and fish stock and recruitment;

iii. The “offset” seagrass research program;

iv. Post-dredging physical surveys in the Entrance;

v. Monitoring of deep reef recovery;

vi. The “offset” deep reef research program.

Elements i-iii above could be integrated to a substantial degree within a “Great Sands environmental monitoring and research program”, while elements iv-vi could be integrated within a deep reef monitoring and research program.

The IEG will be well-placed to review and advise on the scientific design and interpretation of these programs, as well as their technical execution.

5. RESPONSE TO INQUIRY RECOMMENDATIONS

The following table sets out the Inquiry’s recommendations from its main report, together with my assessment response.

Inquiry recommendations to Government and PoMC	Minister's assessment response
1. PoMC amend Version C of the EMP to: 1.1 Include detailed channel design, construction depths and dredging tolerances, defined as control measures.	Accepted. It is my assessment that detailed channel design, including construction depths, widths and dredging tolerances, be included as control measures, as part of the EMP, with auditing procedures to ensure compliance.
1.2 Adopt the revised CDP schedule that includes Yarra River dredging in spring 2008.	Accepted. It is my assessment that the revised schedule for dredging in the Yarra River from early September to early October 2008 would provide a suitable accommodation of both ecological protection of the Grayling migration and avoiding interference with the operations of the Newport power station, by taking advantage of a scheduled shutdown for major maintenance. Refer to section 4.3.7 of my Assessment fr further details.
1.3 Provide for proportionate offset impacts on protected species (such as Australian Grayling) including improvements to their habitats in other parts of their range (eg. Maribyrnong River).	Accepted. It is my assessment that to offset the CDP impact on the Australian grayling in the lower Yarra River, PoMC make a $300,000 contribution to a grayling recovery program in Victoria, with the specific priorities to be guided by advice from the Arthur Rylah Institute. The priority should be scientific or restoration work that is likely to be of enduring value, rather than necessarily work in the contiguous river catchment. No mitigation or offset measures are warranted specifically to address potential impacts on the mudfish – which may now be extinct in the lower Yarra River. No other protected species are likely to be significantly affected, such as to warrant an offset.
1.4 Deploy alternative noise producing devices to deter marine fauna from approaching the hydrohammer prior to its use in the Entrance, if it cannot be used at lower power for this purpose.	Accepted. It is my assessment that this mitigation measure be included as part of the EMP to further minimise effects of the underwater noise from the hydrohammer on fish, penguins and cetaceans migrating in the Bay. This mitigation measure should also apply to all pile driving works likely to emit

		high levels of impulsive underwater noise.
1.5	Evaluate opportunities for potential reuse of dredged materials for beach renourishment in the CDP and future maintenance dredging programs.	Noted. It is my assessment that it would not be logistically practicable for PoMC to sort, transport and place sediment potentially suitable for beach renourishment, i.e. as part of the CDP program. There are several other issues: i. The suitability of sand dredged during the CDP for beach renourishment; ii. The timing of associated works required to ensure the renourished beach remains stable over the long term, and associated approvals; and iii. The cost-effectiveness of sand sourced from the CDP compared with alternate sources. Depending on the equipment utilised in future maintenance dredging programs, there may be an opportunity to reuse some dredged material in local beach renourishment. However, a higher priority for sand from South Channel may be to place it locally in order to sustain the stability of the Great Sands. I note that some material to be dredged from the South Channel is to be used in the CDP for the capping of the Port Melbourne DMG extension. Not withstanding the comments above, I note that beach renourishment is a long term issue for the management of the Bay's foreshores.
1.6	Mount an information campaign to inform the public of the implications of any dredging programs and other sources of influence on the marine environment, particularly with regard to sediment contamination risk in the Yarra River and other estuarine and marine ecosystems.	Accepted in part. It is my assessment that: i. As part of the EMP, PoMC mount an information campaign to inform the public and Bay user groups of the implications of any dredging programs; ii. Government consider whether any additional public advisory measures are needed, having regard to public concerns about the CDP as well as the results of planned monitoring.

1.7 Undertake a monitoring program for placing and capping contaminated material to: - ensure that the final location and surface bathymetry of contaminated material placed in the northern DMG extension are as predicted; and - confirm that there are no failures of capping, turbidity plumes beyond those predicted, or reduction in water quality in the vicinity of the DMG extension.	Accepted. It is my assessment that these measures be incorporated into the EMP. The EMP should include additional monitoring of the plume at the Port Melbourne DMG extension, i.e. during placement of contaminated material, to confirm that: i. The turbidity plume is not greater than predicted in the SEES; and ii. Water quality in the vicinity of (outside) the DMG is not affected by the plume. I note that the current EMP includes a long-term program to monitor the structural integrity of the bund and cap to ensure that there are no failures that may potentially release contaminants into the environment.
1.8 Strengthen governance arrangements to ensure the PoMC is accountable for bund structure and effectiveness. Include additional monitoring for possible bioaccumulation and biomagnification up the food chain before and after the capping is put in place.	Accepted in part. It is my assessment that: i. If a performance bond or similar performance mechanism is applied to the CDP, one relevant consideration would be the integrity and effectiveness of the DMG bund and capping; ii. Governance arrangement be established to ensure accountability for the integrity and effectiveness of the bund and capping; iii. The approach to monitoring of contaminants in fish that is proposed as part of Annexure 8 of the CDP EMP (Revision C) is satisfactory, including the proposed first stage sampling approximately three months after the completion of dredging. I note, however, that any increment in bioaccumulation which might occur in the 140 days between completing the placement of dredged material at the DMG and the capping taking place would be most unlikely to be detectable. See section 4.3.2 of this Assessment.

1.9	Log all maintenance dredging to update existing data to assist ongoing assessments of the Great Sands.	Accepted. It is my assessment that PoMC log all future maintenance dredging in the shipping channels in order to inform the management of material dredged during future maintenance programs. This logging data will assist improved understanding of sediment budgets and hence guide the management of dredged material.
1.10	Ensure a fit-for-purpose program that can detect long-term changes to sediment transport in the Great Sands. Include monitoring surveys to be conducted during and after the CDP, and link these to scheduling of future maintenance dredging campaigns.	Accepted. It is my assessment that a long-term sediment transport monitoring program be implemented as part of the EMP, to detect long-term changes to sediment transport that may result from the CDP and/or future maintenance dredging. The sediment transport monitoring program should include Lonsdale Bight but focus on the Great Sands region, including Mud Islands and the Bay's southern beaches. The purpose of this monitoring is to inform the management of material dredged during future maintenance programs, as well as management of sediment supply to beaches in Lonsdale Bight.
1.11	Increase the accuracy of sediment transport predictions in the Great Sands by calibrating SEES modelling against LIDAR and multi-beam surveys, maintenance dredging volumes and channel infilling rates.	Accepted. It is my assessment that sediment transport be calibrated on the basis of a 'fit-for-purpose' monitoring program (see 1.10 above), including LIDAR and multi-beam surveys, maintenance dredging volumes and channel infilling rates. The primary purpose of the modelling would be to synthesize data, in order to inform future maintenance dredging and management of material dredged from South Channel in order to sustain sediment supply in the Great Sands.
1.12	Expand the monitoring of water quality to provide a reference and a back up to the automatic turbidity monitoring by adding PAR measurements to the suite of indicators.	Accepted. It is my assessment that PAR sensors be used at least at conformance sites within Marine Protected Areas (at Nepean Bay and Mud Islands), as well as at some other sites that are likely to be affected by the CDP dredge plume (including Blairgowrie), to enable direct monitoring of compliance with irradiance objectives.

1.13	Apply the IEG recommended Fox approach, based on quality control statistics to assessment of appropriate Bay-wide monitoring programs.	Accepted. It is my assessment that the "Fox approach" to setting environmental limits for seagrass, as recommended by the IEG, also be applied where appropriate to the design of other Bay-wide monitoring programs. The features of this approach, as identified by the IEG in its 4 September advice on the CDP EMP (Revision C), are: • "Limits are related to a clearly-stated ecological objective; • There has been a rigorous statistical analysis of experimental data and observations, to relate the ecological objective to statistical limits for turbidity; • Historical background data and model predictions have been used to assess the likelihood of both Type 1 and Type II errors for proposed environmental limits" Control charting was the specific technique used by Fox in setting turbidity limits to protect seagrass during dredging operations, which may also be applicable to the design and analysis of other Bay-wide monitoring programs. Its suitability will depend on the nature of the data, including specified intervention points.
1.14	Strengthen relevant clauses to ensure that the health status of the Little Penguin colony at St Kilda is monitored during and post dredging.	Accepted. It is my assessment that PoMC monitor the health status of the St Kilda penguin colony both during and for at least one year after the completion of CDP dredging. This monitoring program should be designed and implemented in consultation with the managers of the St Kilda penguin colony. I note that one of the "Baywide" monitoring programs proposed as part of the CDP EMP (Revision C) is monitoring of trends in body weight of Little Penguins from the Phillip Island colony.
1.15	Provide offsets to improve fish stocks, including improvement of key habitat sites or reduction of threats within the affected species range.	Noted. It is my assessment that: ii. The monitoring of fish stocks and recruitment that is to be undertaken as part of the CDP EMP "Baywide" monitoring programs during and for two years after completion of dredging, will provide a satisfactory response to potential CDP effects on fish stocks, in the first instance;

	iii. Government determine an appropriate response to enhance fish stocks and address related issues, if (a) a significant decline in fish stocks and recruitment occurs during or after the CDP and (b) is determined to be attributable to the CDP; iv. If a performance bond or similar performance mechanism is applied to the CDP of this Assessment and Recommendation 4 below), one relevant consideration would be the CDP impact on fish stocks and recruitment. v. Offsets payable by PoMC include: • The introduction of an independent monitor to advise Government on the compliance with the Environmental Management Plan. • $2.5 million offset for cool temperate reef community recovery research linked to impacts in the Port Phillip Heads area. • $3 million offset for seagrass research. • $300,000 contribution for Australian Grayling recovery program. • $500,000 for Ramsar site improvements. • Substantial contribution for observation and monitoring of seabirds. • Substantial contribution for Indigenous Heritage management on the Bay coastline.
1.16 Monitor fish subsequent to the CDP, while existing fishing advisories and limitations are in place, using these data to review advisories.	Accepted. It is my assessment that the monitoring of fish stocks and recruitment, together with the monitoring of contaminants in fish from the lower Yarra River and potentially Hobsons Bay, that is to be undertaken as part of the CDP EMP “Baywide” monitoring programs, will provide a satisfactory monitoring response. See also response to Recommendation 1.6 above.

1.17	Ensure PoMC is accountable for CDP impacts on fish populations.	Noted. See my response to Recommendation 1.15 above.
1.18	Include the following measures to improve Entrance management: - increase the frequency and extent of cleaning runs, both inside and outside the dredging zones; - increase the frequency of bathymetric sounding surveys both inside and outside the dredging zones; - reduce ripper teeth length as the final depth is approached or consider use of a more conventional, lighter draghead; - use methods other than trailing to remove any stubborn high spots; - use the trawl net to remove specific caprock pieces; - carry out all dredging runs when swell heights are at a relatively low level; and - further cleanup after completion of dredging to deal with loose rocks that are found.	Accepted. It is my assessment that these measures, which were suggested by the IEG: i. Be applied as necessary and appropriate to minimise rock spill and rockfall in the Entrance, in order to reduce both rock scour and deep reef impacts, to the extent practicable; ii. Be included either as environmental controls or contingencies in the Entrance Dredging PDS, as part of the CDP EMP. See also section 4.3.5 of this Assessment.
1.19	Ensure control measures are clearly defined to ensure maximum clean up of rockfall in the Entrance.	Accepted. See my response to Recommendation 1.18 above. It is my assessment that clean up of rockfall in the Entrance should be undertaken to the “maximum extent practicable”, acknowledging the practical constraints, diminishing effectiveness and high costs involved in these difficult rock clean-up operations.
1.20	Include control measures to ensure maximum capture of rock prior to removal of ridges along the	Accepted. See my response to Recommendation 1.18 above. It is my assessment that:

	canyon wall.	i. "Capture" of rock in the Entrance be undertaken to the "maximum extent practicable", acknowledging the practical constraints, diminishing effectiveness and high costs involved; ii. Precise identification of the canyon edge be ensured, in order that the "draghead lift-off distance" and the 5 m wide ridge on Nepean Bank can be geographically specified for audit purposes.
1.21	Refer each collaborative monitoring program, including review timeframes to the IEG prior to project approval, for confirmation that it is 'fit-for-purpose' for timely consideration of data and addresses an appropriate package of potential flow on effects. In doing so, the IEG should confirm that Bay-wide monitoring programs are appropriately designed to measure changes against natural variation so that CDP management may take account of these during and after dredging.	Accepted. It is my assessment that: i. The integrated design of monitoring and associated assessment model and management response strategy be completed, to the extent practicable and necessary, prior to the commencement of the relevant project component(s). In this context, staged endorsement of these components of the EMP, including at least an outline of the statistical approach, may be acceptable; ii. Prior to the endorsement of the EMP, or components of it, the IEG or other independent experts be requested to advise on the suitability of proposed response levels and environmental limits, in the context of supporting statistical analyses (especially for protection of seagrass); iii. Prior to the endorsement of the "Baywide monitoring programs", the IEG advise on the design of each program in terms of fitness-for-purpose to detect long-term changes in environmental assets, and inform decisions on CDP management, based on an appropriate, integrated approach to spatial/temporal data collection, statistical analysis and interpretation.

1.22	Include post-dredging investigations of major risk events to confirm the extent of changes relative to predictions.	Accepted. It is my assessment that the EMP Baywide monitoring programs, in combination with other post-dredging investigations identified in this Assessment, including reef recovery and monitoring of the Great Sands, will enable evaluation of the extent of changes relative to SEES predictions for key environmental assets. I note that the SEES risk assessment identified no CDP effects of higher than a "moderate" consequence rating, in terms of the adopted methodology. The rock scour scenario, however, led to the upgrading of the effect on intermediate reefs to "major". Further, the SEES did not identify any "high" risk events.
1.23	Consider appropriate mechanisms for ensuring the project stops if a significant or unexpected impact occurs.	Accepted. It is my assessment that the authorisation regime proposed in section 4.4 of the Assessment would provide a suitable basis for ensuring that CDP dredging is halted if a significant or unexpected impact occurs, and does not recommence until the issue is satisfactorily resolved. Key aspects of this potential regime are: i. The EPA might designate the Secretary DSE under s.66A of the EP Act as the responsible protection agency for oversight of the turbidity, suspended sediment and nutrient effects of the CDP dredging and dredged material management activities, including an ability to direct that dredging cease or restart. In exercising this function, the Secretary DSE might be advised by an independent project monitor. EPA would, however, retain responsibility for control over the dredging and placement of contaminated material; ii. A binding agreement, including between PoMC and the Secretary DSE might be made under one or more heads of power, including a commitment by PoMC to comply with any direction from the Secretary DSE to stop works; iii. The Minister for Roads and Ports is able to issue a direction to PoMC under s.91H of the *Port Services Act 1995* to implement

	specified measures in accordance with an EMP developed and certified under the Act.
1.24 Provide additional monitoring to address Commonwealth issues: - Commonwealth of Australia lands and Ramsar sites; - Seagrass in Ramsar areas such as Swan Bay; - Gannets and terns; and - Grayling.	Accepted in principle. It is my assessment that adequate monitoring in relation to the EPBC Act controlling provisions applying to the CDP will be provided by: i. Planned monitoring of the presence of cetaceans in the vicinity of the operating dredge; ii. Planned monitoring of ecologically based turbidity limits, in combination with monitoring of the plume intensity and extent and seagrass (including a conformance site within Swan Bay) iii. Monitoring and further modelling of sediment transport within the Great Sands region (which encompasses Mud Islands and adjoins Swan Island); iv. Monitoring of any lateral movement in habitats within the Port Phillip Ramsar site that may be affected by the expected small change in tidal ranges as a result of the CDP; v. A cooperative program to monitor seabirds and shorebirds, including listed migratory species, within the area that may be affected by the CDP. The latter three programs are proposed as part of this Assessment. No monitoring of the Australian grayling in the lower Yarra River is required. This may well be impracticable, and even if successful it could potentially contribute to mortality of some of the expected small number of grayling. Further, the proposed offset for the expected CDP impacts on the Australian grayling should encompass some monitoring within the selected target areas.

2. Following revision of (1) above, PoMC seek IEG endorsement that the EMP satisfies acceptable standards of scientific and statistical definition.	Accepted in principle. See response to Recommendation 1.21 above. It is my assessment that the IEG be requested by the Secretary DSE to advise on the suitability of a refined EMP, or components of the EMP, prepared by PoMC, in terms of the standard of scientific and statistical definition.
3. The Government appoint an independent monitor to advise Government on unexpected or significant changes to schedule and dredging strategies and associated timetables; responses to significant environmental exceedences; compliance with the EMP (including where a response level is triggered); and adverse outcomes identified by monitoring programs.	Accepted. It is my assessment that a person of suitable authority and experience be administratively appointed as an independent monitor to advise on the delivery of the CDP in accordance with the EMP, and that the role of this person be as set out in this Assessment.
4. The Government consider whether the Alliance should deposit an environmental performance bond linked to safe and effective CDP delivery, and post recovery.	Accepted. It is my assessment that the Minister for Environment and Climate Change, in consultation with the Minister for Roads and Ports, consider whether the Alliance should provide a substantial performance bond, or similar performance mechanism, linked to safe and effective CDP delivery and post-construction recovery. I note that PoMC is responsible for ensuring that the Alliance complies with external requirements for the project.
5. PoMC develop a strong and effective communication strategy for the duration and post recovery of CDP. This should include: 5.1 Appointing a professional of sufficient seniority and capability as "*Community Liaison Officer*" to respond to community inquiries.	It is my assessment that recommendations 5.1 to 5.3 be accepted and included as part of the EMP.
5.2 Establishing a "*Community Liaison Group*", including representatives from the existing Project Stakeholder Advisory Committee, for an initial period of three	Accepted. Refer above. It is my assessment that the Community Liaison Group receive regular reports from PoMC on the environmental performance of the project.

	years. It should meet regularly while the project is being undertaken, and continue during the recovery process.	
5.3	Maintaining effective communication with relevant community groups interested in Bay use and conditions, as well as commercial fisheries.	Accepted. Refer above. It is my assessment that PoMC maintain regular and effective communication with key Bay user groups, including dive groups, eco-tourism operators and commercial fishing organisations, especially in relation to the scheduling of dredging operations and the likely area of the dredging plume (to the extent practicable).
5.4	Consulting the community during and after the CDP to raise awareness of potential for future use of dredged material.	Noted. Refer above. See response to Recommendation 1.5 above.

APPENDIX A - ASSESSMENT OF CONTROLLED MATTERS UNDER EPBC ACT

A.1 Matters of National Environmental Significance

The *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (the EPBC Act) is the Australian Government's key piece of environmental legislation for any proposed action, including projects, developments, activities or alteration of these things, likely to have a significant impact on matters of national environmental significance.

On 20 March 2002, the delegate for the Australian Government Minister for the Environment and Heritage declared the CDP to be a 'controlled action' under the EPBC Act. The controlling provisions of the EPBC Act for the CDP are the following matters of national environmental significance:

- Sections 16 and 17B (wetlands of international importance)
- Sections 18 and 18A (listed threatened species and communities)
- Sections 20 and 20A (listed migratory species)
- Sections 26 and 27A (protection of the environment of Commonwealth land).

The delegate for the Australian Government Minister accredited the EES process for the CDP as the assessment approach under section 87 of the EPBC Act.

The project is described in section 1.3 of this Assessment and in Chapter 4 of the SEES. Chapters 6 and 7 of the SEES describe the alternatives considered in channel design, dredging technology, scheduling and dredged material management.

This section of the Assessment addresses the relevant impacts of the CDP on the controlling provisions under the accreditation arrangements. Section 4.2 of this Assessment outlines the mitigation measures to be undertaken to prevent or minimise impacts on matters of national environmental significance (as well as other the other environmental effects of CDP).

This Assessment, along with other matters specified in the EPBC Act, will inform the decision by the Australian Government Minister for the Environment and Water Resources whether to approve the CDP under section 130 of the Act.

A.2 Wetlands of International Importance

Context

The wetlands of international importance relevant to the consideration of potential effects of the CDP are the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar wetlands, which are protected under the EPBC Act. The specific wetlands (components) of this Ramsar site that are the focus of this aspect of the Assessment are:

- Swan Bay
- Mud Islands
- the Spit Wildlife Reserve (The Spit) component of the western shoreline of the bay.

All other components of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, such as the Western Treatment Plant and Lake Connewarre, are not covered explicitly in this section as there were no threats or effects from the CDP that were predicted to occur within the vicinity of these areas.

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar wetlands is recognised as having international significance under Article 2 of the Ramsar Convention (Ramsar 1971). The strategic management plan for the Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar site[115] sets outs the overarching principles and management directions for these wetlands. Both Swan Bay and Mud Islands are also included in the Port Phillip Heads Marine National Park due to their significant ecological and geomorphological values as well as their cultural and historical significance to many people in the community (especially the Traditional Owners), and are therefore listed on the Register of the National Estate[116].

This Ramsar site is of special value for maintaining the genetic and ecological diversity of the flora and fauna of the region, including many migratory species. The Ramsar site accommodates 579 non-marine flora species, of which at least 42% are non-indigenous and 304 species of fauna, 19 of which are non-indigenous. The western shoreline of the bay, including the Spit Wildlife Reserve and the Western Treatment Plant (WTP), contains breeding colonies of Pied Cormorants and has a high diversity of habitat types and high value for birds including trans-equatorial migratory shorebirds. The rare and endangered Orange-bellied Parrot is found at the WTP and the Spit Wildlife Reserve, as well as on Commonwealth land at Swan Island.

The Swan Bay ecosystem is one of the most significant in the Bay. The intertidal mudflats and surrounding fringe of saltmarsh support large numbers of waderbirds including many that migrate from the Northern Hemisphere. Internationally significant populations of shorebirds occur at Swan Bay including, Grey Plover, Eastern Curlew, Sharp tailed Sandpiper, Rednecked Stint and Curlew Sandpiper. The Orange-Bellied Parrot uses the saltmarshes fringing Swan Bay as a winter refuge and feeding ground. The seagrass meadows in Swan Bay provide significant habitat for some native fish species, particularly King George whiting.

Mud Islands provide excellent habitat for many birds, including endangered and long distance migratory species and supports the largest colonies of breeding waterbirds and seabirds in the Bay, including over 2,000 pairs of Crested Terns, up to 5,000 Whitefaced Storm Petrels, several hundred Australian Pelicans, thousands of Straw-necked Ibis and a small colony of Yellow-billed Spoonbills. It is also a significant breeding site for the Straw-necked Ibis, White Ibis, Caspian Terns, Crested Terns and Royal Spoonbills. There are dense beds of *Zostera* seagrass around Mud Islands which also play important roles in the lifecycle of some native species dependent on these wetlands.

[115] Department of Sustainability and Environment, (2003) *Port Phillip Bay (Western Shoreline) & Bellarine Peninsula Ramsar Site Strategic Management Plan.*

[116] Parks Victoria, July 2006, *Port Phillip Heads Marine National Park Management Plan.*

Analysis of Key Issues

This section draws heavily on the technical analysis within the previous sections of the Assessment on the ecological impacts, particularly that for Objective 3.

The following key impact pathways or threatening processes affecting the ecological character of these wetlands were considered, in the context of the Commonwealth's reasons for including Sections 16 and 17B (wetlands of international importance) as controlling provisions for the CDP:

- Changes to tidal levels, tidal currents and wave refraction around Port Phillip Heads, possibly resulting in long-term, permanent impacts on the hydrology of Ramsar wetlands.
- Changes to waves and tides causing shoreline instability and erosion which could affect seagrass meadows and pose a serious disruption to the lifecycle of native species dependent on the wetland seagrasses.
- Increased turbidity, nutrient and pollution loads which are likely to impact on water quality of the wetlands and alter the physico-chemical status of the wetlands.

The SEES assessed the effects on the ecological character of the Ramsar areas from the CDP due to direct and indirect impacts - i.e. changes to sediment transport and hydrodynamics, diminished water quality, altered waves and tides (changed coastal inundation). This was done largely by undertaking a terrestrial ecological assessment which considered literature and field surveys, in addition to the input from relevant SEES studies such as the hydrodynamics and sediment transport modelling. While the CDP would not directly disturb the land and terrestrial habitats within the Ramsar areas listed above, the SEES did give careful attention to potential adverse effects on the coastal fringes, including saltmarsh areas along the western shoreline and within Swan Bay, as well as around the intertidal area of Mud Islands.

The Inquiry largely concurred with the SEES findings that small changes to tidal levels, currents and hydrology around the Ramsar wetlands may occur but not affect the ecological character of the Ramsar wetlands, including the important intertidal mudflats and Saltmarsh environments. However, PoMC's supplementary analysis in the Rock Scour Supplementary Assessment reports does predict some perceptible changes in tidal levels for short periods (less than one hour) at specific times (high or low water during spring tides), including around the low-lying perimeters of Mud Islands, Swan Bay and the Spit Wildlife Reserve:

- 20 mm lower and 20 mm higher near Spit Wildlife Reserve.
- 27.5 mm lower and 17.5 mm higher at Mud Islands.
- 35 mm lower and 15 mm higher around entrance to Swan Bay (Queenscliff).

It is anticipated that the frequency of normal inundation of the saltmarsh environments will increase slightly and therefore PoMC estimate that further inundation and landward migration of the coastal saltmarsh is likely to occur in some places[117]:

- Spit Wildlife Reserve: (south of the Spit) inundation and landward migration of coastal saltmarsh of 10 to 25 m.
- Swan Bay: landward migration of coastal saltmarsh of potentially up to 3 m.

[117] PoMC (2007) Rock Scour Supplementary Assessment

- Mud Islands: slight landward migration of coastal saltmarsh is predicted, although limited survey data is available and therefore the distance of migration is not quantified.

PoMC has concluded that no net loss of coastal saltmarsh community is expected from the CDP and that it is more likely to result in an increase in the extent or horizontal landward migration of saltmarsh vegetation (see above). Any changes could potentially be within the bounds of natural variation.

PoMC has predicted that effects on intertidal mudflats are likely to result in slightly more exposed intertidal habitat, with such an increase in these areas benefiting wading birds, due to possible increases in habitat opportunities. The SEES did not specify the possible increase in area of intertidal habitat during low sea level (due to small tidal changes), so there is some uncertainty associated with the predicted impact and its effect on intertidal species including in-fauna and seagrass. Based on the gradient of the land in this part of the Bay it may be reasonable to assume that the reduction in tidal levels (i.e. approximately 20 mm) could expose a further 10 to 20 m of intertidal mudflats. This is not predicted to be ecologically significant.

Turbidity modelling indicated that the turbidity from the dredging (i.e. plumes) is not likely to occur at high concentrations within the Ramsar wetlands and considers the effects to be negligible due to being largely within natural variability. This includes the *Zostera* seagrass beds around Mud Islands and within Swan Bay.

In addition, there are no predicted impacts from contaminated sediments within the Ramsar wetlands, given the very limited extent that contaminants could be mobilised, compared with background processes. The SEES also predicts that the load of additional nutrients released during the CDP are small in the context of total annual nutrient loads entering the Bay and is therefore predicted to have negligible effects on the Bay's nutrient cycling processes. Thus it is unlikely there will be any flow-on effects to Ramsar areas.

The SEES concluded that hydrodynamic and sediment transport modelling did not identify any measurable changes to tidal currents or waves around Ramsar wetlands. Therefore, it is assumed that there are no significant changes to sediment transport that the CDP will cause that would bring about any erosion or coastal instability in these Ramsar areas. However, the IEG and PoMC peer reviewer considered there to be some uncertainty associated with the longer term predictions generated by the hydrodynamic and sediment transport modelling, including for the long-term predictions of sediment transport in the Great Sands area and Mud Islands. Some of this uncertainty relates to the effects arising from future maintenance dredging as well as the CDP capital dredging. It was recommended that this uncertainty be addressed by PoMC's EMP monitoring, both prior to and after CDP. The monitoring should cover the Great Sands region, including the southern bay beaches and Mud Islands, and be designed to assess significant changes to bathymetry, for example in the depletion of sediment within the Sands region. If changes are detected remedial action could be implemented (e.g. placement of dredged sands within appropriate areas).

The important ecological features of the site's wetlands include freshwater lakes, estuaries, mangroves, saltmarshes, intertidal mudflats and seagrass meadows[118].

[118] Parks Victoria, May 1999, *Information Sheet on Ramsar Wetlands 18 – Port Phillip Bay (Western Shoreline and Bellarine Peninsula*.

The potential for impact on the 'ecological character' of this declared Ramsar site also needs to be considered in terms of the following criteria from the Commonwealth's policy statement 1.1[119], which states that an impact of significance may occur on the ecological character of the wetlands, if there is a real "possibility that it will result in:

a) areas of the wetland being destroyed or substantially modified;

b) a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland;

c) the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependant upon the wetland being seriously affected;

d) a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or

e) an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland."

Based on the analysis within this Assessment of the CDP impacts and issues, only two of these criteria are considered to be potentially relevant for the Ramsar wetlands: b) and d), which are explored below.

Whilst there is the potential for some very minor changes to the hydrology and sediment transport in the Great Sands region of which Mud Islands is a part, the predictions from PoMC's modelling suggests that they will be insignificant in comparison to natural variation. However, as previously noted, the IEG and PoMC peer reviewer consider there to be some areas of uncertainty associated with the predictions from hydrodynamic and sediment transport modelling given the rock scour scenario (in particular for the longer term predictions). Therefore a precautionary approach should be adopted during and after the project's implementation in order for modelling predictions to be assessed, and if required in the Great Sands area (including Mud Islands), the management of future maintenance dredging programs adjusted.

The other aspect of the hydrology that may alter is the increase in the tidal range in the Bay, particularly for low-lying areas. As noted above, under the rock scour scenario tidal levels are predicted to alter by up to 15 - 35mm around the low-lying perimeters of Mud Islands, Swan Bay and the Spit Wildlife Reserve, albeit for only short periods (less than one hour during spring tides). These changes are potentially significant, depending on the biological and ecological consequences for the intertidal and coastal zone (discussed below).

PoMC reports predict that inundation of the saltmarsh environments is likely to increase slightly and may bring about landward migration of this ecological community in some places. Further to this, the important mudflats around these low-lying Ramsar areas will also be increased with slightly more exposed intertidal habitat at certain times. Whilst some uncertainty surrounds the predicted changes and possible consequences for intertidal species (e.g. in-fauna, seagrass, fish etc), it was

[119] Australian Government, May 2006, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*.

not considered to be ecologically significant. Rather, an increase in these intertidal habitats may be of benefit to some wading birds.

The SEES and subsequent PoMC reports have predicted the changes to water quality using hydrodynamic modelling. Turbidity or increased concentrations of suspended sediment as well as sedimentation were considered for all the relevant Ramsar wetland areas. The plumes generated during dredging are predicted to reach Mud Islands, with concentrations of less than 5mg/l, but with short duration and low frequency. The ecological consequence of this is considered to be insignificant; the seagrass beds are in water less than 3m deep and are not likely to be affected. The plumes are not predicted to reach Swan Bay (or the Spit Wildlife Reserve), expect in very low concentrations of up to 1 – 3 mg/l for very short durations and frequency, and is therefore considered to be within natural variation. Impacts on both Swan Bay's and The Spit's biota from turbidity are predicted to be negligible.

Sedimentation at Mud Islands, Swan Bay and The Spit are predicted to be negligible or within natural variation. Mud Islands will receive the most sediment of these areas, although it is predicted that the amount of sediment expected will resuspend and move around sufficiently to have no net impact on accretion in this area.

Whilst the CDP is predicted to have some impact on the behaviour and distribution of some birds in the southern part of the Bay, the impacts are not considered to be significant enough to be of consequence for the ecology of the Ramsar areas.

Conclusion

It is concluded that the CDP will not significantly impact on the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar wetlands - predicted effects on extent of coastal vegetation/communities due to tidal changes are not likely to have a significant effect on ecological values and character of these wetland environments. It is noted that the minor and possibly imperceptible effects of the CDP will not be clearly distinguishable from the predicted effects of natural or anthropogenic induced variations on water levels, water quality and related environmental changes.

There is some minor potential for some medium to long term changes to hydrodynamics and coastal processes in the Great Sands area, which are predicted to be of minor consequence. However, this uncertainty needs to be further assessed and monitored to ensure the impacts on these coastal fringes and intertidal zones remain insignificant. Therefore some monitoring of sediment movement, bathymetry and water quality trends and any impacts on seagrass habitats and saltmarsh habitats is needed during and following the CDP. It could also be prudent to monitor the state of coastal and intertidal ecological communities including sites within Swan Bay, the Spit Wildlife Reserve and in particular Mud Islands.

A.3 Listed Threatened Species and Communities

The species which are listed as threatened under the EPBC Act and which are relevant to the CDP are:

- Great White Shark *Carcharodon carcharias*
- Grey Nurse Shark *Carcharodon taurus*
- Australian Grayling *Prototroctes maraena*

- Yarra Pygmy Perch *Nannoperca obscura*
- Dwarf Galaxias *Galaxiella pusilla*
- Blue Whale *Balaenoptera musculus*
- Southern Right Whale *Eubalaena australis*
- Humpback Whale *Megaptera novaeangliae*
- Australian Sea-Lion *Neophoca cinera*
- Leatherback Turtle *Derochelys coriacea*
- Blue Petrel *Halobaena caerulea*
- Fairy Prion *Pachyptila turtur*
- Grey-headed Albatross *Thalassarche chrysostoma*
- Northern Giant-Petrel *Macronectes halli*
- Shy Albatross *Diomedea cauta*
- Southern Giant-Petrel *Macronectes giganteus*
- Wandering Albatross *Diomedea exulans*
- Orange-bellied Parrot *Neophema chrysogaster.*

Sharks. The Great White Shark is widely distributed throughout Australian coastal waters and the world, specifically in South Africa and North America. They are not dependent upon the Bay for primary habitat, and they are rarely sighted in the bay. The SEES investigations have confirmed that the CDP is unlikely to affect this species.

The east coast population of the Grey Nurse Shark is generally confined to the coastal waters of southern Queensland and New South Wales. No confirmed sightings have been recorded in the Bay, although there are reports of unconfirmed sightings. This species is unlikely to be affected by the CDP.

Freshwater Fish. The Yarra Pygmy Perch and Dwarf Galaxias are both native to the Port Phillip catchment. The Yarra Pygmy Perch is now extinct in the Yarra River and believed to be absent from the wider bay catchment. The Dwarf Galaxias occurs sporadically and does not leave freshwater habitats. For these reasons the CDP is unlikely to affect the either the Yarra Pygmy Perch or the Dwarf Galaxias.

In Victoria the Australian Grayling has been most frequently recorded from the Tambo, Barwon, Mitchell and Tarwin River systems. There are recent records of the species from the upper reaches of the Yarra River[120]. It also occurs in coastal streams in NSW and Tasmania. While no surveys of Yarra River fish populations were undertaken as part of the SEES, it is assumed that a viable population of Australian Grayling continues to utilise the lower Yarra River, as part of its diadromous lifestyle migrating between fresh and brackish or salt waters.

The key hazards to grayling and mudfish posed by the CDP are:

- Reduced visibility due to turbidity from dredging affecting the migration of fish in the lower Yarra River, particularly the upstream migration of juveniles;
- Suspended sediments clogging the gills of migrating fish, particularly at the most sensitive larval stage;

[120] McDowall (1976), Zampatti, B. (2003) *Assessment of the rock-ramp fishway at Dights Falls, Lower Yarra, Melbourne.* Unpublished report Arthur Rylah Institute for Environmental Research, DSE, Melbourne.

- Underwater noise from dredging by the TSHD and berthworks in the Yarra River port area affecting upstream migration of juveniles.

The period in which grayling is most vulnerable to dredging is following spawning until their upstream migration, in the Spring/early summer period.

A combination of elevated turbidity and elevated noise are likely to present at least a partial barrier to upstream migration of fish, if dredging (or berthworks) coincide with the migration period. Clogging of larval gills is likely to exacerbate the overall level of impact. However, the latter effect is likely to be less significant in itself as the level of suspended sediments generated by CDP dredging in the lower Yarra River is predicted to be slightly below the level of 100 mg/L found to cause mortality of larvae of some fish species (PIRVic, 2006). Nevertheless, there is no specific information available on the sensitivity of the grayling and mudfish to suspended sediments.

The SEES proposed an indicative dredging schedule with TSHD dredging in the Yarra River occurring from December 2008 to February 2009, and in the Williamstown Channel from June to August in both 2008 and 2009. Use of a backhoe or grab dredge in the Yarra River is proposed in June-July 2008 and December to May 2009. This schedule was designed to avoid TSHD dredging in the Yarra River and Williamstown Channels during the period of upstream migration by the grayling and mudfish. However, a modified schedule tabled by PoMC at the SEES Inquiry following negotiations with Ecogen, proposed dredging in the Yarra River from mid July to early August 2008, and from early September to early October 2008, as well as from mid December 2008 to late March 2009.

Several sources of uncertainty need to be taken into account in assessing potential CDP impacts on the grayling. These include uncertainty regarding:

1) Whether grayling spend their juvenile period in the Yarra River estuary or in the Bay itself; and

2) The level of suspended sediments causing both lethal and sub-lethal effects in the species.

The assessment with respect to the Australian grayling concludes that:

1) It is likely to be still present in the lower Yarra River, though in relatively small numbers;

2) Its downstream larval drift is unlikely to be significantly affected if dredging in the lower Yarra River during the period March-July is limited to an overlap of less than two months

3) Its upstream migration is unlikely to be significantly affected if dredging in the lower Yarra River avoids the period October-early December.

Having regard to (a) the extensive occurrence of the grayling elsewhere in south-eastern Australia, (b) the likelihood that the migration of the grayling in the Yarra River would not be significantly affected by the proposed dredging schedule, and (c) the ability of grayling populations to recover from a poor migration season, the assessment recommends that:

1) A temporary and limited reduction in habitat suitability for Australian grayling in the lower Yarra River due to the proposed CDP dredging program is acceptable, since population recovery within one to two years can be reasonably assured;

2) To offset the CDP impact on the Australian grayling in the lower Yarra River, PoMC make a $300,000 contribution to a grayling recovery program in Victoria, with the specific priorities to be guided by advice from the Arthur Rylah Institute.

Mammals. The Blue Whale, Southern Right Whale and the Humpback Whale are known to regularly occur in Victorian coastal waters in the vicinity of the Bay, however they are not resident in the bay. These whales are not likely to be affected by activities associated with the CDP. In the event that a whale entered the bay, the cetacean procedures of the EMP would need to be activated to ensure that the whales are not affected by the CDP e.g. hydrohammer noise).

The Australian Sea-Lion is an occasional visitor to the Bay. The CDP is unlikely to affect this species because the Bay does not provide significant habitat and sea-lions feed and breed elsewhere.

Reptiles. The Leatherback Turtle is found in the coastal waters of New South Wales, Victoria, Tasmania and Western Australia. There are no known records of the species in the Bay hence the CDP is unlikely to have a significant effect on the species.

Seabirds. The following seabirds, which are listed as threatened under the EPBC Act, occasionally enter the Bay:

- Blue Petrel *Halobaena caerulea*
- Fairy Prion *Pachyptila turtur*
- Grey-headed Albatross *Thalassarche chrysostoma*
- Northern Giant-Petrel *Macronectes halli*
- Shy Albatross *Diomedea cauta*
- Southern Giant-Petrel *Macronectes giganteus*
- Wandering Albatross *Diomedea exulans*

When these species enter the Bay, they generally occur in small numbers and range extensively over the Bay without being confined to one particular location. Importantly the above species all breed outside the Bay environs. It is therefore considered that the CDP would not significantly affect these species.

Orange-bellied Parrot. The saltmarsh habitats of the Spit Nature Conservation Reserve and Swan Bay support a significant population of the Orange-bellied Parrot (OBP) when the species migrates from to the mainland from its breeding area in south-west Tasmania. The potential effects on its habitat are considered in section 4.3.4 of this Assessment. It is expected that the hydrodynamic changes resulting from the CDP would lead to a net increase in saltmarsh (if any change), thereby providing potential benefits for the OBP.

Conclusion

It is concluded that the potential effects of the CDP on listed threatened species is not likely to be significant, however a precautionary approach is warranted in respect to the Australian Grayling. If dredging occurs in the Yarra River and Hobsons Bay during the upstream migration of juveniles, it is considered that effective offsetting measures should be incorporated into the EMP for the CDP. Monitoring of effects on saltmarsh habitats should be undertaken both during and following the CDP to confirm no significant effects on the OBP.

A.4 Listed Migratory Species

This section discusses migratory species that are not listed as threatened under the EPBC Act. This category mostly relates to seabirds and shorebirds. Migratory whale species (Blue Whale, Southern Right Whale and the Humpback Whale) relevant to the CDP are discussed in the preceding section on listed threatened species.

Seabirds
The following seabirds are listed as migratory, but not threatened, under the EPBC Act in this category include:

- Arctic Jaeger *Stercorarius parasiticus*
- Arctic Tern *Sterna paradisaea*
- Common Tern *Sterna hirundo*
- Light-mantled Sooty Albatross *Phoebetria palpebrata*
- Little Tern *Sterna albifrons*
- Pomarine Jaeger *Stercorarius pomarinus*
- Short-tailed Shearwater *Puffinus tenuirostris*
- Sooty Shearwater *Puffinus griseus*
- Wilson's Storm-Petrel *Oceanites oceanicus.*

None of these seabirds breed within the Bay. Their occurrence in the Bay usually involves low numbers with large and variable distributions. These factors lead to the conclusion that the species would not be significantly affected by the CDP.

The shorebirds listed as migratory, but not as threatened, species under the EPBC Act include:

- Asian Dowitcher *Limnodromus semipalmatus*
- Bar-tailed Godwit *Limosa lapponica*
- Black-tailed Godwit *Limosa limosa*
- Broad-billed Sandpiper *Limicola falcinellus*
- Buff-breasted Sandpiper *Tryngites subruficollis*
- Common Greenshank *Tringa nebularia*
- Curlew Sandpiper *Calidris ferruginea*
- Eastern Curlew *Numenius madagascariensis*
- Great Knot *Calidris tenuirostris*
- Greater Sand Plover *Charadrius leschenaultii*
- Grey Plover *Pluvialis squatarola*
- Lesser Sand Plover *Charadrius mongolus*
- Little Curlew *Numenius minutus*
- Marsh Sandpiper *Tringa stagnatilis*
- Oriental Plover *Charadarius veredus*
- Pectoral Sandpiper *Calidris melanotos*
- Red Knot *Calidris canutus*
- Red-necked Phalarope *Phalaropus lobatus*
- Red-necked Stint *Calidris ruficollis*

- Ruddy Turnstone *Arenaria interpres*
- Sanderling *Calidris alba*
- Sharp-tailed Sandpiper *Calidris acuminata*
- Stilt Sandpiper *Micropalama himantopus*
- Terek Sandpiper *Xenus cinereus*
- Whimbrel *Numenius phaeopus*
- White-rumped Sandpiper *Calidris fuscicollis*

Large numbers of shorebirds occur in the Bay. Most migratory shorebirds utilise coastal habitats in the west and south, where they forage over intertidal mudflats at low tide. At high tide, they fly to roost on sandy beaches and spits, coastal lagoons and/or saltmarshes.

According to the SEES, it is anticipated that there would be an increase in the intertidal area around the bay due to the increased sea level range following the completion of the CDP. The increase in area at each location will be dependent on the gradient of the current subtidal areas which will be exposed at low tide. Therefore, it is anticipated that the shorebird species which forage in intertidal areas will not be affected by the CDP, and may benefit from an increase in habitat.

The SEES also concluded that key breeding and foraging habitat around Mud Islands will not be affected by the CDP. Mud Islands are expected to continue to naturally evolve irrespective of the CDP.

The implications of rock-scour were considered in a separate report[121] tabled at the Inquiry. It was concluded that the increase in channel depth at the Entrance from 19 to 22 metres would result in a larger increase in intertidal feeding area for shorebirds relative to the prediction in the SEES. The change in tidal flushing affecting marine ecosystems would cause a negligible difference in effects.

Conclusion
It is concluded that the CDP is unlikely to have a significant effect on species that are listed as migratory under the EPBC Act. Nevertheless monitoring of coastal and intertidal ecological communities within Swan Bay, the Spit Wildlife Reserve and Mud Islands should be undertaken during and after the CDP to ensure that migratory species are not adversely affected.

A.5 Commonwealth Land

There are a number of areas of Commonwealth land in the vicinity of the CDP. These are:

- Swan Island Defence Precinct, Queenscliff
- Swan Island and Naval Waters, Queenscliff
- Point Nepean Commonwealth area Portsea.

The SEES has demonstrated that there would be no discernible impacts on buildings, other infrastructure or shipwrecks in theses areas from the CDP. The

[121] PoMC (2007) *Rock Scour Supplementary Assessment*

SEES has demonstrated that changes to coastal processes and hydrodynamics would have no significant impact on the environment of these Commonwealth areas.

The potential effects of rock scour at the Entrance have been assessed following the completion of the SEES. Although it was concluded that there would be no property damage[122], some minor changes were noted:

- Possibility of slight increase in erosion due to waves on Point Nepean and Point Lonsdale, but not quantifiable at this time.
- Predicted decrease in potential longshore sediment transport in Lonsdale Bight.
- No impact on the supply of sand to the beaches of Queenscliff and the Sands.

The peer review[123] of this modelling considered that future longer term detailed field studies are needed to calibrate more comprehensive modelling of the sediment transport patterns in the Bight to give better assessment of the impact on the beach system and its sediment budget. Nevertheless, potential impacts from dredging-induced scour are not regarded as being of sufficient magnitude to warrant delay of the CDP.

Conclusion

It is concluded that monitoring of the coastal processes and effects on Commonwealth land should be undertaken during and after the CDP to confirm that the effects are minor.

[122] PoMC (2007) *Rock Scour Supplementary Assessment*

[123] Healy, T. (2007) *Dredging-induced potential scour at the entrance to Port Phillip Bay – a review of reports on scour and modelling the potential impacts a report to Port of Melbourne Corporation*, Department of Earth and Ocean Sciences, University of Waikato

APPENDIX B APPLICABLE LEGISLATION AND POLICY

This appendix describes the objectives and principles of ecologically sustainable development (ESD), and then key aspects of legislation, policy, strategies and guidelines that are pertinent to this Assessment.

B.1 Objectives and Principles of Ecologically Sustainable Development

National agreements. The Australian Government, all States and Territories, as well as the Australian Local Government Association, are all signatories to both the Inter-Governmental Agreement on the Environment (IGAE, February, 1992) and the National Strategy for Ecologically Sustainable Development (December, 1992). These two documents respectively set out agreed principles of environmental policy and the agreed objectives and principles of Ecologically Sustainable Development (ESD).

The agreed objectives and principles of environmental policy and ESD, in varying combined and augmented forms, have subsequently been incorporated in various legislation that are relevant to the CDP.

EPBC Act. Section 3A of the *Environment Protection and Biodiversity and Conservation Act* 1999 incorporates core elements of the IGAE principles as 'principles of ESD', viz.:

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;

(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

(c) the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;

(e) improved valuation, pricing and incentive mechanisms should be promoted.

Environment Protection Act 1970. The 'principles of environment protection' under s.1B to s.1L of the Victorian *Environment Protection Act 1970* (EP Act) are largely derived from the IGAE principles. The principles under this Act are of broad relevance to activities impinging on protection of the environment in Victoria.

Section 1B of the EP Act draws more fully from the IGAE than the EPBC Act in its inclusion of an expanded version of the first principle above, viz.:

(1) Sound environmental practices and procedures should be adopted as a basis for ecologically sustainable development for the benefit of all human beings and the environment.

(2) This requires the effective integration of economic, social and environmental considerations in decision making processes with the need to improve community well-being and the benefit of future generations.

(3) The measures adopted should be cost-effective and in proportion to the significance of the environmental problems being addressed.

Further, s.1C of the EP Act adopts the full IGAE version of the precautionary principle (cf. (b) above), viz.:

"(2) Decision making should be guided by-

(a) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and

(b) an assessment of the risk-weighted consequences of various options".

Similarly, the EP Act closely follows the IGAE statement of the 'principle of improved valuation, pricing and incentive mechanisms' in section 1F, which states *inter alia* that "persons who generate pollution and waste should bear the cost of containment, avoidance and abatement".

Further principles of environment protection incorporated in the EP Act are:

1G. Principle of shared responsibility

1H. Principle of product stewardship

1I. Principle of wastes hierarchy

1J. Principle of integrated environmental management

1K. Principle of enforcement

1L. Principle of accountability.

Commissioner for Environmental Sustainability Act 2003. The nationally agreed goal, objectives and principles of ESD are directly expressed in Victorian legislation under s.4 of this Act, the goal being "development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends". ESD objectives recognised under s.4(2) of this Act include:

(c) the need to consider the global dimension of environmental impacts of actions and policies;

(d) the need to develop a strong, growing and diversified economy which can enhance the capacity for environment protection;

(e) the need to maintain and enhance international competitiveness in an environmentally sound manner;

(g) the need to facilitate community involvement in decisions and actions on issues that affect the community.

Other pertinent Victorian Acts also invoke objectives and principles of sustainable development, as will be outlined in subsequent sections.

Victoria's Environmental Sustainability Framework. In April 2005 the State Government released its environmental sustainability framework *Our Environment, Our Future* which provides direction for governments, business and the community

for including environmental considerations into decision making. Maintaining and restoring healthy marine and coastal areas is a key objective of the framework.

B.2 *Port Services Act 1995* and Policy

Port Services Act 1995. The legislative basis for the development of the CDP lies under this Act. Section 12 of the Act mandates that the objectives of the Port of Melbourne Corporation (PoMC) are (italics inserted):

(a) to manage and *develop the Port of Melbourne in an economically, socially and environmental sustainable manner*;

(b) to ensure that the essential port services of the Port of Melbourne are available and cost effective;

(c) to ensure, in cooperation with other relevant responsible bodies, that the Port of Melbourne is effectively integrated with other systems of infrastructure in the State;

(d) *to facilitate*, in cooperation with other relevant responsible bodies, the *sustainable growth of trade through the Port of Melbourne*;

(e) to establish and manage channels in the Port of Melbourne for use on a fair and reasonable basis.

Under this Act, the PoMC is responsible for strategic planning, development, operation and management of the Port, including its promotion and marketing and the integration of infrastructure and logistics systems with relevant systems outside the port.

PoMC is responsible for advancing the CDP, in accordance with its functions under s.13(1) of the *Port Services Ac* 1995*t,* which include "to manage and, in accordance with standards developed by the Director of Marine Safety, to dredge and maintain channels in port of Melbourne waters".

The *Port Services Act* contains a strong set of provisions for the development, certification, implementation and auditing of environmental management plans (EMPs) for ports that could be applied to the CDP including:

- An obligation of the port manager to prepare an EMP and safety management plan (s.91C), to address specific matters related to hazards and risks (s.91D);
- A requirement for the EMP to be certified by a person approved by the Minister, who is also an environmental auditor appointed under the *Environment Protection Act 1970* (s.91E), and for a certified EMP to be reviewed for effectiveness and audited for compliance by an environmental auditor after two years (s.91F); and
- An ability for the Minister to give directions to the port manager in relation to an EMP, including to implement any of the measures or strategies specified in the EMP to prevent or reduce hazards and risks, and to have an EMP audited (s.91H).

Through consultation with "relevant Ministers", including the Minister administering the *Environment Protection Act,* the EMP provisions under the *Port Services Act* enable effective coordination with other statutory procedures.

CDP policy. The Government's policy statement *Growing Victoria Together 2000* set out its vision for Victoria over the next decade. It recognises the need to better link Melbourne and regional ports to industry and agricultural centres across Victoria as a priority issue.

As noted in section 1.2, the Victorian Ports Strategic Study 2000 provided the basis for the Victorian Government's in-principle support for the CDP announced in December 2001, while the *Victorian Ports Strategic Framework* released in November 2004 recognised the priority of maintaining the Port of Melbourne as Australia's premier container port through developments including the CDP, to maximise the use of Swanston Dock and then warrant the development of the Webb Dock precinct for container handling.

The Government's Economic Statement *Victoria: Leading the Way* released on 20 April 2004 identifies the CDP as a strategic priority for the sustainable growth of trade through the Port of Melbourne, in the context of the increasing draught of vessels servicing Australian ports. This statement is an action plan to generate new opportunities from the changing global economy, to drive new investment in Victoria, stimulate jobs throughout Victoria, lower costs for Victorian businesses and support increased exports through the investment in world's best infrastructure. Action 1 of the statement concludes "channel deepening will support further investment in the port and throughout Victoria. The project will benefit Victorian exporters across the State and have a positive impact on the State's economy….". Consistent with the Government's announcement of in-principle support for the CDP, this policy commitment remains subject to the outcomes of the EES and approvals processes as well as resolution of financial aspects.

Draft Port Development Plan. The PoMC has developed a draft Port Development Plan to address requirements of its charter and to set out a clear plan for managing the expected strong growth of the port to 2035. The draft plan released in August 2006 "recognises the importance of balancing the needs of surrounding communities with the ongoing physical and economic development of the port" (p3).

B.3 *Marine Act 1988* and International Marine Safety Standards

Marine Act 1988. The purposes of the *Marine Act 1988* are:

(a) to re-enact with amendments the law relating to the registration of vessels and the pollution of State waters; and
(b) to implement certain international conventions; and
(c) to provide for the efficient and safe operation of vessels on State waters.

The Act provides controls for the registration of marine vessels, the efficient and safe operation of vessels and associated boating activities, and also establishes Marine Safety Victoria (MSV). The Marine Regulations provide for the regulation of vessels by MSV to ensure their safe operation.

The Director of MSV has number of responsibilities, including the following which relate to the CDP:

- to determine and enforce standards and procedures for navigation and maritime safety on State waters (s.65 H); and
- to develop appropriate standards for the provision and maintenance of navigation aids for State waters (s.65 I); and

- to develop appropriate standards for the dredging and maintenance of channels in State waters (s. 65 J); and
- to direct the removal of impediments or obstructions to navigation on State waters (s.65 J(a)); and
- after consultation with the Environment Protection Authority, to develop, review, co-ordinate and administer the Victorian Marine Pollution Contingency Plan (s.65 J(b)).

The *Joint PIANC-IAPH Report on Approach Channels - A Guide for Design (Vol 2)* (June 1997) details international best-practice design for approach channels to ensure navigability and safety. It includes aspects of ship handling and maritime engineering which can be applied to the CDP design process.

International Regulations for Preventing Collisions at Sea (1972) are published by the International Maritime Organisation (IMO). They set out the "rules of the road" to be followed by ships and other vessels at sea including roles and responsibilities, steering and sailing rules, and lighting requirements. This needs to be considered in development of the PoMC's Operating Guidelines.

The International Association of Marine Aids to Navigation and Lighthouse Authorities was founded in 1957 to facilitate information sharing and coordination of improvements to visual aids to navigation throughout the world. The CDP must give due consideration to the appropriate use of landside and seaside navigation aids.

B.4 *Environment Protection Act 1970* and associated Policy

Environment Protection Act 1970. This Act (EP Act) provides for the prevention of pollution and the protection of the environment and establishes the Environment Protection Authority (EPA).

Works Approval and licensing of the CDP is not required under the EP Act. Dredging works and the placement of dredged material within the Bay from dredging vessels (a premises) are not prescribed under the *Environment Protection (Scheduled Premises and Exemptions) Regulations 2007*. The CDP must, however, comply with the pollution control measures in the EP Act.

There are two aspects of the EP Act that are relevant to the CDP:

1) State Environment Protection Policy (SEPP) and Waste Management Policy, made under s.16 and 16A respectively, that guide (a) action to maintain environmental quality necessary to protect beneficial uses of Victoria's environment, and (b) the management of wastes. SEPP (Waters of Victoria (WoV)) is of particular relevance to the CDP. Other SEPP relevant to the CDP are SEPP (Air Quality Management) and SEPP (Control of Noise from Commerce, Industry and Trade) N1; and

2) Powers available to the EPA to both (a) audit environmental practices and conditions and (b) take enforcement action to protect the environment.

State Environment Protection Policy (Waters of Victoria). The SEPP (WoV) applies to all surface waters in the state and defines environmental quality objectives and indicators that must be met to protect beneficial uses (including aquatic ecosystems, water suitable for navigation and shipping, water suitable for aquaculture and consumption of crustaceans, molluscs and fish).

The SEPP (WoV) Schedules F6 and F7 are statutory instruments to protect the Waters of Port Phillip Bay and the Yarra River Catchment, respectively. These schedules prescribe the beneficial uses of the environment that are to be protected within specified geographic segments, as well as the environmental quality objectives and attainment measures to be applied. Beneficial uses protected in different segments include:

- Maintenance of natural aquatic ecosystems and associated wildlife;
- Water-based recreation;
- Production of molluscs for human consumption;
- Commercial and recreational use of edible fish and crustacea;
- Navigation and shipping; and
- Industrial water use.

"Maintenance of natural aquatic ecosystems and associated wildlife" is generally the most limiting beneficial use in the various segments, in terms of acceptable water quality. The Aquatic Reserves segment in Schedule 6 specifies that "natural ecosystems" are to be protected, while the Inshore segment (fringing most of the Bay) and the General segment (including most of the inner part of the Bay) require "substantially natural ecosystems with some modification" to be protected. The Hobsons Bay segment under Schedule 6 and the Yarra River Port segment under Schedule 7 require "highly modified ecosystems with some habitat values" to be protected.

Clause 13 of Schedule F6 deals with dredging and disposal of dredged material[124]:

13(1)(a) "these activities are [to be] "conducted in accordance with current best practice or any code of practice approved by the authority";

13(1)(b) "these activities are [to be] conducted and managed to ensure local exceedances of the environmental objectives listed in Table 2 [of F6] are confined to the smallest practicable area and over the smallest practicable time in the vicinity of the dredging and disposal operation;

13(1)(c) "these activities [are not to] re-suspend and/or disperse sediments or accumulated contaminants that will be detrimental to the long-term protection of beneficial uses; and

13(1)(d) "dredged spoil is [to be] disposed to land wherever practicable and environmentally beneficial as determined by the Authority."

13(1)(e) "protection agencies must ensure that any permit issued or approval given in relation to a planning scheme for dredging or de-silting operations contain requirements that are consistent with sub-clauses 1(a), (b), (c) and (d)."

Schedule F7 contains a similar clause. These policy clauses provide important directions for this Assessment of the CDP.

Port Phillip Bay Environmental Management Plan 2002. Clause 11 of Schedule F6 requires that a Port Philip Bay Environmental Management Plan (PPB EMP) be developed and implemented to achieve the objectives of the Schedule. Clause 12 further requires that, as a component of the PPB EMP, a Nutrient Reduction Plan be implemented to achieve by 2006 a reduction of 1000 tonnes in the annual load of

[124] Clause 44 of SEPP (Waters of Victoria (WoV)) provides general measures to be applied to "dredging and de-silting management". More specific measures are set by clause 13 of Schedule F6.

nitrogen discharged to the Bay, relative to a 1992-1996 baseline. This latter provision addresses a key factor affecting the ecological health of Port Philip Bay, i.e. the maintenance of a nitrogen-limited Bay ecology.

The PPB EMP was prepared by the former Department of Natural Resources and Environment in accordance with Schedule F6 and released in 2002. It emphasises the importance of conserving the Bay's biodiversity and provides a framework for the coordination of management actions based on a set of key objectives and environmental risks. It identifies two principle risks to the environmental management of the Bay, i.e. increased nutrients and the introduction of exotic marine pests. To address these risks, the PPB EMP includes a nutrient program and a marine pest program.

Best Practice Environmental Management Guidelines for Dredging. In relation to clause 13(1)(a) of Schedule F6, the current best practice guidance for dredging is provided by the *Best Practice Environmental Management Guidelines for Dredging* (BPEMGD), published by the EPA in 2001. Key strategies identified by these guidelines, which are largely pertinent to the CDP, are to:

- Minimise the need for dredging and spoil disposal
- Minimise the physical effects of spoil disposal (e.g. beneficial re-use of spoil, minimise area covered by spoil)
- Minimise the effects of contaminated sediments
- Minimise the effects on water quality
- Optimise dredging and disposal methods
- Control dredging noise
- Control odours released from sediments
- Establish appropriate monitoring programs.

Best practice is defined in the SEPP (WoV) as "the best combination of techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of that industry sector or activity". In making decisions in relation to best practice, clause 12 of SEPP (WoV) states that practicability is a relevant consideration in the implementation of best practice to ensure effective environmental management. It also states that the setting of priorities in implementing SEPP (WoV) to the extent practicable is to take account of environmental, social and economic considerations.

Two of the matters covered by the BPEMGD are the characterisation of potentially contaminated sediments and the selection of disposal sites. However, the EPA has advised that more current guidance on these aspects of best practice for dredging assessment is provided by the National Ocean Disposal Guidelines for Dredged material (NODG) (Australian Government, 2002).

Wastes hierarchy. The principle of wastes hierarchy under s.1I of the EP Act is relevant to the CDP. This principle dictates that careful consideration should be given to opportunities for waste avoidance, then re-use, recycling etc before disposal is considered. Treatment and containment need to be considered before disposal is resorted to. The appropriate management of different components of a waste stream, including dredged material, will depend on the character of those wastes as well as the technologies, costs, practical opportunities and environmental consequences of different management options.

SEPP Control of Noise from Commerce, Industry and Trade (SEPP N1). This SEPP provides controls for noise emissions from commercial or trade premises within the metropolitan region. All works will comply with the SEPP N1, despite it applying only to activities that the dredging contractor will take in the north of the Bay.

Responsibility for implementation of the EP Act extends well beyond the EPA. Indeed, "protection agencies" with powers or duties under any other Act with respect to the environment or a segment of the environment have responsibilities to protect the Victorian environment in accordance with the Act[125]. It is pertinent to note that, as a public body responsible for managing environmental resources, PoMC is a protection agency within the terms of the EP Act.

B.5 *Coastal Management Act 1995* and *Victorian Coastal Strategy*

Coastal Management Act 1995 (CM Act). Under section 37 of the CM Act, the use or development of coastal Crown land, which includes the sea floor within the Bay as well as the lower Yarra River, requires the consent of the Minister for Environment and Climate Change. Section 40 specifies that the Minister may grant consent with or without conditions or may refuse consent. This consent under the CM Act is the main Victorian approval required for the CDP.

In considering an application for consent under s.40(2), the Minister must have regard to:

(a) the Victorian Coastal Strategy; and

(b) any Coastal Action Plan applying to the land; and

(c) any recommendation of the Land Conservation Council for the land in respect of which notice has been given to the Department of Natural Resources and Environment under section 10(3) of the *Land Conservation Act 1970;* and

(d) the purposes for which land was reserved, in the case of land reserved or deemed to be reserved under the *Crown Land (Reserves) Act 1978.*

There is no applicable Coastal Action Plan relating to the area directly affected by the CDP. Further, there is no recommendation of the Land Conservation Council that applies, and no land reserved under the *Crown Land (Reserves) Act* is required.

Victorian Coastal Strategy. Section 15(1) of the CM Act requires the Victorian Coastal Strategy to provide for the long term planning of the Victorian coast (italics inserted):

(a) to ensure the *protection of significant environmental features* of the coast[126]; and

(b) to provide clear direction for the future use of the coast including the marine environment; and

(c) to identify suitable development areas and development opportunities on the coast; and

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[125] The Act provides that a protection agency may be designated under section 66A as having specific responsibilities to protect the environment.

[126] Section 4(b) gives more specific direction on the aspects of the environment to be protected, in relation to the objectives of the CM Act, viz: "to protect and maintain areas of environmental significance on the coast including its ecological, geomorphological, geological, cultural and landscape features".

(d) to ensure the *sustainable use* of natural coastal resources.

Consistent with both the Act and the IGAE principles, the Victorian Coastal Strategy (2002, pp.17-21) establishes a hierarchy of four principles to guide decision-making for coastal planning and management:

1. Protection of significant environmental features.
2. Sustainable use of natural coastal resources, in the interests of intergenerational equity, *inter alia* by:
    i. Coastal and marine environments are recognised as long term public assets …
    ii. Natural dynamic processes and systems which shape and maintain the coastline and its living resources must be respected …
    iii. The use and management of the coast will be designed to work with nature rather than against it …
    iv. Risk will be actively managed.
    v. Continuous improvement in processes, activities and discharges that have an impact on coastal values shall be encouraged.
    vi. User and polluter pays principles will be pursued to recover the costs of long term coast use or damaging processes.
3. Direction for the future through integrated coastal zone planning and management that is based on ESD principles.
4. Sustainable development on the coast is that which provides an environmental, social and/or economic benefit, enhancing the community's value of the coast. It will generally be coastal dependent or related to coastal dependent uses (e.g. ports).

When the first three principles have been met, sustainable development may be facilitated "within existing modified and resilient environments where the demand for services is evident and requires management" (p.21).

Within the framework of its hierarchy of principles, the Strategy sets out a comprehensive set of objectives and program actions. In relation to marine and estuarine environments, relevant objectives include:

- Protect and improve intertidal habitat, flora and fauna, and marine biodiversity (1.1, 1.3 and 1.4);
- Reduce the impact of sea-based activities on water quality (1.7):
    - under Action 1.7.4, "Dredging proponents will be encouraged to develop long-term dredging strategies in accordance with the Best Practice Environmental Management Guidelines for Dredging to continuously improve practices";
    - under Action 1.7.5, "Approvals agencies will consider the potential impacts on biological diversity from industrial and extractive uses (e.g. port uses …) and seek advice on appropriate environmental assessment, including the need for an Environment Effects Statement".

Objective 6.2 is to 'Ensure appropriate port and coastal dependent industrial development', and has two actions:

- Coastal land with deep water access will be maintained for appropriate port and industrial development. Commercial port uses at Portland, Geelong, Hastings and Melbourne will be maintained. (Action 6.2.1).
- Proposals for new industries or large scale expansions to existing coastal industry or infrastructure should be subject to appropriate environmental assessment to determine whether the likely effects on the environment, including cumulative and long term effects, are acceptable and have appropriate mitigation and management measures. (Action 6.2.2).

B.6 *Flora and Fauna Guarantee Act 1988* and Biodiversity Policy

Under section 4(1) of the *Flora and Fauna Guarantee Act 1988* (FFG Act), the objectives of flora and fauna conservation and management in Victoria include:

> (a) to guarantee that all taxa of Victoria's flora and fauna other than the taxa listed in the Excluded List can survive, flourish and retain their potential for evolutionary development in the wild; and
>
> (b) to conserve Victoria's communities of flora and fauna; and
>
> (c) to manage potentially threatening processes; and
>
> (e) to ensure that the genetic diversity of flora and fauna is maintained.

Under s.4(2), "a public authority must be administered so as to have regard to the flora and fauna conservation and management objectives".

Part 3 of the FFG Act establishes a process of listing threatened species and ecological communities which are in a demonstrable state of decline which is likely to result in extinction, as well as potentially threatening processes which could pose a significant threat to the survival or evolutionary development of a range of flora or fauna. Action statements provide background information about the listed threatened species, reasons for its decline and the threats which affect it. Action Statements also state what has been done to conserve the species and what is proposed for conservation of the species.

Section 17 of the Act requires a Flora and Fauna Guarantee Strategy to be prepared. This obligation was met through the preparation of *Victoria's Biodiversity,* published in 1997 following the signing in 1996 by the Victorian Government of the *National Strategy for the Conservation of Australia's Biodiversity*[127]*.*

Victoria's Biodiversity identifies goals for biodiversity management in Victoria, including ensuring that:

- There is a reversal across the entire landscape, of the long term decline in the extent and quality of native vegetation, leading to a net gain with the first target being no net loss by the year 2001;
- The ecological processes and the biodiversity dependent upon terrestrial, freshwater and marine environments are maintained and, where necessary,

[127] *Victoria's Biodiversity* acknowledges its relationship to the IGAE and the National Strategy for ESD, as well as with various Victorian legislation and strategies, in addition to the FFG Act, including the CM Act, the *National Parks Act 1975* and the *Planning and Environment Act 1987*.

restored;

- The present diversity of species and ecological communities and their viability is maintained or improved across each bioregion;
- There is no further preventable decline in the viability of any rare species or of any rare ecological community;
- There is an increase in the viability of threatened species and in the extent and quality of threatened ecological communities.

Victoria's Biodiversity – Directions in Management provides a framework for responding to biodiversity challenges in different bioregions. In relation to Victoria's bays, inlets and estuaries, the document highlights the declines in seagrasses in the Bay and Western Port (as well as at Corner Inlet and the Nooramunga). Priority actions include (p.137):

- increase understanding, protection and monitoring of vulnerable habitats, particularly seagrass, mangroves and saltmarsh;
- increase understanding and protection of vulnerable and threatened species, and significant sites such as seabird breeding locations;
- progressively improve dredging and spoil disposal.

Priority actions in relation to the open coast, which encompasses the Entrance to the Bay, include (p.140):

- increase understanding, protection and monitoring of vulnerable habitats, particularly kelp and epibenthic communities affected by trawling or dredging;
- improve understanding of offshore areas through mapping of marine habitats and developing an inventory of the biological resources.

Victoria's Native Vegetation Management – A Framework for Action (VNVM) (2002) gives effect to the native vegetation goals of *Victoria's Biodiversity Strategy,* as well as reflecting Victoria's commitments to national policies, viz. the *National Framework for the Management and Monitoring of Australia's Vegetation Management* and the National Strategy for ESD.

Under VNVM, it is intended that the reversal across the landscape of the long-term declines in the extent and quality of native vegetation will contribute to significant outcomes including:

> The ecological processes and the biodiversity dependent on *terrestrial, freshwater and marine* environments are maintained and, where necessary, restored. (p.14) (italics inserted)

At least in the case of terrestrial habitats, a 'net gain' in the area and quality of native vegetation is to be achieved, in part, by applying a three-step approach when development proposals are considered:

1. Avoid adverse impacts, particularly through vegetation clearance.
2. Minimise impacts if they cannot be avoided.
3. Offset impacts that cannot be avoided or minimised.

The VNVM is implemented largely though the *Planning and Environment Act 1987*, in particular through clauses 15.09 and 52.17 under the Victorian Planning Provisions that apply to all planning schemes. Even in areas, such as coastal marine land, where planning schemes do not extend, the principles of the VNVM remain relevant.

The VNVM is not explicit, but achieving a 'net gain' outcome may not be practicable in the context of development proposals affecting freshwater or marine environments. Nevertheless, in concept, the three-step approach should still be applied. Further, a habitat-hectare method of assessing losses of vegetation quality and quantity may not be readily applicable to non- terrestrial habitats. Nevertheless, the principles that the priority of avoidance and the extent of required offsets should be in proportion to the conservation significance of the vegetation that could/would be lost can be applied.

B.7 *National Parks Act 1975* and Marine National Parks and Marine Sanctuaries

The *National Parks Act 1975* provides the legislative framework for protection of Victoria's designated parks. The objectives of the Act under section 4(a) are "to make provisions, in respect of national parks, State parks, marine national parks and marine sanctuaries [including] -

(i) for the preservation and protection of the natural environment including wilderness areas and remote and natural areas in those parks;

(ii) for the protection and preservation of indigenous flora and fauna of features of scenic or archaeological, ecological, geological, historic or other scientific interest in those parks;

(iii) for the study of ecology, geology, botany, zoology and other sciences relating to the conservation of the natural environment in those parks; and

(iv) for the responsible management of the land in those parks.

The *National Parks (Marine National Parks and Marine Sanctuaries) Act 2002* established a system of marine national parks and marine sanctuaries to protect representative examples of Victoria's unique marine environment. Thirteen marine national parks and eleven marine sanctuaries were established, including some within the Bay: Port Phillip Heads Marine National Park, Ricketts Point Marine Sanctuary, Point Cooke Marine Sanctuary and Jawbone Marine Sanctuary.

The Act requires the Secretary of DSE to preserve and protect the natural condition of the Marine National Park and its natural and other features and, to provide for the use of the park by the public for enjoyment, recreation and education. A Management Plan has been prepared by Parks Victoria for the park - *Port Phillip Heads Marine National Park Management Plan, July 2006*. It sets out the array of protected values of the different segments of the park, as well as the proposed management of them.

While consent is needed for works inside designated parks, no consent is needed for works outside parks unless those works affect the environment within the park. This latter circumstance may apply to the CDP.

In light of the purpose and objectives of the parks system, any potential adverse effects of the CDP on the Port Phillip Heads Marine National Park or any of the marine sanctuaries in the Bay are relevant considerations for this Assessment.

B.8 *Fisheries Act 1995*

The *Fisheries Act 1995* provides for the regulation, management and conservation of Victorian fisheries including aquatic habitats.

The objectives of this Act include the following (amongst others):

(a) to provide for the management, development and use of Victoria's fisheries, aquaculture industries and associated aquatic biological resources in an efficient, effective and ecologically sustainable manner;

(b) to protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity;

(c) to promote sustainable commercial fishing and viable aquaculture industries and quality recreational fishing opportunities for the benefit of present and future generations;

Under section 71(1) of the Act, it is an offence to "take, injure, damage, destroy, possess, keep, display for reward, release into Victorian waters or sell any protected aquatic biota without a permit or unless authorised by an Order in Council under section 73". The CDP may impact upon *Sygnathidae*, which are listed aquatic biota, and therefore would require a permit under either the *Fisheries Act* or the *Flora and Fauna Guarantee Act*.

It is also an offence under this Act to allow material to create or cause an obstruction to fish movement across or within a bay, inlet, river or creek which would block the passage of fish or leave fish stranded, unless permission has been obtained.

B.9 EPBC Act and International Agreements

International Agreements (Ramsar Convention, JAMBA and CAMBA). Several international conventions and treaties are relevant to the CDP, in particular:

- The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is listed under the Convention on Wetlands of International Importance (Ramsar Convention) (1971), which promotes the conservation, wise use and repair of wetlands and obliges member countries to list Wetlands of International Importance and protect their ecological character;
- Several of the migratory waterbird species that frequent the Ramsar site and the Bay are listed under the Japan – Australia Migratory Birds Agreement (JAMBA); the China – Australia Migratory Birds Agreement (CAMBA); and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

The State Planning Policy Framework obliges planning and responsible authorise under the *Planning and Environment Act 1987* to consider the implications of proposals with respect to these treaty obligations (see section B.10).

EPBC Act. The constitutional head of power for the EPBC Act largely derives from the Commonwealth's responsibility with respect to the biodiversity-related international treaties.

As the Commonwealth has accredited the EES process under the EPBC Act, the SEES (and/or EES) have needed to include assessment of any impacts of the CDP on the four applicable controlling provisions under the EPBC Act:

- Sections 16 and 17B (Wetlands of international importance);
- Sections 18 and 18A (Listed threatened species and communities);
- Sections 20 and 20A (Listed migratory species);
- Sections 26 and 27A (Protection of the environment from actions involving Commonwealth land).

While some particular species were cited in the reasons for the Commonwealth's decision to declare the CDP a controlled action, the effect of these controlling provisions is that impacts on any relevant species or aspects that could be significantly affected would need to be assessed. Key priorities in this regard are potential impacts on:

- The ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site, especially including Mud Islands and Swan Bay as well as inter-tidal wetlands;
- The listed Australian Grayling and the Yarra Pygmy Perch in the lower Yarra River, noting the evidence that the Yarra Pygmy Perch is now extinct in the lower Yarra River;
- Listed migratory birds (e.g. Australasian Gannet, Crested Tern, White-faced Storm Petrel, Orange-bellied Parrot) especially in the south of the Bay;
- Accelerated erosion or accretion of sand or other environmental impacts at Swan Island (as this is Commonwealth land) including loss of habitat or heritage features.

As part of the accreditation of the EES process, an Assessment Report is to be submitted to the Australian Government Minister for Environment and Water Resources. This report needs to include:

1) a description of the action, the places affected by the action, any matters of national environmental significance that are likely to be affected by the action and

2) a summary of the relevant impacts of the action;

3) a description of feasible mitigation measures, changes to the action or procedures to prevent or minimise environmental impacts on relevant matters of national environmental significance proposed by the proponent or suggested in public submissions;

4) to the extent practicable, a description of any feasible alternatives to the action that have been identified through the assessment process, and their likely impact on matters of national environmental significance;

5) a statement of conditions for approval of the action that may be imposed to address identified impacts on matters of national environmental significance;

6) a statement of State approval requirements and conditions that apply, or are proposed to apply, to the action when the report is prepared, including a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.

This current Assessment under the EE Act represents the Assessment Report required under the accredited process. It is supported by the CDP EES, SEES and the EES Inquiry and SEES Inquiry reports, together with the IEG Advice.

In deciding whether to approve the Channel Deepening Project, and what conditions to attach to the approval, under s.136 of the EPBC Act, general considerations to be taken into account by the Australian Government Minister include:

- matters relevant to a controlling provision for the action;
- economic and social matters;
- the principles of ESD; and
- the assessment report (if any) relating to the action.

B.10 *Planning and Environment Act 1987* and Planning Policy

Only minor elements of the CDP (i.e. navigation aids) are subject to approval under the *Planning and Environment Act 1987* (PE Act), in accordance with existing planning schemes. Planning schemes currently only cover part of the land underlying fringing areas of the Bay. However, s.4(1) of the PE Act establishes broad objectives to guide planning and development in Victoria, which are potentially applicable to *all* land in the State, including that under the Bay, and therefore warrant consideration in the context of the CDP (italics inserted):

(a) to provide for the *fair, orderly, economic and sustainable use and development of land*;

(b) to provide for the protection of natural and man-made resources and the *maintenance of ecological processes and genetic diversity*;

(c) to secure a *pleasant, efficient and safe working, living and recreational environment* for all Victorians and visitors to Victoria,

(d) to conserve and enhance those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest or otherwise of special cultural value;

(e) to protect public utilities and other assets and *enable the orderly provision and coordination of public utilities and other facilities for the benefit of the community*;

(f) to facilitate development in accordance with the objectives set out in paragraphs (a), (b), (c), (d) and (e);

(g) to *balance the present and future interests of all Victorians*.

State Planning Policy Framework (SPPF). The SPPF, which forms part of the Victoria Planning Provisions, has the goal under clause 11.02 of ensuring that the objectives of planning in Victoria (under s.4 of the Act) are "fostered through appropriate land use and development planning policies and practices which *integrate relevant environmental, social and economic factors in the interests of net community benefit and sustainable development*" (italics inserted). The commentary concepts of 'net community benefit' and 'sustainable development' are not defined under either the PE Act or the SPPF. However, in combination, they have an essentially equivalent meaning to 'ecologically sustainable development', encompassing as they do both the social and economic implications of land use and development for the community and implications for environmental protection, natural

resource and ecological aspects of sustainability, in the context of inter-generational equity.

Clause 11.03 of the SPPF establishes seven principles of land use and development planning. The 'environment' principle, which draws on the principles of the IGAE, indicates that planning should, *inter alia*:

- Adopt a best practice environmental and risk management approach which aims to avoid or minimise environmental degradation and hazards;
- Prevent environmental problems created by siting incompatible land uses close together;
- Help to protect the health of ecological systems and the biodiversity they support (including ecosystems, habitats, species and genetic diversity);
- Protect areas and sites with significant historic, architectural, aesthetic, scientific and cultural heritage values.

Several aspects of the SPPF establish policy on topics relevant to the CDP, including:

- Clause 15.08 – 'Coastal areas', which identifies the needs for land use and development planning to be coordinated with the requirements of the CM Act, and for decision-making under the PE Act to be consistent with the hierarchy of principles in the Victorian Coastal Strategy
- Clause 15.09 – 'Conservation of native flora and fauna', which states *inter alia* that:

  > Planning and responsible authorities must ensure that any changes inland use or development would not adversely affect the habitat values of wetlands and wetland wildlife habitats designated under the Convention on Wetlands of International Importance (the Ramsar Convention) or utilised by species designated under the Japan-Australia Migratory Birds Agreement (JAMBA) or the China- Australia Migratory Birds Agreement (CAMBA)

- Clause 18.05 – 'Ports', which recognises "the importance to Victoria of economically sustainable major ports".

Melbourne 2030. The Metropolitan Strategy Melbourne 2030, released in 2002, identifies the critical importance of both the Ports of Melbourne and Hastings and protects them as special activity centres with transport links to other designated industrial areas and freight terminals.

B.11 *Cultural Heritage Legislation*

Aboriginal Heritage Act 2006. In accordance with the *Aboriginal Heritage Act,* an act that harms or is likely to harm Aboriginal cultural heritage will only be permitted to occur in accordance with a cultural heritage permit or approved Cultural Heritage Management Plan (CHMP). Irrespective of any harm caused by the CDP, preparation of a CHMP is mandatory for the CDP under s.49 of the Act, since this section requires an CHMP if works are subject to a EES. PoMC will need to prepare such a plan for the CDP to be approved by the relevant registered Aboriginal party(ies) (RAP) or in the absence of a RAP, Aboriginal Affairs Victoria. The CHMP need not be exhibited with the EES/SEES.

Heritage Act 1995. This Act provides for the protection, conservation and registration of places and objects of cultural heritage significance in Victoria. The Act also provides for protection of shipwrecks, archaeological sites and archaeological relics in the survey area. The *Heritage (Historic Shipwrecks) (General) Regulations 1996* made under the Act prescribe the form of notice required for the discovery of new shipwrecks or relics.

The following requirements are likely to be triggered by the CDP:

- Permits under s.113(1) to explore or recover historic shipwrecks and associated relics which are not on the State Heritage Register;
- Consents under s.129(1) to uncover, excavate or damage an archaeological relic.