Mornington Safe Harbour

Expert Witness Statement of Dr David Goldie Provis

December 2010

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1. INTRODUCTION

1.1 Name and Address

Dr David Goldie Provis

Cardno

150 Oxford Street

Collingwood VIC 3066

1.2 Qualifications and Experience

Academic Qualifications

BSc (1st Hons), Flinders University of SA, 1972

PhD University of Essex (UK), 1975

Grad Dip Business Admin Swinburne University of Technology 1992

Professional Associations

Australian Marine Sciences Association

Australian Meteorological & Oceanographic Society

American Geophysical Union

American Meteorological Society

Comp IE Aust

Senior Principal, Cardno Group

Member, National Committee on Coastal and Ocean Engineering, Engineers Australia

1.3 Statement of Professional Expertise

Design and execution of oceanographic field work.

Development of instrumentation for measurements in the ocean, including coastal processes.

Oceanographic instrumentation, including selection, deployment, mooring, design and ship-board operations.

Coastal oceanography.

Analysis and presentation of oceanographic data including tidal analysis.

Use of numerical models in oceanography.

Development of criteria for marine operations and design.

Familiarity with dredging operations and monitoring of environmental impacts.

Development of techniques for the assessment of coastal vulnerability to climate change.

Other Significant Contributors to the Report

There are no other significant contributors to the report.

A copy of my Curriculum Vitae is provided in Appendix A.

1.4 Instructions and Information

I was commissioned by Jan Oliver, President of Mornington Environment Association Inc. to comment on the Mornington Safe Harbour proposal.

1.5 Facts, matter and assumptions

I have reviewed the documents supporting the EES which are relevant to my field of expertise, these are referenced below where referred to. Other material is referenced as required in my statement.

2. BACKGROUND

In assessing the proposal, I have read the documents provided with the Environment Effects Statement (EES) which are relevant to my field of expertise and make comment on these.

I have visited the site and am familiar with the location.

3. HYDRODYNAMICS

I have reviewed "Mornington Harbour Hydrodynamics Investigation" by Water Technology, October 2008 (Appendix O of the EES) and make the following comments:

- No calibration or validation of hydrodynamics model. Model is stated as being calibrated, but no evidence of reference is presented other than the tide level at Williamstown. This does not demonstrate model performance on the small-scale nested model of the project area.
- Inclusion of 0.4 m for climate change, based on 50 year life span, is considered reasonable and consistent with Victorian Coastal Strategy 2008.
- No mention of the "typical wind conditions" used to create figure 4-3 and 4-4.
- No mention of three-dimensional effects in flushing. While unlikely to change the conclusions markedly, these effects should be acknowledged.

The lack of validation of the model means that the results have to be judged on "what might be expected". This reduces the value of applying modelling technology, since the only option for assessing the value of the modelled outcomes is professional judgement.

Assuming the validity of the model, the conclusions are reasonable and there do not appear to be any significant issues with the proposal from the hydrodynamics point of view.

4. WAVES

I have reviewed "Mornington Harbour Wave Investigation" by Water Technology, October 2008 (Appendix N of the EES) and make the following comments:

- There is no calibration or validation of wave models. There is no validation of the wave generation model and resulting wave climate. There is a statement that the Boussinesq model has been validated against a physical model, but no reference is provided.
- The water surface elevation is set at 0 m AHD (page 20). This is not conservative and appears to contradict comments made earlier in the report (section 3.2). It does not even account for tides, and certainly does not include storm surge. Wave penetration into the harbour and for coastal processes will be affected by sea level and investigations should include higher sea-levels.
- Reflected waves appear to be an issue in terms of safe refuge. The normal entry to the boat ramp can become hazardous. This issue is discussed further below.

The lack of model validation results in a level of uncertainty in the model results. The most serious outcome of errors in the wave model results would be in the design criteria for the wave screens and associated structures. It is not clear how uncertainty is taken into account in the design process. Table 4-2 in the Wave Investigation report presents design wave conditions to three significant figures without any mention of uncertainty. This level of precision is unwarranted and provides a false sense of the accuracy of the calculations. Allowance for uncertainty may be included in design computations, but these have not been seen by the author. The uncertainty will apply to the wind data used to drive the model, the wave model itself and the sea level used in the wave model to compute the design values (set to 0.0 m AHD, page 20). I would have expected the wave modelling for this type of investigation to have at least explored

the sensitivity of the results to sea level and to have included, as a minimum, cases with Mean Higher High Water and the One Year Design Water Level.

5. COASTAL PROCESSES

I have reviewed "Mornington Harbour Coastal Processes Investigation" by Water Technology, October 2008 (Appendix R of the EES) and make the following comments:

- The Boussinesq wave modelling used a sea level of 0.0 m AHD and this seems to have been continued in the coastal process modelling. Higher sea-levels must be included in the modelling of both the present day conditions and with an allowance for sea-level rise.
- It is not clear on what basis the beach profiles in figure 4-5 have been selected, which part of the beach they are taken as normal to. This has impact on the wave climate which, according to the sentence immediately above this figure, is set at the offshore end of the profile. These wave climates appear to become increasingly more offset from the line of the wave energy affecting the shorewards end of the profile, particularly in the developed case for profiles 1 and 2.
- Results in table 6-3 appear too neat to be real and do not provide confidence in the numbers. There appears to have been significant rounding or adjusting of the numbers.
- The LITPAK analysis appears to be compromised by the locations selected for the wave climate. However the conclusions appear valid in a qualitative sense.
- Figure 6-20 and 6-23 do not include consideration of any retreat of the shoreline to the west of the groyne or artificial reef.

I agree with general conclusions of the report. It must to be recognised that 12 months of monitoring may not be sufficient time to fully assess the beach response. Regardless of whether the offshore artificial reef or groynes are used to limit sand movement on the beaches, there will be an on-going requirement to artificially move sand from the west to the east due to the removal of the eastward transport by waves behind the wave screens. The costs and management of such transport needs to be addressed.

The report contains no discussion of response to sea-level rise and modelling appears to have been carried out at a sea level of 0.0 m AHD. The response of the beaches to climate change, both for the existing conditions and in the developed case is not discussed. This is a serious omission. There is also no discussion of the effect of a large storm, where high waves are combined with a large storm-tide resulting in erosion of the beach and movement of material offshore, so-called "storm-bite". The impact of the project on this process and the subsequent recovery is not addressed.

The report and analysis deals with uncertainty by recommending monitoring and responding to the results of the monitoring. There is significant uncertainty in the model results, due to the uncertainty in the sediment transport models themselves, as well as the uncertainty in the inputs, including the wave climate. The levels of uncertainty have not been defined and therefore it is not possible to rule out significant changes to the beaches. The sensitivity of the model results to the selection of the profile locations and hence the wave climate applied to each profile is one factor.

6. DISCUSSION

The proposal is to provide a "safe harbour'. Boating Coastal Action Plan 2007 (Central Coastal Board), policy 3.1 states that (emphasis added)

> *"Safe harbours .....will be:*
>
> *• Strategically located and promoted at key locations around Port Phillip and Western Port, having regard to reasonable boat travel times;*
>
> *• **Designed and developed to provide haven and safe launch and retrieval facilities from the weather conditions that are most severe at that particular location**; and*
>
> *• A priority for investment in upgrade works".*

The second of these dot points, is particularly relevant. The wave modelling demonstrates that the proposal will provide a safe place to moor boats. However, there is also a requirement for "safe launch and retrieval facilities" under adverse conditions. The wave screens are very good reflectors of wave energy. The wave conditions shown in the wave modelling suggest very hazardous conditions may exist on the path into the harbour under conditions when a vessel may need to seek shelter. The Wave Investigations Report shows significant wave heights in excess of 2.6 m (and this is the highest value plotted) on or adjacent to the path into the boat ramp. For a vessel approaching from the west, there are significant areas of what is likely to be a very confused and violent sea-state with wave heights which may reach over 5 m maximum wave height immediately off the entrance to the safe harbour.

The potential impacts of climate change depend on the time-scale under consideration. The most likely impacts are an increase in overtopping of the wave screens and the decks of jetties. The effect on the beaches is more complex, but increased erosion of the back of the beaches is likely.

I have also reviewed the report by Coastal Engineering Solutions "Mornington Harbour Coastal Engineering Advice" August 2009. In general I agree with the comments and conclusions in that report.

I have also read a letter from Dr. E.C.F. Bird to Jan Oliver, President, Mornington Environment Association dated 5 September 2010 and agree with his comments on the patterns of sand movement and the difficulties of long-term beach management.

7. CONCLUSIONS

7.1 Conclusions

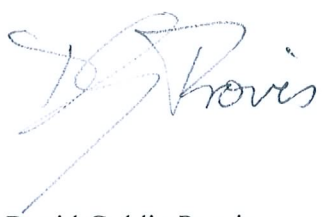
- There is no validation quoted for the numerical models for hydrodynamics, wave generation or Boussinesq wave model. The models are recognised commercially available systems, but the implementation in this application has not been validated.
- Wave modelling has been carried out with a sea level of 0.0 m AHD, close to mean sea-level in 1990. This does not allow for storm tide or sea-level rise and does not explore the sensitivity of the wave modelling results to variation in sea level.
- The wave screens are very close to perfect reflectors of wave energy and the modelling indicates that this will result in large increases in wave height in the areas in front of the screens potentially creating dangerous conditions for vessels seeking access to the safe harbour under storm conditions.

- The discussion of coastal processes identifies significant changes in long-term average conditions but does not address the short-term impact of a large storm with high waves and storm tide. There is also no discussion of the likely response of the coastal processes under climate-change scenarios.

7.2 Declaration

I formally adopt these conclusions and the information and reasoning I have presented in support.

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.



David Goldie Provis

20 December 2010

Appendices

APPENDIX A Curriculum Vitae of Dr. D. G. Provis

David Provis

Current Position

Senior Principal Oceanographer
Manager Melbourne

Years' Experience: 30

Joined Cardno

January 1995

Profession

Oceanographer

Qualifications

BSc(1st Hons), PhD, Grad Dip Business Admin

Affiliations

AMSA, AMOS, AGU, AMS, IEAust

Publications

Author or co-author of more than 20 publications

www.cardno.com

Summary of Experience/ Expertise

David is a Senior Principal of the company. He has more than 30 years experience in coastal oceanography including the design and execution of oceanographic field work, data analysis and numerical modelling.He is a member of the National Committee on Coastal and Ocean Engineering,Engineers Australia.

David leads the Cardno Melbourne-based team in Coast, Ocean and Environment. His experience includes aspects of marine meteorology and the application of measured data in operational situations as well as in numerical modelling. He has expertise in the analysis and interpretation of sea-level and tides. His diverse experience across a range of specialty areas includes;

- Oceanographic instrumentation including selection, deployment, mooring, design and ship - board operations;
- Analysis and presentation of oceanographic data including tide and sea level analysis;
- Use of numerical models in oceanography;
- Use of oceanographic data and models in support of port operations, including dredging;
- Preparation of input for environmental assessments on marine and related topics;
- Appearance as an expert witness and peer reviewer on coastal and marine issues;
- Development criteria for marine operations and design.

Significant Projects

- Port of Melbourne Corporation Channel Deepening Project
- Port of Geelong Channel Improvement Program
- Bass Strait Bream B Pipeline Project
- Manila Bay Land Reclamation Project
- Impact of Sea-Level Rise on the Gippsland Lakes
- Lonsdale Bight Coastal Processes Study
- Tasmania Natural Gas Pipeline Project
- Lakes Entrance Coastal Processes Study
- Under-Keel Clearance - Current and Wave Measurements
- Clifton Springs beach resoration
- Victorian Desalination Project

Professional History

Jan 1995 - Current

Senior Principal Oceanographer
Manager, Melbourne

- Project manager and principal investigator for the Hydrodynamics, Sediment Transport and Water Quality Modelling and Coastal Engineering for the Channel Deepening Project, Port of Melbourne Corporation
- Measurement and analysis of waves generated by vessels in Port Phillip
- Carried out an investigation into the coastal processes of the northern coast of the Bellarine Peninsula Port Phillip Bay, City of Greater Geelong
- Responsible for development of design criteria for an offshore platform in Bass Strait and subsea pipeline to Victoria for the BassGas project, Origin Energy Resources Limited
- Provided input into environmental impact assessment for the BassGas project in marine and coastal matters and in surface water
- Responsible for feasibility studies into hydraulics, sedimentation and coastal engineering for the Channel Deepening Project in Port Phillip Bay
- Responsible for development of oceanographic design criteria, including shore crossings, for Tasmania Natural Gas Project pipeline from Victoria to Tasmania,Duke Energy International
- Project Manager, directional wave measurement programme, Lakes Entrance, also expert comments on coastal processes and sand movements at Lakes Entrance and modelling of the behaviour of the entrance during and after dredging
- Manager of scientific and technical monitoring for environmental impact of dredging in the Port of Geelong Channel Improvement Program
- Monitoring of turbidity during a trial dredging exercise for the East Coast Armaments Complex, Point Wilson, Victoria
- Team leader for oceanographic and dispersion modelling for Victorian Desalination Project including functional design of the diffusers
- Development of methodology for Coastal Hazard Vulnerability Assessment under climate change scenarios

Jan 1981 - Jan 1995

Oceanroutes Australia Pty Ltd - Oceanographic Measurements and Data Analysis

- Review of Oceanography and pollutant dispersion, Northern Spencer Gulf, South Australia
- Oceanographic measurements, Stony Point, South Australia for a proposed petrochemical plant.
- Oceanographic measurements for a proposed power station development, Wallaroo, South Australia.
- Oceanographic measurements and modelling for design criteria for pipeline crossing of Spencer Gulf, South Australia.
- Analysis of the hydrodynamics of tidal channels, Queenscliff, Victoria.
- Current measurements for comparison with dispersion modelling, Burnie, Tasmania.
- Determination of tidal datum and correction factors for hydrographic survey, Port Phillip Heads, Victoria.
- Sea level and tide height computations for design of a sea wall and breakwater as part of a boat launching facility Sorrento, Victoria.
- Analysis of measurements of internal solitons in the Andaman Sea and preparation of design currents for offshore oil drilling.
- Current measurement programme for Port Phillip Bay Environmental Study.
- Coastal processes for Frankston Coastline Management Study.

Jan 1981 - Jan 1995

Oceanroutes Australia Pty Ltd - Numerical Modelling

- Air quality modelling for Environmental Impact Statement for Multi Function Polis, Adelaide.
- Development of a numerical model for the prediction of oil-spilll trajectories in Bass Strait.
- Development of an oil-spill model for contingency use in the Timor Sea.
- Review of oil-spill trajectory models for the Australian National Plan to Combat Pollution of the Sea by Oil.

Jan 1981 - Jan 1995

Oceanroutes Australia Pty Ltd - Real-Time Data Acquisition and Display Systems

- Design and installation of a real-time current measurement system, Port Stanvac, South Australia and subsequent upgrade and replacement of the system.
- Design and installation of a real-time current, tide and wind monitoring system, Hobart, Tasmania.
- System design, hardware and software specification and installation of a network of telemetering tide gauges in Port Phillip Bay.

Jan 1981 - Jan 1995

Oceanroutes Australia Pty Ltd - Instrumentation

- Supervision of the supply of 22 tide gauges to the ASEAN nations including the preparation of manuals and delivery of an instruction course for installation, operation and data processing. Preparation of data processing software package for IBM PC and compatible computers.
- Hardware design and project supervision of the development of an acoustic current meter for oceanographic use.
- Feasibility study and project design for sea-level monitoring in the Republic of the Maldives.

Jan 1976 - Jan 1981

Flinders University

- Design, deployment and recovery of current meter and tide-gauge moorings in the South Australian gulfs and eastern Great Australian Bight.
- Processing and analysis of data from oceanographic instruments including detailed tidal analysis.
- Deployment of coastal tide-gauge and meteorological network.
- Design and development of instruments for measurements in the surf zone.

Papers / Presentations

Sep 2009

Prediction of plume generation and movement from dredging operations in Port Phillip Bay, Melbourne

Provis, D.G. and Aijaz, S.Proceedings, Coasts and Ports 2009 conference, Wellington, New Zealand.

Sep 2007

Understanding the waves at Port Phillip Heads, Melbourne, Australia

Lesser, G., Turner, M., and Provis, D.G., Proceedings, Coasts and Ports 2007 conference, Melbourne, Vic. Australia.

Sep 2005

Hydrodynamics of Port Phillip Heads

Provis, D.G. an S. Aijaz, 2005, Proceedings, 17th Australasian Coastal and Ocean Engineering Conference, Adelaide, SA, Australia.

Sep 2003

Modelling of the Bar System at Lakes Entrance, Victoria

Provis, D.G., and Taylor, C.J. (2003). Proc. Coasts and Ports, Australiasian Conference, 9-12 September 2003, Auckland, New Zealand.

Jan 2003

Calibration and Testing of a Hydrodynamic Model of the Gippsland Lakes

McMaster, M.J., Provis, D.G., Grayson, R.G., and Bishop, W.A. (2003). MODSIM 2003, International Congress on Modelling and Simulation, 14-17 July 2003, Townsville, QLD, Australia.

Jan 2002

Representing Terrain Accurately for Flood Modelling in Large Coastal Lagoon

Wealands, S.R., Grayson, R.B., McMaster, M.J., Tan K.S. and Provis, D.G. (2002). 27th Hydrology & Water Resources Symposium, 20-23 May 2002, Melbourne, VIC, Australia.

Sep 2001

Modelling of Lakes Entrance

McMaster, M.J., Provis, D.G., Grayson R.G. and McCowan A.D. (2001). The 15th Australasian Coastal and Engineering Conference and the 8th Australasian Port and Harbour Conference, 25-28 September 2001, Gold Coast, QLD, Australia

Jan 1999

The Interaction of Waves and Currents at Port Phillip Heads

Provis, D.G and McCowan A.D. (1999). Proc. Australasian Conference on Coasal and Ocean Engineering, Perth, WA, Australia. Vol. 2, pp 544-549.

Jan 1999

Corio Bay Channel Improvement Program, Turbidity Monitoring

Provis D.G. and Taylor, C.J. (1999). Proc. Australasian Conference on Coastal and Ocean Engineering, Perth, WA, Australia. Vol. 2, pp 550-554.

Jan 1997

Tides and Currents in 'The Rip' at the Entrance to Port Phillip Bay

Provis, D.G. (1997). Proc. Australasian Conference on Coastal and Ocean Engineering, Christchurch, New

Zealand. Vol. 1, pp 81-86.

Jan 1995 **Port Phillip Bay Environmental Study - Hydrodynamic Data Collection**

Provis, D.G. and Rice, R.A. (1995). Proc.Australasian Coastal and Ocean Engineering Converence, Melbourne, VIC, Australia. Institution of Engineers Australia pp 251-255.

Jan 1993 **Telemetering Tide Gauges for the Port of Melbourne**

Provis, D.G. and Street, N.(1993). Proc. Australasian Confernce on Coastal and Ocean Engineering, Townsville, QLD, Australia. Instituite of Engineers Australia pp 709-710.

Jan 1988 **Real-Time Data Gathering and Telemetry for Port and Harbour Operations**

Provis, D.G.(1988). Proc. Australasian Port, Harbour and Offshore EngineeringConference, Brisbane, QLD, Australia. Institute of Engineers Australia pp 105-107.

Jan 1985 **Wave Measurements in the Great Australian Bight**

Provis, D.G. and Steedman, R.K. (1985). Proc. Australasian Conference on Coastal and Ocean Engineering, Christchurch, New Zealand. Vol. II, pp 51-60.

Jan 1984 **A Shallow Water Directional Wave Recorder**

Buchan, S.J. Steedman, R.K., Stroud, S.A. and Provis D.G. (1984). Proc. 19th International Conference on Coastal Engineering, September 2-7, 1984, Houston, Texas. pp 287-303.

Jan 1983 **Eddy Viscosity and Tidal Cycles in a Shallow Sea**

Provis, D.G., and Lennon, G.W. (1983). Estuarine, Coastal and Shelf Science, 16, pp 351-361.

Jan 1983 **Experiments on Wave Trapping by a Submerged Cylindrical Island**

Barnard, B.J.S., Pritchard, W.G. and Provis, D.G. (1983). Geophysical Astrophysics Fluid Dynamics, 24, pp 23-48.

Jan 1981 **Some Oceanographic Measurements in the Great Australian Bight**

Provis, D.G. and Lennon, G.W. (1981). Proc. 5th Australasian Conference on Coasal and Ocean Engineering. Institute of Engineers Australia, pp 272-277.

Jan 1979 **Sea-level Oscillations Along the Australian Coast**

Provis, D.G. and Radok, R. (1979). Australian Journal of Marine and Freshwater Research, 30, pp 295-301.

Jan 1978 **Equipment for Measurements in the Nearshore Zone**

Provis, D.G. (1978). Proc. 4th Australasian Conference and Ocean Engineering. Institute of Engineers Austraila, pp 241-242.

Jan 1977 **Experimental Studies of Wave Refraction in Waves on Water of Variable Depth**

Provis, D.G. and Radok, R. (eds)(1977). Springer-Verlag Lecture Notes in Physics, Vol. 64.