Port of Hastings Development Project
Preliminary Siltation Analysis, Western Port Shipping Channel and Berth Pockets

Prepared for Port of Hastings Development Authority by
Haskoning Australia Pty Ltd (a company of Royal HaskoningDHV)

Draft for discussion purposes (Issue B)

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CONTENTS

EXECUTIVE SUMMARY

There is a requirement as part of the geometric design and operation of the shipping channel (including berth pockets and swing basins) to understand the existing rates and patterns of changes in bathymetry (associated with sediment accretion). In addition, assessments of future sedimentation rates are required for planning purposes.

A preliminary analysis of sedimentation in the location of the existing shipping channel, swing basins and berth pockets has been undertaken. For the purpose of making assessments of future sedimentation rates, the analysis also includes adjacent areas, particularly north of the existing channel limit, to account for a potential future channel footprint.

The analysis has made use of three primary sources of information, namely:

- existing and available literature;
- reported and anecdotal evidence obtained from a review of dredging history in Western Port (see Haskoning Australia report HY-0007); and
- analysis of measured sedimentation using a times series of hydrosurveys.

Discussion of existing sedimentation patterns and rates are discussed for five areas, with the findings summarised in the table below.

Area	General location	Extent	Preliminary assessed future sedimentation rates
1	Channel	Western Entrance to south of Sandy Point	It is considered that there is no sedimentation within this area sufficient to impact on the declared depth.
2		Confluence, south of Sandy Point to Crib Point	It is considered that sand waves in certain parts of the channel will regrow to a level above the proposed declared depth following capital dredging and will require ongoing dredging to maintain the declared depth. The ongoing dredging is likely to be required at a frequency in the order of years rather than months but further analysis of this issue will be required.
3		Crib Point to BlueScope Jetty	It is assessed that global sedimentation within this area will be unlikely to exceed 50mm / year, including an allowance for an assumed increased rate of siltation following capital dredging.
4A	Berth pockets	BlueScope berth pocket	It is assessed that global sedimentation within the proposed berth pocket (and swing basin) will be unlikely to exceed 50mm / year, including an allowance for an assumed increased rate of siltation following capital dredging.
4B		Long Is. Pnt. berth pocket	
4C		Crib Point berth pocket	
4D		Stony Point berth pocket	
5	Channel, Swing Basin and Berth Pocket	Proposed channel, berth pocket(s) and swing basin(s) north of BlueScope (details not yet defined)	It is assessed that global sedimentation within this area will be unlikely to exceed 50mm / year, including an allowance for an assumed increased rate of siltation following capital dredging.

The conclusions in this report are preliminary. More detailed assessment of sedimentation will be undertaken in the future as part of the hydrodynamics work stream.

1 INTRODUCTION

There is a requirement as part of the geometric design and operation of the shipping channel (including berth pockets and swing basins) to understand the existing rates and patterns of changes in bathymetry (associated with sediment accretion). In addition, assessment of future sedimentation rates are required for planning purposes.

A preliminary analysis of sedimentation in the location of the existing shipping channel, swing basins and berth pockets has been undertaken. For the purpose of making an assessment of future sedimentation rates, the analysis also includes adjacent areas, particularly north of the existing channel limit, to account for a potential future channel footprint.

The analysis has made use of three primary sources of information, namely:

- existing and available literature;
- reported and anecdotal evidence obtained from a review of dredging history in Western Port (see Haskoning Australia report HY-0007); and
- analysis of measured sedimentation using a times series of hydrosurveys.

The conclusions in this report are preliminary. More detailed assessment of sedimentation will be undertaken in the future as part of the hydrodynamics work stream.

2 AREA OF INTEREST

For the purposes of this analysis the existing shipping channel has been split into four areas as shown in **Figure 1.** In addition, a fifth area covers the proposed shipping channel footprint (north of the existing channel limit), which is yet to be defined. Selected characteristics of each area are described in **Table 1**.

Table 1: Selected characteristics of study areas.

Area	General location	Extent	Typical Depth (m CD)	Seabed Type (from Marsden et al, 1979)
1	Channel	Western Entrance to south of Sandy Point	-16.5m to -36m (rarely reaching above -17m)	Medium to Coarse Sand
2		Confluence, south of Sandy Point to Crib Point	-14m to -26m (sand waves)	Medium to Coarse Sand
3		Crib Point to BlueScope Jetty	-15m to -19m	Medium Sand in Lower North Arm to Fine Sand/Silt in upper North Arm
4A	Berth pockets	BlueScope Jetty	Jetty: -11m Berth Pocket: -13m	Fine Sand to Silt
4B		Long Island Point Jetty	Jetty: -15m Berth Pocket: -16.5 to -17.5m	Fine Sand to Silt
4C		Crib Point Jetty	Jetty: -14 Berth Pocket: -16m to -17m	Fine Sand to Silt
4D		Stony Point Jetty	Jetty: -5m Berth Pocket: -8.5m	Fine Sand to Silt
5	Channel, Swing Basin and Berth Pocket	Proposed channel, swing basin(s) and berth pocket(s) north of BlueScope (details not yet defined)	0m to -19m	Fine Sand to Silt

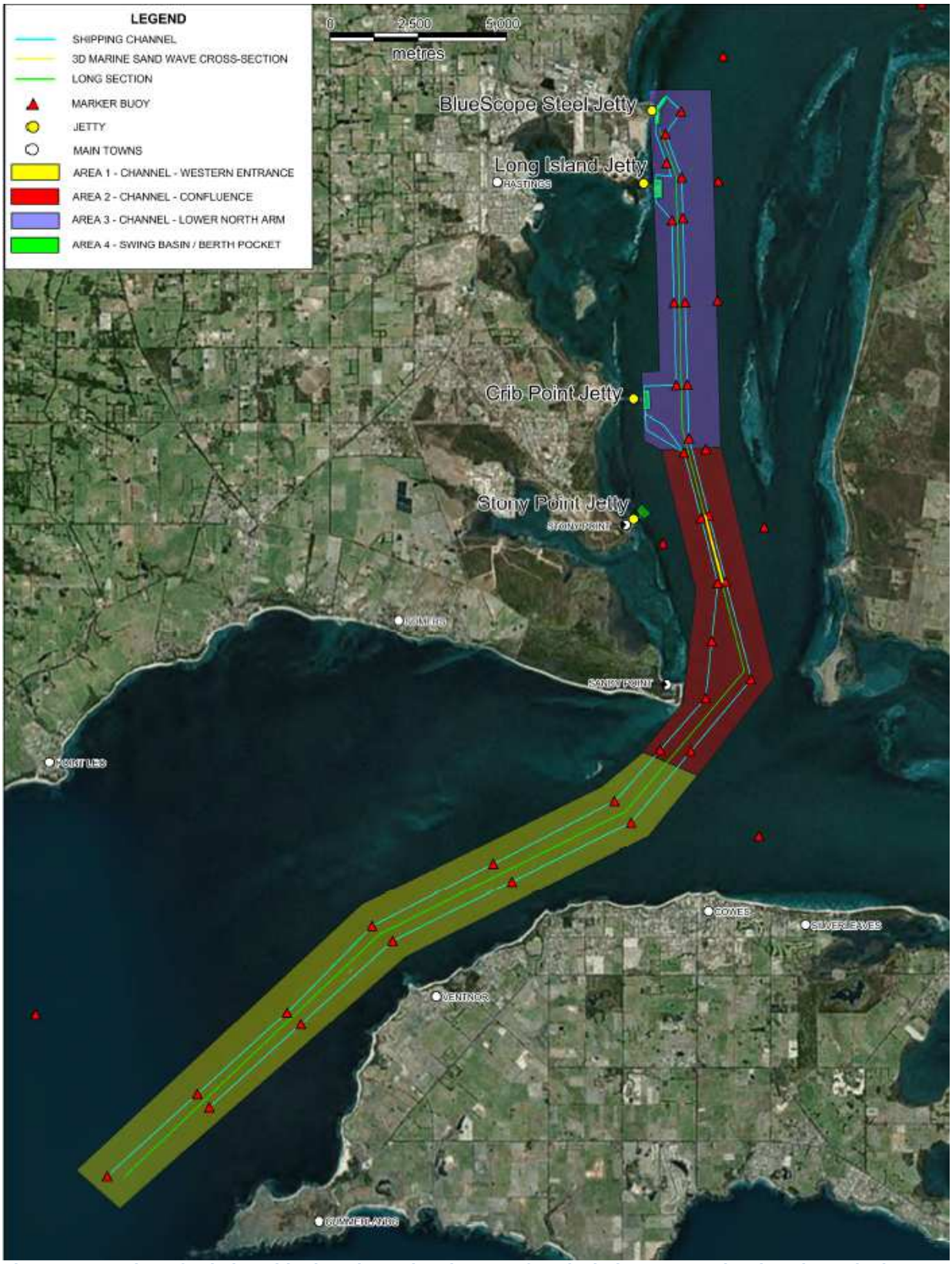


Figure 1. Location of existing shipping channel and areas of analysis (Areas 1 to 4). Also shown is the location of sand wave cross sections (yellow line) south of Stony Point.

To allow the analysis to account for future changes to the shipping channel footprint, a number of assumptions have been made concerning the proposed channel and berth pocket arrangement based on discussion with the Design and Engineering work stream. These include:

- the proposed horizontal alignment of the shipping channel in Area 1 and Area 2 will not change significantly;
- the proposed horizontal alignment of the shipping channel in Area 3 will not change significantly;
- an area immediately to the north of Area 3 may include berth pockets, swing basins and an extension to the shipping channel. This area forms part of the study area but is not shown on **Figure 1**; and
- an indicative future declared depth for all proposed areas of -16.5mCD.

3 REVIEW OF EXISTING INFORMATION

There is various available literature regarding sedimentation rates in Western Port. This has varying degrees of relevance to the area of interest (Western Entrance and Lower North Arm). Locations presented in the literature include:

- intertidal mudflats in the north east and south east of Western Port (Hancock et al., 2001);
- intertidal mudflats at Yaringa (Bird, 1986) and mangroves at Quail Island (Rodgers et al., 2006); and
- sand waves in the Lower North Arm, only a portion of which are in the channel (Anon, 1980, Lawson and Treloar, 2002).

3.1 Intertidal mudflats

Although useful for context, reported sedimentation rates in intertidal areas (mudflats and mangroves) are not considered to be representative of the area of interest, but rather representative of intertidal areas. Furthermore, sedimentation rates in the area of the proposed port have the potential to be impacted by changes to bathymetry, hydrodynamics and sediment regime, principally caused by the port reclamation and dredging.

Sediment accretion rates across the intertidal mudflats of the Upper North Arm, tidal divide and East Arm were estimated to be between 3mmyr^{-1} and 5.5mmyr^{-1} (Hancock et al., 2001). For the western parts of the bay, just north of the proposed port location are quoted as typically less than 4mmyr^{-1} (Hancock et al., 2001).

Bird (1986) measured mudflat accretion over a period of 11 months at 12 sites about 9m seaward of the mangrove fringe south of Yaringa. Seven of the sites showed net vertical accretion between 0.8cm and 4.4cm (8.7 - 48mmyr^{-1}) and five demonstrated net vertical erosion between 0.6cm and 2.8cm (6.5 - 30.5mmyr^{-1}).

3.2 Sand Waves

A number of previous studies have described the location and nature of sand waves. Using a combination of hydrographic charts, side-scan sonar and vibrocores from 1979, Anon (1980) described the seabed features of the main channel of the Lower North Arm between Phillip Island and Quail Island (north of Yaringa Marina).

North of Sandy Point to Stony Point the channel floor is dominated by a field of sand waves with approximately east-west crest alignments. Immediately north of Sandy Point the sand waves are about 3.5m high (crest to trough) with wavelengths of 100-150m in 27m of water, reducing in size to about 2m high and 60m wavelength at Stony Point in 16-17m of water. Individual sand waves can reach 5m in height with wavelengths of about 130m. The sand wave field continues north covering areas of the bed either side of Middle Spit. On the west side of Middle Spit the sand waves cover half the width of the channel floor, from the Spit side of the channel. Further north the sand wave field becomes narrower and patchier towards Tyabb where more of the bed becomes featureless with exposed 'basement' clay or a thin sediment veneer (0.1-0.4m) over the clay. South of Sandy Point, sand waves occur as isolated patches up to 200m across, surrounded by the featureless channel floor (Anon, 1980).

The sand waves are asymmetrical with their steeper slopes facing south. This would indicate that the sand waves are migrating to the south, forced by a dominant ebb-tide current. There are often

smaller sand waves superimposed on the longer gentler slopes of the larger sand waves. These smaller sand waves are up to 1m high with wavelengths of 15-20m (Anon, 1980).

Lawson and Treloar (2002) investigated the behaviour of sand waves in the Western Port channel, between buoys 19 and 20 from 1995 to 2001. Contour plots and difference plots (between surveys) were presented showing a relatively uniform progression of the sand waves in a southerly direction. Maximum peaks at -13.9mCD were observed (Lawson & Treloar 2002).

3.3 Review of Dredging History

A review of dredging history in Western Port was undertaken by Haskoning Australia (see HY-0007). Selected relevant findings of that study are summarised below:

- sand wave dredging took place in 1980, 1988 and 1994. These were located between Tankerton buoys No. 19-21 (Dick Cox pers. comm.).
- sand wave dredging after the Port was privatised in 1997 occurred less. Post-1997 a sweep bar was used to level off sand waves (Dick Cox pers. comm.).
- there have been two previous Notice to Mariners issued in relation to reduction of maintained depths due to sand wave shoaling in the shipping channel between the No.19 and No.21 buoys. Notice No.7/97 advised a reduction in the maintained depth to -14.2mCD and Notice No.61/00 advised a peak of -14.0mCD as being due to sand waves. The recovery of maintained depths due to the dynamic nature of the sand wave field was evidenced by a hydrosurvey undertaken in April 2008, which identified only two spots in the vicinity of Buoy No.19 (eastern channel boundary) where sand waves had peaked at -14.2mCD.
- a Notice to Mariners (No.64T-2008) has also been issued to identify a localised shoal extending 100m into the eastern side of the shipping channel halfway between Buoys No.13 and No.15 that reduced the minimum depth to -13.4mCD in that area. This area was monitored with annual hydrographic surveys.
- BlueScope berths are generally considered as 'self-cleansing' as they are aligned within the channel (Dick Cox pers. comm.).
- under the management of Patrick Ports Hastings the BlueScope berths were (maintenance) dredged in 2002 with approximately 16,000m^3 of material being dredged by a cutter suction dredge and disposed within the Old Tyabb Reclamation Area. The build-up of sediment within the berths had been previously managed by issuing a Notice to Mariners (No.8/97, 6 February 1997), which advised that the maintained depths within Berths No.1 and No.2 had been amended to -11.0mCD and -10.0mCD respectively.
- periodic dredging has occurred in the BlueScope berths to remove sedimentation. Little sedimentation occurs within the berth pocket at Long Island Point (Dick Cox pers. comm.).
- the Port of Hastings Dredging Strategy 2006-2012 was prepared by Patrick Ports Hastings. The strategy outlines a general policy of no planned dredging and monitoring of problem sand wave areas and the BlueScope, Long Island Point and Crib Point berths with annual hydrographic surveys.
- no historical dredging has occurred in the Western Channel (Shane Vedamuttu pers. comm.).

4 ANALYSIS OF BATHYMETRIC DATA

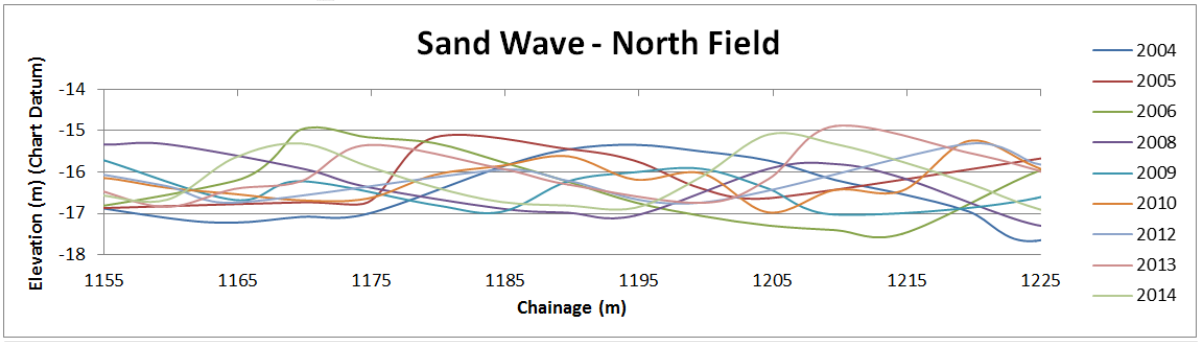
Hydrosurveys were undertaken on behalf of Patrick Ports between 2004 and 2014 by 3D Marine. The location of surveys included parts of the North Arm shipping channel, the Western Entrance shipping channel, the anchorage and the numerous berth pockets. This data has been analysed with the findings summarised below. Data was not available for areas north of the existing shipping channel limit.

4.1 Sand waves within shipping channel

A number of cross sections through sand waves are presented in **Appendix A.** The general locations of the cross sections are shown in **Figure 1** (yellow line south of Stony Point). Two examples of cross-sections of sand waves are shown below in **Figure 2.** These were extracted to better display the nature of sand wave migration direction and rates. The particular locations of these cross sections are shown in **Figure 3**.

Analysis of the 3D Marine bathymetric data demonstrates that:

- in agreement with previously reported literature, sand waves are present within and adjacent to the existing shipping channel south of Stony Point;
- the particular geometry (steepest slope facing south) and direction of migration (southerly) correlate with data presented above;
- sand waves in this location can migrate southwards by up to 10m per year, but typically migrate southwards at 3-8m per year;
- typically sand wave growth (increase in vertical crest elevation) is minimal between 2004 and 2014, possibly inferring an equilibrium (or close to) crest elevation;
- sand waves generally do not occur higher than the existing -14.2mCD declared depth, other than a small number of sand waves on the eastern edge of the shipping channel, which are at -14.1mCD; and
- sand wave crests regularly occur above the assumed future declared depth of -16.5mCD.



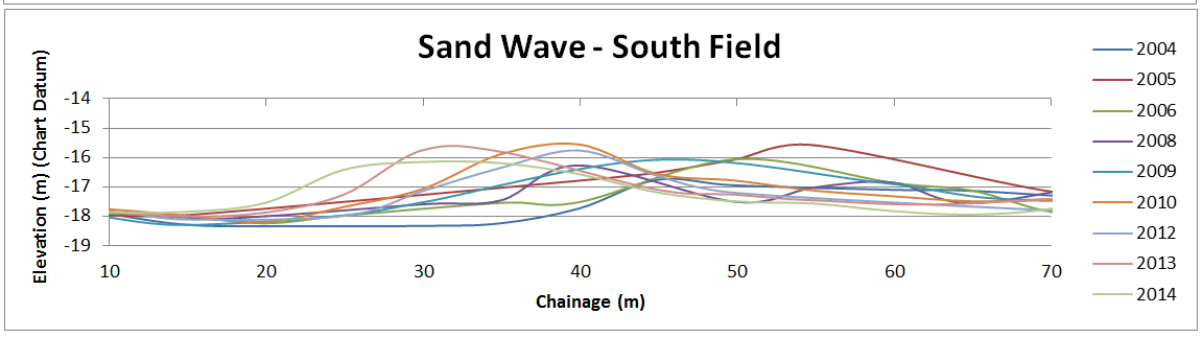


Figure 2. Cross sections of sand waves (see Figure 3 for locations) running north-south (right-left).

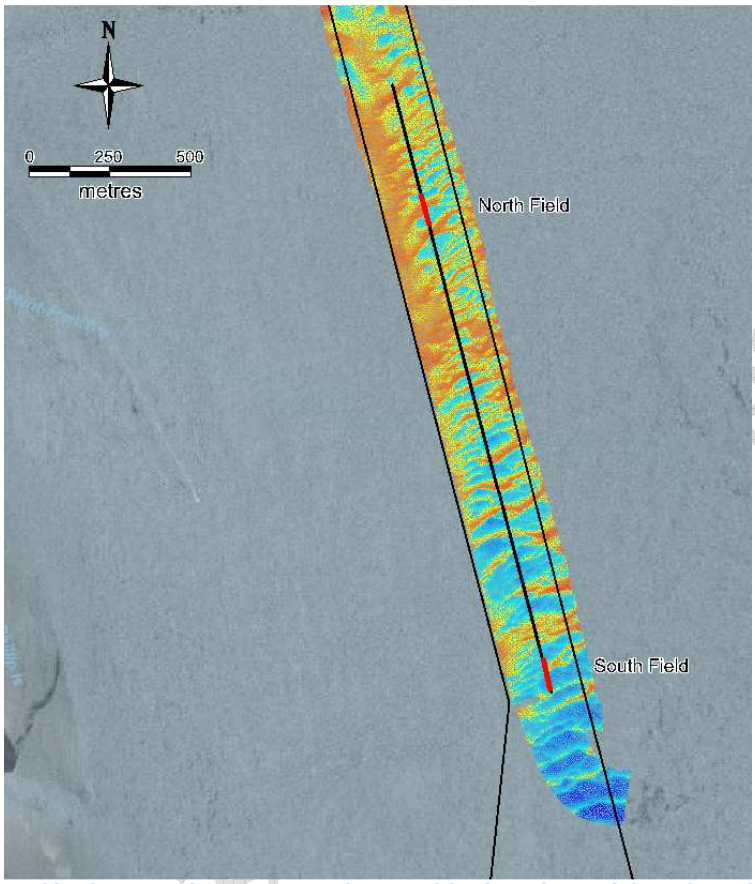


Figure 3. Extract of bathymetry in Lower North Arm shipping channel, location of cross-sections presented in Appendix A (black centreline) and location of cross-sections presented in Figure 2 (red centreline).

4.2 Bathymetric changes in existing berth pockets

Using data collected annually between 2004 and 2014, bathymetric cross-sections taken perpendicular to the shoreline (generally west-east) were extracted for each of the four (4) existing berth pockets/swing basin areas. These plots are shown in **Figure 4** and the associated patterns of sedimentation within each are described below in **Table 2**.

Table 2. Summary of bathymetric change in berth pockets (Area 4).

Berth Pocket	Summary of bathymetric change
BlueScope	• The existing berth pocket is 40m wide (E-W) with a maximum depth of -13mCD (2014 survey) • No clear pattern of global sedimentation (no spatially consistent increase in elevation) • Maximum observed positive change in seabed elevation was 300mm between 2008 and 2010 surveys • Changes in elevation between 2004 and 2014 occur within a 500mm vertical range
Long Island Point	• The existing berth pocket is 40m wide (E-W) and maximum depth -17.5mCD (2014 survey) • No clear pattern of global sedimentation • Changes in elevation occur within a 500mm vertical range • Maximum observed positive change in seabed elevation was 200mm between 2009 and 2010
Crib Point	• The existing berth pocket is 100m wide and has a maximum depth of -17mCD (2014) • Changes in elevation fluctuate and occur within a 500m vertical range
Stony Point	• The existing berth pocket is 90m wide and has a maximum depth of -8.5mCD • Maximum 1.0m seabed lowering at bottom of berth pocket between 2005 and 2010, however this is likely due to interpolation between points

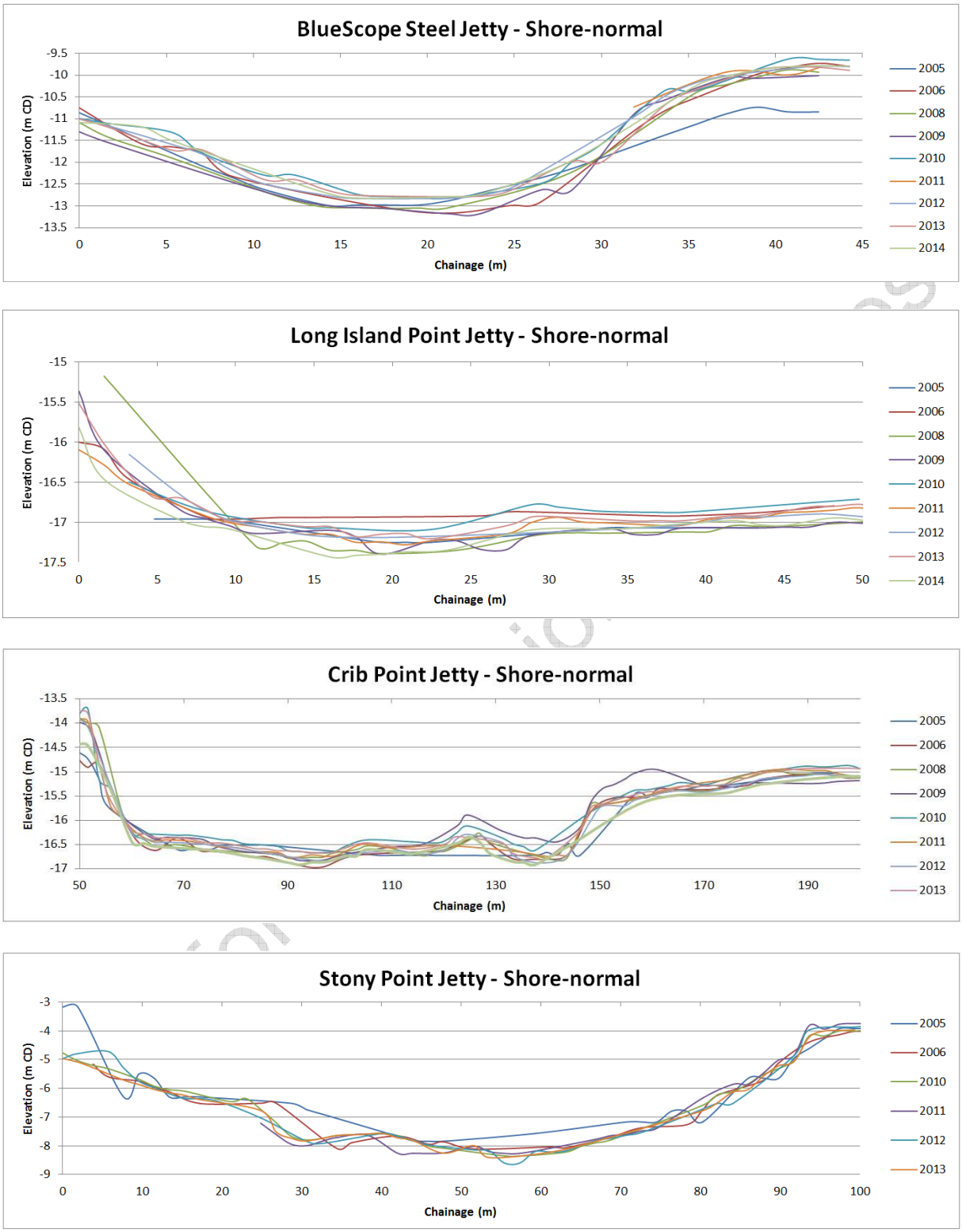


Figure 4. Seabed elevation at berth pockets shore-normal based on 3D Marine data

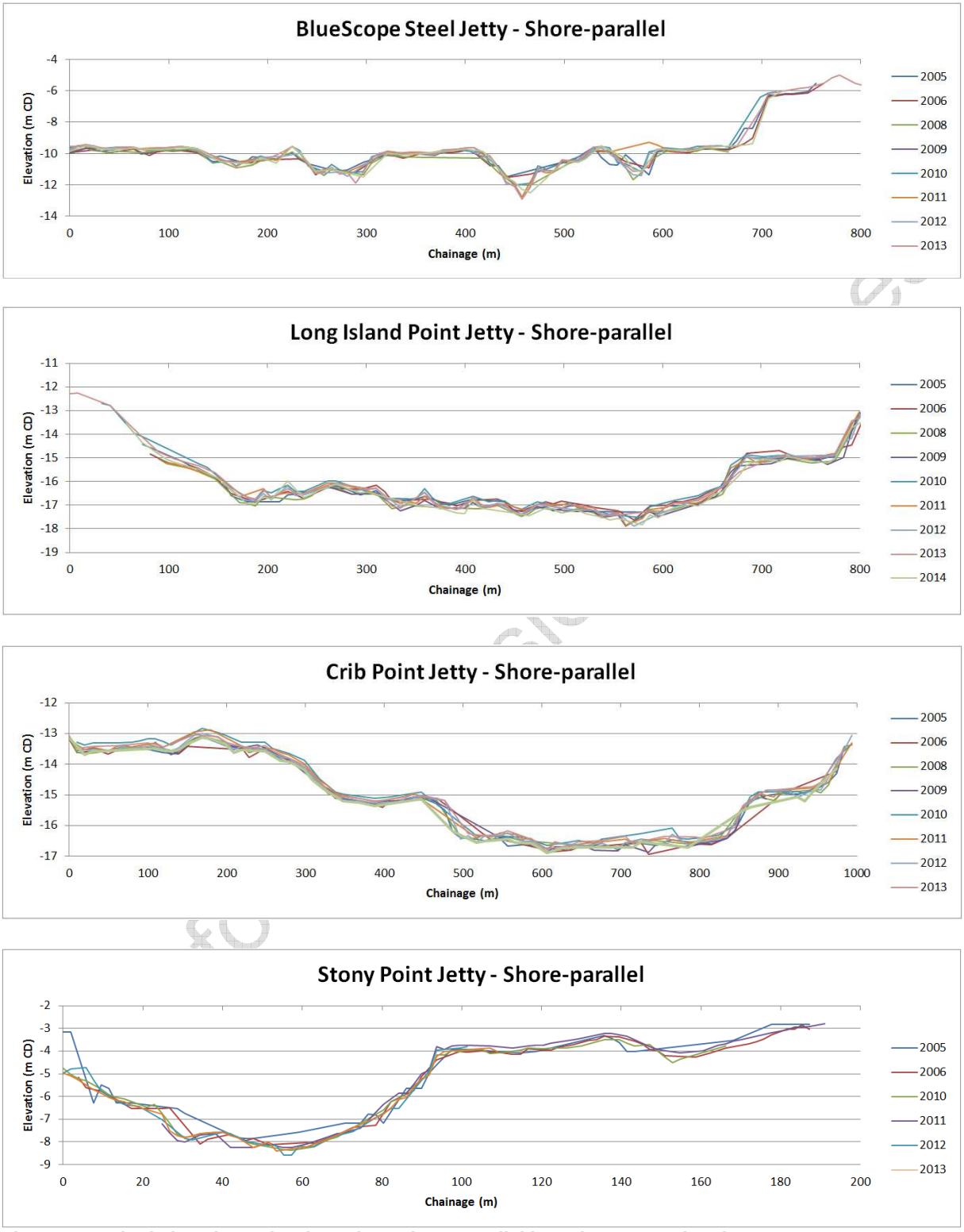


Figure 5. Seabed elevation at berth pockets shore-parallel based on 3D Marine data

5 DISCUSSION AND CONCLUSIONS

For the purposes of providing preliminary siltation rates to inform channel, swing basin and berth pocket design and operation, discussion of existing sedimentation patterns and rates of sedimentation are discussed below for five locations, namely:

- Western Channel, covered by analysis Area 1;
- Lower North Arm shipping channel (confluence zone up to Crib Point), covered by analysis Area 2;
- Lower North Arm shipping channel, covered by analysis Area 3; and
- Proposed swing basin and berth pockets, informed from analysis of Area 3 and Area 4.

5.1 Area 1 - Channel - Western Entrance

Summary of existing patterns
There is little measured change in bathymetry within this area observed in the survey period 2004 to 2014. In addition, the bathymetry in the area is typically between -16.5mCD and -36mCD and rarely above -17mCD. It is therefore deeper than both the existing and proposed future declared depth. The impact from sedimentation is considered to be limited in this area.

It is noted that adjacent to this area there are large seabed features, namely Middle Bank, present adjacent to the channel. The analysis of these features is outside the scope of this analysis.

Preliminary sedimentation rates
For the purposes of this analysis, it is considered that there is no sedimentation within this area sufficient to impact on the declared depth.

5.2 Area 2 - Channel - Confluence (inc. Sand Waves)

Summary of existing patterns
Rather than global sedimentation (which would result in a consistent reduction in depth), the most significant potential issue with a change in bathymetry in Area 2 is likely the elevation of sand wave crests. At present, the sand waves generally do not impact on the existing declared depth of -14.2mCD. This is evident from the analysis of sand waves conducted in this report and correlates with the lack of recent dredging activity. It is a reasonable assumption that sand waves in the shipping channel are at or close to an equilibrium crest elevation.

A change to the depth (to -16.5mCD) in this area by dredging will initially remove the crests of many of the sand waves. Despite these crests being dredged (sediment removed) or 'capped' (crests flattened by a sweep bar or similar) to a depth below -16.5mCD, it can be expected that these sand waves will reform, assuming an ongoing supply of sediment. Given that the observed crest elevation of the existing sand waves is commonly above -16.5mCD, the outcome would likely be regrowth of sand waves over time to the crest elevations currently observed.

Growth rates and regrowth rates (following dredging) of sand waves are difficult to predict. It is useful to consider observed growth rates, both in Western Port and elsewhere. Mention has already been made of the previous recovery of sand waves in Western Port following dredging (Section 3.3). Elsewhere, vertical regrowth rates of up to 300mm / year have been observed in Port Phillip Bay following dredging. In Rotterdam Harbour sand waves have been observed to

totally recover in one to three years (Hulscher, 1996; Nemeth, 2003), which was considered much faster than theoretically predicted.

Preliminary sedimentation rates
For the purposes of this analysis it is considered that sand waves in certain parts of the channel will regrow to a level above the proposed declared depth of -16.5mCD following capital dredging and will require ongoing dredging to maintain the declared depth. The ongoing dredging is likely to be required at a frequency in the order of years rather than months, but further analysis of this issue will be required.

5.3 Area 3 - Channel – Lower North Arm

Summary of existing patterns
There is little global sedimentation (a spatially consistent trend) observed within this area, however some local changes of less than 500mm elevation are observed during the 10 years of survey (2004 to 2014). Typically, localised year to year fluctuations are in the order of 100-300mm (between survey dates).

It would be expected that, generally speaking, siltation would increase once capital dredging has occurred due to a deepening of the channel and berth pockets and a local reduction in current velocities.

Preliminary sedimentation rates
For the purposes of this analysis, and based on the information presented above, it is assessed that global sedimentation within the proposed berth pocket and swing basin will be unlikely to exceed 50mm / year, including an allowance for an assumed increased rate of siltation following capital dredging.

5.4 Area 4 – Existing Berth Pockets

Summary of existing patterns
There is little global sedimentation (a spatially consistent trend) observed within the existing berth pockets, however some local changes of less than 500mm elevation are observed during the 10 years of survey (2004 to 2014). Typically, localised year to year fluctuations are in the order of 100-300mm (between survey dates).

The review of dredging history demonstrates that maintenance dredging in the existing berth pockets is seldom required.

It would be expected that, generally speaking, siltation would increase once capital dredging has occurred due to a deepening of the channel and berth pockets and a local reduction in current velocities.

Preliminary sedimentation rates
For the purposes of this analysis, and based on the information presented above, it is assessed that global sedimentation within the proposed berth pocket and swing basin will be unlikely to exceed 50mm / year, including an allowance for an increased rate of siltation following capital dredging.

5.5 Area 5 – Proposed Channel, Berth Pocket(s) and Swing Basin(s) North of Blue Scope

Summary of existing patterns
There is no time series of data available for Area 5, north of the existing channel limit. However, existing (and future) sedimentation rates in the area are expected to be relatively similar to Area 3 and Area 4.

It would be expected that, generally speaking, siltation would increase once capital dredging has occurred due to a deepening of the natural bed to create the channel, swing basin(s) and berth pocket(s), and consequent local reduction in current velocities.

Preliminary sedimentation rates
For the purposes of this analysis, and based on the information presented above, it is assessed that global sedimentation within the proposed channel, berth pocket(s) and swing basin(s) will be unlikely to exceed 50mm / year, including an allowance for an increased rate of siltation following capital dredging.

6 REFERENCES

Anon. 1980. Sediments and Seafloor Morphology North Arm Western Port. Report No. 80-7-20.

Bird, E.C.F. 1986. Mangroves and intertidal morphology in Westernport Bay, Victoria, Australia. Marine Geology, 69, 251-271.

Hancock, G.J., Olley J.M. and Wallbrink P.J. 2001. Sediment transport and accumulation in Western Port. Report on Phase 1 of a study determining the sources of sediment to Western Port. CSIRO Land and Water Technical Report 47/01, November 2001, 47pp

Hulscher, S.J.M.H. 1996. Tidal-induced large-scale regular bed form patterns in a three-dimensional shallow water model. Journal of Geophysical Research. 101: 20727-20744.

Lawson and Treloar. 2002. Western Port Sand Waves. Report to Toll Western Port.

Marsden, M.A.H., Mallett C.W. and Donaldson A.K. 1979. Geological and physical setting, sediments and environments, Western Port, Victoria. Marine Geology, 30, 11-46.

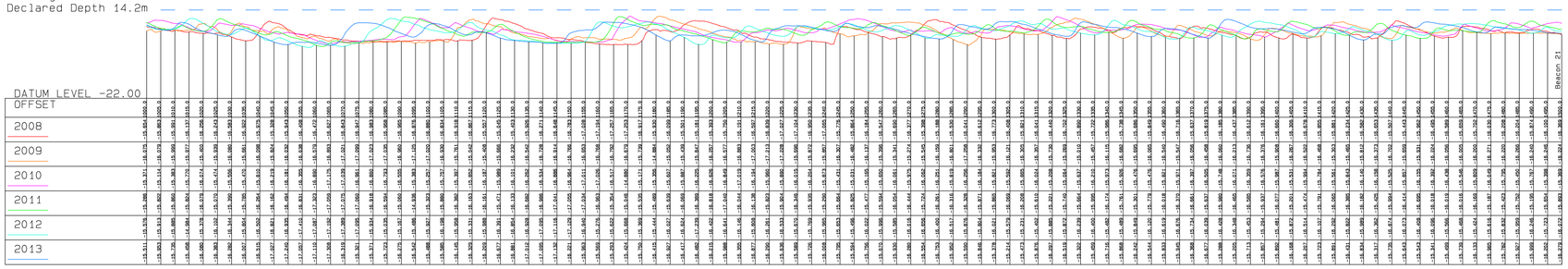
Nemeth, A.A., Hulscher, S.J.M.H., de Vriend, H.J. 2002. Modelling sand wave migration in shallow shelf seas. Coastal Shelf Research. 22: 2796-2806.

Rogers, K., Wilton, K.M. and Saintilan, N. 2006. Vegetation change and surface elevation dynamics in estuarine wetlands of southeast Australia. Estuarine, Coastal and Shelf Science, 66,559-569.

Appendix A
Sand Wave Cross Sections

Station 1000 - 1500m
Horizontal scale 1 : 1000
Vertical scale 1 : 250

Center line Coordinates
E = 346502.115
N = 5750899.740
Bearing of cross section = 344°19'40"
Declared Depth 14.2m



Station 500 - 1000m
Horizontal scale 1 : 1000
Vertical scale 1 : 250

Center line Coordinates
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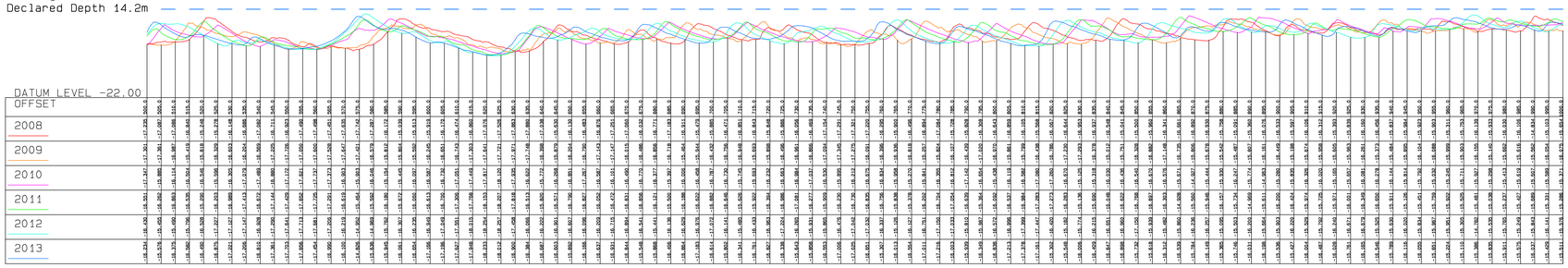
Declared Depth 14.2m



Station 0 - 500m
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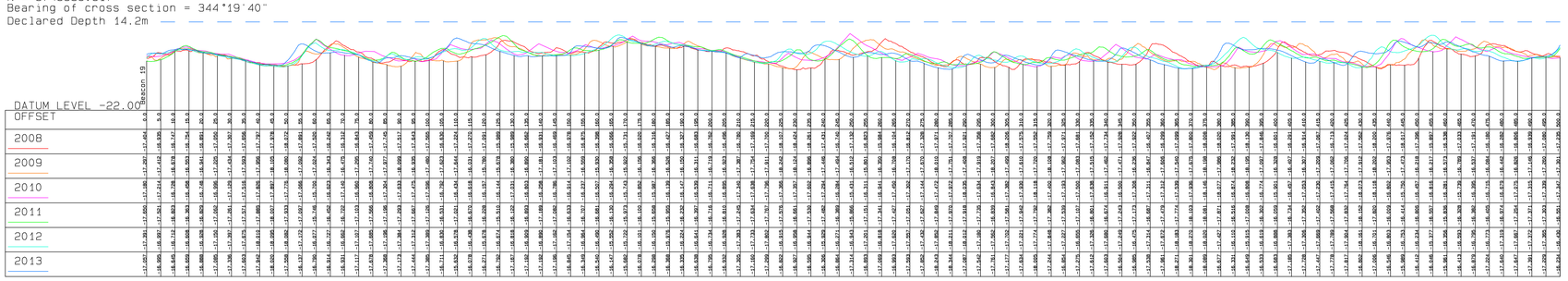

Key:

Year:	Colour:
2008	RED
2009	ORANGE
2010	PINK
2011	GREEN
2012	LIGHT BLUE
2013	DARK BLUE

Sheet Index:

THIS SURVEY HAS BEEN CARRIED OUT USING A GEOSWATH INTERFEROMETRIC WIDE SWATH SURVEY SYSTEM TO I.H.O. S44 STANDARD FOR SPECIAL ORDER SURVEYS AND THUS:

(A) A FULL SEARCH AREA (ie TOTAL BOTTOM COVERAGE) HAS BEEN ACHIEVED OVER THE SURVEY AREA;

(B) A DEPTH ACCURACY FOR REDUCED DEPTHS (95% CONFIDENCE LEVEL) OF +/- n/a m HAS BEEN ACHIEVED.

DATA PROCESSING AND MODELLING HAVE BEEN CARRIED OUT USING A n/a m GRID.

SELECTED SOUNDINGS SHOWN ON THIS PLAN ARE MINIMUM DEPTHS WITHIN A n/a m CIRCLE OF INFLUENCE.

CLIENT REF. No.

3D MARINE MAPPING Job No.: H0002l3.50.07

Notes:

SCALE of METRES

BEFORE REDUCTION 1: 1000

0 20 40 60 80 100

Vertical Datum:

SOUNDINGS ARE IN METRES AND DECIMETRES REDUCED TO CHART DATUM.
CHART DATUM IS APPROX. L.A.T. AND IS 5.214m BELOW B.M. 259 BITTERN, A ROD TYPE PM NEAR RETAINING WALL OPPOSITE SHORE END OF STONY PT. JETTY. EL.= 3.535m A.H.D.

Horizontal Datum:

MGA94 ZONE 55
(BASED ON GDA 94)

Equipment:

GEOACOUSTICS GEOSWATH PLUS SURVEY SYSTEM AND POSMV 320 IP68 USING AMSA BEACON DGPS CORRECTIONAL SERVICE.

DEPTHS REDUCED USING POSPAC SMARTBASE SOLUTION.

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WESTERNPORT, VICTORIA

BEACONS 19 - 21
CHANGES IN SEABED PROFILE
2008 - 2013

Drawing No.:

Revision No.: 00

Checked & Approved:

R.H.Lange
Licenced Surveyor

Drawn: BCA

Surveyor(s): RHL/BCA

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