Seafloor Mapping Survey
HAWKS NEST
SEA CAGE INVESTIGATION
SEAFLOOR MAPPING
2011

Coastal and Marine Unit
Waters and Coastal Science Section
Office of Environment & Heritage, New South Wales.

Personnel
Dr Peter Davies, Senior Environmental Scientist (Marine)
Mr Tim Ingleton, Environmental Scientist (Marine)
Michelle Linklater, Environmental Scientist (GIS)
Richard Gardiner, (Master Class V)

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New South Wales Office of Environment and Heritage
Contact: Dr Peter Davies peter.davies@environment.nsw.gov.au +61-2-9995-5664
Mr Tim Ingleton tim.ingleton@environment.nsw.gov.au +61-2-9995-5517

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BACKGROUND

The Office of Environment and Heritage (NSW OEH) was requested to complete seafloor surveys of the area just north of Cabbage Tree Island in Providence Bay, Hawks Nest. The surveys and resulting habitat maps were commissioned as part of the environmental investigations for a proposal to install a series of finfish grow out cages by the NSW Department of Primary Industries (NSW DPI).

This report describes the methods used and the data provided by the habitat surveys of the area for investigation for the proposal for a Research Lease.

METHODS

Surveying

Sonar data was obtained using the NSW OEH’s pole mounted Geoswath 125kHz interferometric swath bathymetry system. The Geoswath collects the time, angle and amplitude of echoes returned from the seafloor across a swath width up to 8 times the water depth. Real-time horizontal positional information was provided by an Omnistar sub-meter differential GPS system. Motion correction was achieved using a POSMV Wavemaster system. The POS receives GNSS (satellite) data and outputs high resolution roll, pitch, yaw and heave data that was then combined with heading (dual-GPS sensor array) corrects the sonar soundings for vessel motion. An improved attitude solution was obtained by post-processing the attitude data using satellite 9-day ephemeris corrections available on-line. Using the proprietary software POSPac and a post-processing module termed Precise Point Positioning (PPP). Timestamping was applied using pulse per second corrected ZDA sentence. Water level data are provided within the PPP solution and thus local gauge need not be applied.

Speed of Sound

Surface water sound velocity was measured (1Hz) at the transducer heads using a Valeport Mini-Sound Velocity Sensor (SVS) and averaged 1524 ms⁻¹. Sound velocity profiles (SVP) were also collected in the vicinity of the survey area using a pumped Sea-Bird SBE9+ CTD on a rosette sampler. SVPs provide a means to account for path length differences and the refraction of sound (ray bending) due to changes in water density with depth. Data were post-processed and binned to interval of 1 m. Stratification of the water column was limited with variability in sound velocity of <1m/s (range 1020-1023 ms⁻¹) up to 25 m water depth for all profiles examined. Limited variability in the sound velocity at the site was likely due to seasonal overturning of the water column and the oceanic and shallow nature of the water column at the site.

Attitude Solution

In order to provide an improved motion solution for the sounding data, 9-day ephemeris data was downloaded from the internet and processed using Precise Point Positioning (PPP) in POSPac (Applanix, USA). Improvements to the X + Y
(horizontal) and Z component (vertical)accuracies using PPP compared to real-time were obtained (Table 1) and used to then provide an alternative Smoothed Best Estimate of Trajectory (SBET). The SBET was exported from POSPac and then applied to the Raw Data File in GS+ to produce alternative attitude, position (navigation) and heading files for data processing.

**Table 1:** RMS values for XYZ components of the motion solution from real-time and PPP post processing.

<table>
<thead>
<tr>
<th>3-D component relative to sonar transducers</th>
<th>Accuracies (m) Range of root-mean square error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Real-Time Acquisition</td>
</tr>
<tr>
<td>X (horizontal as fore-aft)</td>
<td>0.45-0.83</td>
</tr>
<tr>
<td>Y (horizontal as port-starboard)</td>
<td>0.41-0.57</td>
</tr>
<tr>
<td>Z (vertical as up-down)</td>
<td>0.6-1.7</td>
</tr>
</tbody>
</table>

**Processing**

Raw data files were filtered using amplitude, box, along-track and across track filtering options within the processing module of the software GS+. Swath (bathymetry), swamp (backscatter), echosounder and soundings files (as GSF - Generic Sensor Format) were output from the process. Settings for each of the individual filters applied to the raw data in GS+ are provided in Table 2. Cleaned bathymetric data (swaths) was initially gridded at 2 m to produce a draft bathymetric surface as a check for gross motion or positional errors.

**Table 2:** Filter settings for coarse processing of bathymetric data in GS+.

<table>
<thead>
<tr>
<th>Filter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal to Noise Ratio</td>
<td>Filter out &lt;3%</td>
</tr>
<tr>
<td>Bin Filter</td>
<td>Min 2 pings per bin</td>
</tr>
<tr>
<td>Amplitude</td>
<td>Filter out &lt;3.5% signal return</td>
</tr>
<tr>
<td>Box</td>
<td>Min slant range 2 m</td>
</tr>
<tr>
<td></td>
<td>Max slant range 40 m</td>
</tr>
<tr>
<td></td>
<td>Min Horizontal range –5 m</td>
</tr>
<tr>
<td></td>
<td>Max horizontal range 30 m</td>
</tr>
</tbody>
</table>
Soundings from all GSF files were combined to calculate a CUBE (Combined Uncertainty Bathymetric Estimator) surface within Fledermaus (IVS, USA) that was then used to filter all sounding points to International Hydrographic Office (IHO) 1 standard specifications. This technique provides a means to identify erroneous soundings and edit the dataset for an improved bathymetric solution surface. Areas of the bathymetric surface with soundings lying more than 2 standard deviations from the cube surface were extracted as sounding clouds and individual points determined to be erroneous were flagged. Once editing was completed a sub-set of “clean” soundings were exported and gridded for the production of a 0.5 m bin bathymetric model (XYZ).

Backscatter data was processed using Geotexture software. Traces were normalised using survey specific beam and scatter functions. Slant range corrected sidescan swaths were merged into a georectified mosaic using an average of overlaying swaths.

**Grids and Bathymetry**

The results of the survey are presented in Figures 1 and 2. The area is composed of soft sediment sloping gently downward the east. Depths within the proposed area of investigation range from 15 to 22 m. The seafloor is composed of a number of different sediment types. The coarser sediment can be seen in the darker areas of the backscatter image. This is probably shell grit or coarse sand with shell grit. There are a series of sand waves or ripples running across the seafloor in a north westerly direction which indicates the direction of current at the time of the survey. The dark lenses between the sand waves indicate coarser material sitting in the troughs of the sand waves. Currents were stronger nearer to Cabbage Tree Island where the sand waves are more pronounced.
**Figure 1:** Hillshaded bathymetry for the area proposed for the Research Lease in Providence Bay.
Figure 2: Acoustic backscatter data of the area proposed for the Research Lease.
Data

Spatial layers of bathymetry and backscatter data for the area for investigation will be provided in requested format.

Metadata

Copies of the edited soundings files and bathymetric models have been retained and are available from NSW OEH upon request. Metadata statement pertaining to the investigation area is currently held within the NSW OEH bathymetric database and can also be provided upon request.