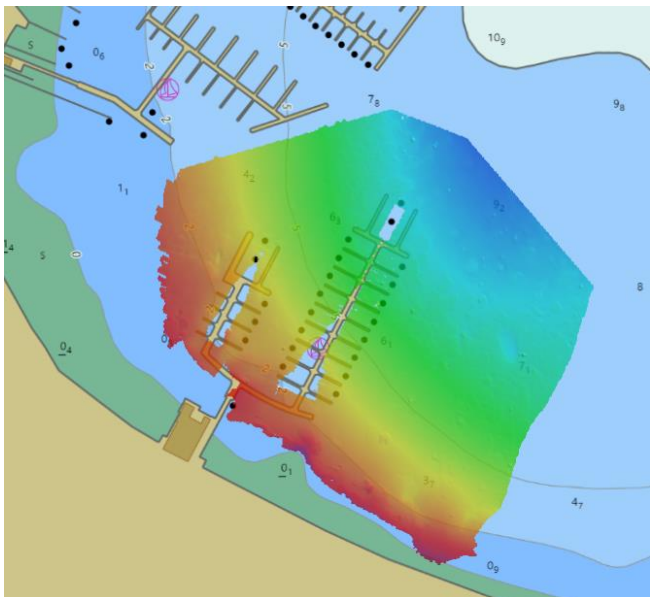
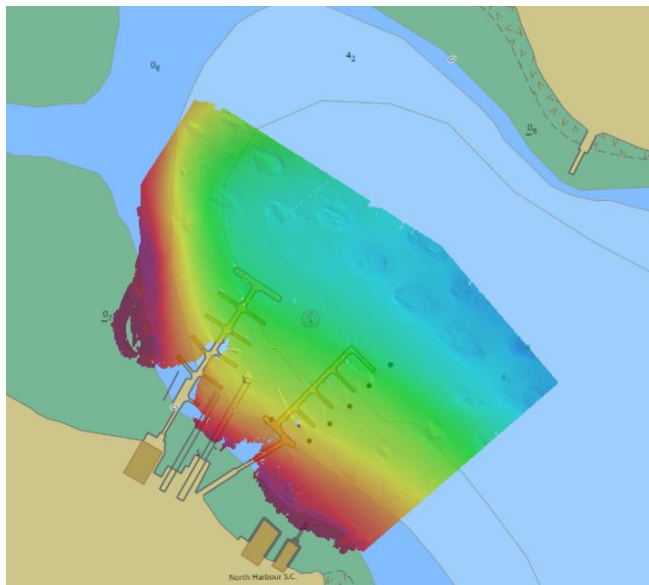
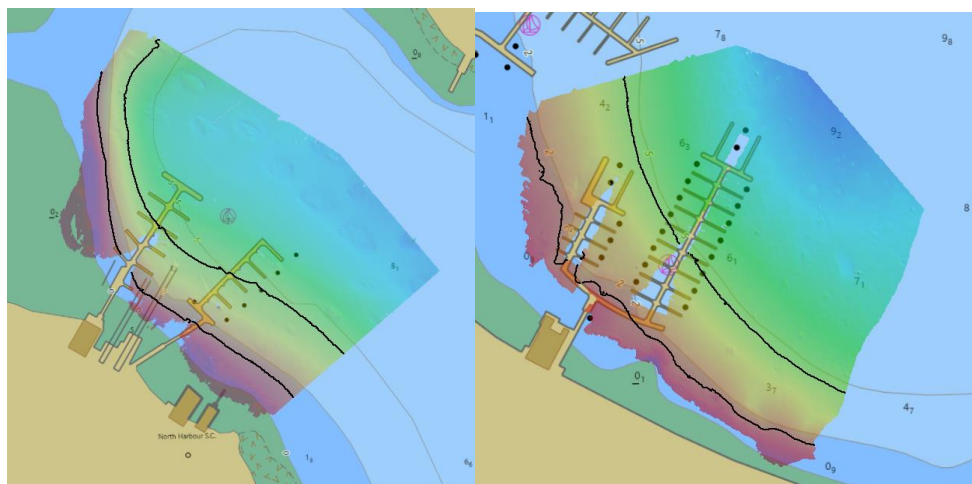


Date: 19 th January 2024 File No: C24/20 Harbour Master Myron Fernandes		Port Authority NSW Hydrographic Survey SURVEY REPORT		Survey Date: 11 th January 2024	
Port		Survey Area		Survey Class (Ports Australia Principles)	
PORT JACKSON, NSW		Planned Marina Extension – Rose Bay & North Harbour Marinas Pre Construction Survey		A	
					
Hydrographic Surveyor – Charge			Certification		
Isaac Reeves			AHSCP Level 2		
Survey Manager			Certification		
Venessa O’Connell			AHSCP Level 1		
Purpose of Survey					
Purpose of Survey		PANSW was contracted to conduct a pre-construction hydrographic survey around the existing Rose Bay and North Harbour Marinas. The survey covered the existing structure as well as the surrounding seabed. Where applicable, bathymetric data was captured a minimum of 50m either side of the Marina.			

Survey area <i>Declared Depth & Survey Coverage</i>	No declared depth exists in the survey areas. North Harbour Marina Coverage: The majority of the survey area was captured with the exception of the Southern extents of Arms A & B. It should be noted no bathymetric data was captured in this area due to shallow depths. Rose Bay Marina Coverage: Due to the size of the vessels occupying Rose Bay Marina, no bathymetric data was captured below the walkways of Arm A & B. The seabed below the proposed "Arm C" was captured in full. The survey coverage has been displayed on the attached charts.
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Surveyor Comments

Relevant Survey Information	• Survey fieldwork was completed in full on the 11th January 2024 • Weather and traffic conditions were favourable. • The CORS station FTD2 was utilised for the survey • Seabed obstructions have been displayed on both charts. • Some sections could not be surveyed due to the size of vessels at the Marina & shallow depths. Refer to survey chart for further details. • Wharf & pontoon position has been approximated using satellite imagery.										
Comparison with previous Survey	• A difference surface has been computed against the ENC. PANSW does not possess any previous bathymetric data in either location to conduct a comparison. • The following images are a graphical representation of the comparison results.  • The following table is a numerical breakdown of the survey difference comparison. <table><tr><th></th><th>Minimum (m)</th><th>Maximum (m)</th><th>Mean (m)</th><th>Std dev (m)</th></tr><tr><td>Difference</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr></table> • The 2m & 5m contour from the dataset has been compared to the contours displayed on the ENC. • Both contours at each location depict similar interpretations of the seabed, with the ENC more conservative then the PANSW dataset.		Minimum (m)	Maximum (m)	Mean (m)	Std dev (m)	Difference	N/A	N/A	N/A	N/A
	Minimum (m)	Maximum (m)	Mean (m)	Std dev (m)							
Difference	N/A	N/A	N/A	N/A							

Hazards, Shoals, and Obstructions	- An obstruction List (Obstructions.xlsx) has been provided outlining all seabed objects identified within the survey corridor. This list can be used for comparison with the post-construction survey to assist identifying any new obstructions resulting from construction. - All obstructions are displayed on the charts provided.
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Depth Measurement

Survey Vessel Description (Length, Beam, Hull Type)	Survey Vessel: Brian Cecil Length: 8.3m Beam: 3.2m Draught: 0.35m Hull Type: Catamaran	
Method used to Determine Least Depths	Multibeam Echo Sounder	Reason T50-P
	Beams & Frequency	1024 Equi-Distant @ 400 kHz
	Swath Angle	100-120°
	Mounting	USM Rear Mount – between engines
	Positioning and VRU	Applanix POS MV OceanMaster GNSS aided inertial navigation system V5.
	Base Station	FTD2 CORS – Used for Real-time corrections
	Sound Velocity	- RESON SVP 70 at sonar transducer head - AML Base X3 Sound Velocity Probe used over side during survey operations.
Method and Date of Echo Sounder Calibration	MBES patch test calibration conducted: 11/1/2024	
Method to Compensate for Vessel Motion	Applanix POS MV OceanMaster GNSS aided inertial navigation system	

Horizontal Positioning

Datum: GDA 2020 (1-1-20), Map Projection: MGA zone 56

Connection to Horizontal Datum	CORSnet – FTDN Reference Station GDA2020 (port 2020)
Methods of Obtaining Horizontal Position	- Real-time corrections transmitted via NTRIP in RTCM3.2 Format. (FTD2 CORSnet station). - Differential corrections received via NTRIP configured through Applanix POSView. - Differential data transmitted via LAN to POS PCS - Applanix POS MV OceanMaster Position & Orientation System with combined position solution using dual RTK & Inertial navigation system.

Connection to Local Survey Control	• Site calibration of local SCIMS marks to determine horizontal accuracy of position data and determine any data shifts required is repeated on routine basis. • For each survey mark raw observations are logged for 10 minutes a minimum of twice at different times of the day to account for changes in satellite configuration. • Average residuals in Easting and Northing are less than 0.02m. No shift to the survey data has been made. Results of these surveys can be produced on request.
Vertical Datum Datum: ZFDTG (0.925m below AHD)	
Connection to Vertical Datum	• CORSnet NSW– Fort Denison 2 (FTD2) Reference Station GDA2020 • GNSS checks on local BM's and SCIMS marks to confirm heights adopted. • Fort Denison Tide Gauge E 335865 N 6252544 • Level run to connect CORS antenna with Fort Denison tide gauge, BM's and chart datum. Ellipsoidal Height of 28.390m adopted for FTD2 CORSnet station.
Method of Measuring Tidal Heights	• RTK tide from Applanix POS MV OceanMaster GNSS aided inertial navigation system. GDA2020 Ellipsoidal heights are reduced to Zero Fort Denison Tide Gauge. • Real-time check of GNSS tide against Tide Gauge. • Processed GNNS Tide compared against Tide Gauge

Connection to local survey Control	• A level run has been carried out to connect the Fort Denison CORS station to the Fort Denison tide gauge, BMs and chart datum. • An ellipsoidal height of 28.390m has been adopted for the FTD2 ARP. • Static GNSS data is logged over the tide gauge benchmarks for a minimum of 10 minutes and results compared using the adopted ellipsoid height for Fort Denison. Residuals < 10mm • Levelling and GNSS checks are repeated on a yearly basis to coincide with the annual tide gauge calibration.
Comparison with Tide Gauge	• RTK tide from Applanix POS MV OceanMaster GNSS aided inertial navigation system. GDA20 Ellipsoidal heights are reduced to Zero Fort Denison Tide Gauge Datum using AUSGEOID20, then by subtracting 0.925. • Infield dynamic comparisons between onboard GNSS derived tides and Fort Denison Tide Gauge observations. • Comparison between 1 min Tide Gauge Data and static PPK tides (POSPac). Average Differences are less than 10mm. Comparison chart is available on request.

Seabed Coverage

Process for sounding Berth and Channel Limits	- Survey lines dynamically set to ensure at least 100% overlap on each edge of swath. - Toe lines and shorelines run twice to ensure 200% coverage. - Survey coverage extends outside the 50m buffer to ensure minimum 200% coverage is achieved.
Survey Vessel Speed	Variable 3-6 knots
Sounding Line Spacing and Orientation	- Sounding line dynamically set to enable 200% seabed coverage. - Sounding lines run parallel to significant batters, where not restricted by moored vessels or shoreline structures.
Feature Detection	The feature detection capabilities of the Brian Cecil exceed the specifications for Class A surveys as defined by the Ports Australia Principles

Sounding Reduction and Data Presentation

Methods to Reduce Raw Data to Sounding Datum	- Soundings reduced to datum by converting post processed GDA20 Ellipsoidal heights to AHD (Derived) using AUSGeoid20 then to Chart Datum by adding 0.925m. - AusGeoid20 has been interpolated at 250m spacing.
Principle and Method used in Sounding Selection	Raw soundings containing xyz shoal biased data have been processed and exported as an ASCII file at 0.5m resolution.
Positioning of Selected Soundings	- Filtering of the gridded dataset has been carried out to preserve soundings on a shoal bias. The filtering interval for plan display is 10mm at map scale. - Soundings provided are in true horizontal position. - Contours have been created using soundings generated at four times the filtering interval
Scale of Plans	- SRBM 001-A 1:750 @ A1 - SNHM 001-A 1:400 @ A1

Data Quality and Retention

The Method(s) used to Derive the Quality of the Data and Ability to meet the Depth Tolerance as Required in the Standards

- Multibeam data manually processed and verified.
- TPU filtering applied to reject any sounding that does not meet the following parameter's:

Order	Depth		Horizontal	
	a (m)	b	m	%
User Defined	0.15	0.0075	2	0

Total Propagated Uncertainty (TPU)

- Posteriori Total Propagated Uncertainty (TPU) statistics have been computed using CARIS Hip & SIPS for the total survey area. TPU calculation inputs include RMS approximations for lever arm offsets, calibration results, sound velocity profile and sound velocity at the sonar head, horizontal and vertical datum connections, geoid and real-time RMS data from post processed position and orientation.
- Sonar characteristics used in the calculation are applied directly from the CARIS vessel file
- A statistical analysis of the TPU calculation is given below based on a 0.5m Shoal Depth True Position surface.
- Vertical and horizontal TPU values are available as separate layers within the CSAR file provided with this report.

TPU	Minimum	Maximum	Mean	Count
Depth	0.05	0.154	0.076	1,280,313
Horizontal	0.042	0.13	0.071	1,280,313

- HIPS does not include beam width resolution in the horizontal TPU calculation. Because of this TPU values for this survey could be expected to be up 150mm greater than the mean result.
- Posteriori TPU estimates compare well with Priori TPU estimations undertaken for the Port Explorer in similar depths of water.

The Time Frame(s) and Those Responsible for Retention of Raw Data Gathered during the Survey and the Final Results

- Raw & Final survey data will be stored locally for a minimum of 2 years by Port Authority NSW.

I certify that this Survey Report and the methods described herein conform to the hydrographic survey meeting the Survey Class.

Isaac Reeves

(Signature)

Isaac Reeves

Hydrographic Surveyor - AHSCP 2

Venessa O'Connell

(Signature)

Venessa O'Connell

Group Survey Manager – AHSCP 1