Review of potential marine sand resources for beach renourishment in the Hunter–Newcastle region

May 2020
Executive summary

The City of Newcastle has undertaken several studies to address the problem of the ongoing erosion of the southern end of Stockton Beach, adjacent to the suburb of Stockton. Mining, Exploration and Geoscience (MEG) in Regional NSW was asked by the Deputy Premier to undertake a desktop study to identify marine sand bodies that may be suitable for beach renourishment at Stockton Beach.

Some key historical data has not been located. The available data indicates that the medium-grained, quartzose sands of the Newcastle inner shelf sand sheet (ISSS) on the floor of Stockton Bight appear to be suitable for beach renourishment and represent the largest potential sand resource in Stockton Bight. However, the extent, thickness and continuity of the sand sheet is unclear and further investigation is required to confirm its suitability.

The lobe and spoil dumps off Nobbys Head also contain sand that may be suitable. However, some data suggest that the composition and grain size of the sand in these areas may not be as uniform as that of the Newcastle ISSS.

More data needs to be acquired to properly assess and locate sufficient volumes of suitable sand for the renourishment of Stockton Beach.

This report makes three key recommendations for further work:

1. That MEG continues its attempts to locate previous data.
2. That a comprehensive offshore sampling program is undertaken to identify and better characterise a suitable sediment source for Stockton beach renourishment.
3. That a collaborative project team comprising experts from the relevant government agencies is established to progress the offshore sampling program.
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Introduction

Stockton Bight stretches 32 km northwards from the Stockton breakwall at the entrance to the Hunter River to Morna Point, east of Anna Bay (Figure 1). Stockton Beach borders the length of the bight and the suburb of Stockton is located at the southern end of the bight and beach, within the Newcastle local government area.

The City of Newcastle has undertaken several studies to address the problem of the ongoing erosion of the southern end of Stockton Beach, adjacent to the suburb of Stockton. These studies have been summarised in the Newcastle Coastal Zone Management Plan (NCZMP) 2018. The NCZMP (2018) identified that beach renourishment is necessary for any of the options proposed to remediate the issue. Long-term sediment transport modelling has shown that Stockton Beach has experienced northward transport of sediment of approximately 20 000–30 000 m$^3$ per year. WorleyParsons (2012) identified that between 410 000 m$^3$ and 515 000 m$^3$ of sand are required initially to replenish the sand that has been lost from the beach, with an ongoing annual maintenance replenishment of up to 30 000 m$^3$ per year.

The draft Stockton Coastal Management Program (Stockton CMP) (Patterson & Turnbull 2020) has provided revised volumes of sands required for renourishment of 2.4M m$^3$ initially and 112 000 m$^3$ annually for maintenance, which is likely to increase with time. The Stockton CMP concluded that given these volumes, terrestrial sources are neither available, or environmentally, socially or economically viable, and that offshore sand sources are the most economically feasible solution.

![Figure 1. Stockton Beach location map, showing the proposed study area and the limit for NSW waters.](image)

Objectives

Mining, Exploration and Geoscience (MEG) in Regional NSW was asked by the Deputy Premier to undertake a desktop study to identify marine sand bodies that may be suitable for beach renourishment at Stockton Beach. This preliminary study will need to be followed by a program of new data acquisition to confirm the presence of a suitable resource. The program would need to include seafloor mapping and sampling to quantify the size and quality of the sand bodies.
Previous studies

Field studies on the physical and geochemical properties of sand deposits on the inner continental shelf of NSW date back to the mid 1970s. These investigations into marine sand bodies have been conducted by various council and government agencies, universities and private companies. Resource depletion and increasing land constraints to onshore sand resources has led to companies looking for options offshore along the coast of NSW. Key reports, particularly those that contain data relevant to this study include:

- Roy and Crawford (1980) Quaternary Geology of the Newcastle Bight Inner Continental Shelf, New South Wales, Australia. New South Wales Geological Survey – Records 19(2), 1455-188. Roy & Crawford (1980) collected 261 samples that included surface sediment samples from a small bucket dredge as well as hand sampling from the beach and surf zone. Subsurface sediment data came from power auger holes in the outer barrier and in the beach. This is the most extensive of the sediment sampling programs within the bight.
- Roy (2001) Sand Deposits of the NSW Inner Continental Shelf.
NSW coastal environment and sand sources

NSW inner continental shelf

The continental shelf extends eastwards from the NSW coastline as a relatively flat submarine plain and is approximately 50 km wide near Newcastle (Figure 2). In this location, the water depth at the shelf edge is 150 m, and there is an abrupt change in slope marking the beginning of the continental slope. The inner continental shelf occupies a region along the entire NSW coastline in water depths of 20–60 m, encompassing an area of 8 000 km².

The entire surface of the NSW inner continental shelf is covered with sand and minor gravel, except in areas where bedrock reefs outcrop on the seabed. The enormous quantities of sand on the inner continental shelf constitute a potentially viable resource of sand for renourishment of beaches along the NSW coastline (Roy 2001).

![3-D view of the south eastern Australian margin](image)

**Figure 2.** 3-D view of the south eastern Australian margin (modified from Boyd et al. 2004).

Morphology of Stockton Bight

The Stockton Bight (often referred to as Newcastle Bight in previous studies) is a gently curved embayment that stretches 32 km east-northeast from the mouth of the Hunter River at Newcastle northwards to Morna Point, just east of Anna Bay. The New South Wales continental shelf reaches its maximum width of about 50 km in the region offshore from Newcastle (Roy & Crawford, 1980).

A study on the sediments and morphology within the Newcastle Bight completed by Roy & Crawford (1980) mapped four subparallel zones (Figure 3):

- nearshore slope zone
- inner shelf plain
- inner shelf slope
- outer shelf plain.
Near shore zone

The near shore zone (NSZ) extends from the beach to depths of 20–30 m before the gradient flattens out onto the inner plain. The NSZ is usually only ~1000–3000 m wide (Boyd et al. 2004) and can be divided into an upper and lower segment. The upper segment includes Stockton Beach, while the lower segment is characterised by a steep seawards slope where submarine rock outcrops off the rocky headlands at either end of the Stockton Bight (Roy & Crawford 1980).

The NSZ profile is a response to wave energy on the shoreline, its depth limit of ~30 m reflects the area of high wave energy. The NSZ is deepest and steepest in areas of the greatest wave energy, typically at the northern end of major coastal compartments (Boyd et al. 2004).

Inner shelf plain

The inner shelf plain is a seaward-sloping surface occurring between 20–65 m depth, between 1.5 km and 11 km wide with an average gradient of 0.05–0.42° (Boyd et al. 2004). The outer boundary terminates at the steepening top of the inner shelf slope. At two locations, within the inner shelf plain in Stockton Bight, bedrock peaks crop out through the sediment cover; the Pinnacles rise from 24–19 m water depth and the Rock Peaks at the northern end rise from 35–28 m water depth (Figure 3).
NSW offshore sand sources

The New South Wales continental shelf hosts vast quantities of sand in water depths of 20–70 m (Whitehouse 2007). The shelf sand is mostly quartzose, fine-to medium-grained, less commonly coarse-grained and due to the energetic wave regime contains almost no mud (Whitehouse 2007). A comprehensive study conducted by Roy (2001) described two main types of marine sand deposits on the inner shelf (Figure 4):

- Inner shelf sand sheets (ISSS)
- Shelf sand bodies (SSB).

Inner shelf sand sheets (ISSSs) form surficial sheet-like units typically 0.25–1.5 m (and up to 5 m) thick and occupy a coast parallel zone 5–10 km wide in water depths of 20–70 m across about 70% of the inner shelf (Whitehouse 2007). Mostly, ISSSs consist of clean, medium-grained sand with a variation of shell gravels near reefs and irregular patches of coarse gravelly sand commonly near the toe of eroding shorefaces (Roy 2001). Over time, ISSSs have been subject to wave reworking that has winnowed out the finer sand component and transported it shoreward resulting in ISSSs being coarser than the underlying sediment (Roy 2001) making them suitable for beach renourishment (Whitehouse 2007).

SSBs form linear, shore parallel deposits off prominent headlands generally less than 5 km from the coast (Roy 2001). They are typically 20–30 m thick, 5–40 km long and 2–4 km wide (Whitehouse 2007). Composition consists of fine- to medium-grained, moderately to well sorted quartz sand with 10–15% biogenic carbonate (shells) and usually < 1% mud (Roy 2001). SSB sand is well suited to concrete manufacturing and industrial applications, including glass manufacturing, but is less suitable for beach renourishment than the ISSSs (Whitehouse 2007).

In Stockton Bight, the Newcastle ISSS is present on the inner shelf plain (Figure 5). No SSBs occur within the study area.

In addition, close to the Newcastle Harbor entrance, there are two other potential sources of sand for beach renourishment, as identified by WorleyParsons (2012): the large sand lobe off Nobbys Head and the dredged sediment spoil grounds located approximately 3 km off Nobbys Head in 25–30 m water depth (Figure 5).
Figure 4 NSW marine sand bodies location map (adapted from NSW Trade & Investment 2016).
Identified marine sand resources

There is a large amount of scientific information available relating to marine sediments in Australia generally, although very little exploration has occurred to allow evaluation of potential uses for many of the marine sand bodies on the inner continental shelf of NSW (NSW Trade & Investment August 2016).

Most of the NSW offshore exploration for sand has occurred in the Sydney area, commencing in the late 1970s when a consortium of companies defined a potential construction sand resource of approximately 21 Mt within the entrance to Broken Bay.

A total of approximately 3000 Mt of sand has been defined from sand bodies located on the inner continental shelf offshore from Sydney, from Black Head in the south to Swansea in the north. The resources occur as ISSSs and SSBs and consist of fine- to coarse-grained sand in water 25–75 m deep.

Due to the cost of transport, it is unlikely that the sand resources identified offshore from Sydney could be cost-effectively used for beach renourishment at Stockton. To reduce transport costs potential sand sources should be located relatively close, in Stockton Bight.
Stockton Bight sand sources

Five sediment units in Stockton Bight have been assessed in this review:

- near shore sands
- inner shelf plain unconsolidated sediments
- Newcastle inner shelf sand sheet
- lobe
- dredge spoil.

To assess these five units all available data (Appendix 1) were compiled from the previous investigations to assess the location, size and quality of marine sand bodies, including:

- Bathymetric data – new topographic (elevation) and bathymetric (depth) data were acquired for the NSW coast July to December 2018 to water depths of 30 m. A hydrographic survey is planned for Stockton Bight for FY2019/2020 by the Australian Hydrographic Office on behalf of the Department of Defence under the HydroScheme 2020 program. This survey will join the new bathymetry data and will greatly assist in understanding the beach morphology and processes in water depths between 30 m and 100 m in the Stockton Bight.

- Sediment data – were sourced from the AUSeaBed database (Jenkins 2001), MARine Sediments (MARS) database and a range of published reports (Shepard 1971; Roy & Crawford 1980; WorleyParsons 2012).

- Geophysical data – primarily seismic data that allows for the thickness of sand bodies and their lateral extent to be imaged below the sea floor. These are important data in estimating the volumes of sand bodies and modelling their 3D geometry. Unfortunately, MEG does not currently have the high-resolution seismic data (Andrews et al. 1979) that covers most of the inner shelf plain in Stockton Bight.

Recommendation 1

There have been numerous surveys in Stockton Bight since the 1960s. However, not all previously acquired data were located prior to completion of this review. It is recommended that MEG should:

- Continue attempts to locate and compile results of all previous sediment ‘grab and coring’ sampling.
- Continue attempts to locate and then reprocess the high-resolution seismic data acquired by Andrews et al. (1979) to map the lateral and vertical extent of the sand bodies.
- If the high-resolution seismic data of Andrews et al. (1979) cannot be found, consider reacquiring the seismic data. Geoscience Australia have indicated that their seismic equipment may be available for use in early 2021.
- Obtain, when competed, the additional Stockton Bight bathymetric data from the Australian Hydrographic Office under the Hydroscheme 2020 program, to support modelling of the beach dynamics and investigate opportunities to extend this survey to cover the southwestern end of Stockton Bight.
Description of sand sources

Near shore sands

Mean grain sizes for the near shore sands range from fine to coarse and are usually well to very well sorted (Roy 2001) (Figure 6). The native beach material of Stockton Beach was found to be medium to medium–coarse sand with a mean grain size of 0.40 mm (WorleyParsons 2012).

As the near shore sands are in the active beach zone they are not considered a suitable source for beach renourishment due to potential environmental impacts.

Figure 6. Sediment grain size superimposed on sediment units (Roy & Crawford 1980).

Inner shelf unconsolidated sediment

The high-resolution seismic survey of the Stockton Bight (Andrews et al. 1979) showed there is greater than 30 m of unconsolidated overlying the bedrock in the Stockton Bight (Figure 7). At this time the properties of this sediment unit are not known and whether it is a potentially viable source of sand for beach renourishment. High-resolution seismic data and coring would be required to make this assessment.

Overlying the unconsolidated unit are three sand sources located on the inner shelf plain (Figure 7), namely the Newcastle inner shelf sand sheet, lobe and dredge spoils. All three are believed to form a relatively thin veneer over the thicker package of unconsolidated sediments.
Newcastle inner shelf sand sheet

Roy & Crawford (1980) described the inner shelf plain sediments of the Stockton Bight as a medium- to coarse-grained, poorly sorted relict sand with a mean grain size ranging from 0.29–0.71 mm. A characteristic of ISSSs is their typically brown to dark brown colour due to extensive iron staining, which increases with water depth (Roy 2001). A band of coarse sediments (Figure 6) was identified by Roy & Crawford (1980) that may correlate with an ancient arm of the Hunter River.

WorleyParsons (2012) described the Newcastle ISSS, at water depths of 20–40 m, as a well sorted quartz sand, with less than 3% gravel. The sediment data reviewed by MEG (Figure 6), shows the ISSS to be mainly composed of medium to medium–coarse sand. Based on the distribution of the medium to medium–coarse sand it appears that the sediments sampled and described by Roy & Crawford (1980) correlate with the Newcastle ISSS, suggesting it may cover the majority of the inner shelf plain. However, at this time its thickness, uniformity and continuity are not known.

Lobe

A large, oblate shaped sand lobe extends off Nobbys Head in a south easterly direction (Figure 5). It is estimated to be about 4.4 km wide, averaging 2–3 m thick with a maximum thickness of 7.5 m (WorleyParsons 2012). Core sampling by WorleyParsons (2012) showed the sands to be medium to medium–coarse grained and suitable for beach renourishment.

Previous surface sediment samples taken on the lobe (Figure 6) also indicated that the lobe is mostly composed of medium to medium–coarse sands. However, the presence of considerably more fine-grained material around the entrance to Newcastle Harbour makes further sampling of the lobe necessary to confirm its suitability as a source of sand for Stockton Beach renourishment.

Dredge spoils

There are several sediment spoil grounds, made up of material dredged from Newcastle Harbour, located offshore of Nobbys Heads. The spoil grounds, which have shifted over the past 40 years during several projects (BHP, Port Waratah Coal Services, Newcastle Coal Infrastructure Group), occur in water depths of 25–40 m.

Figure 7. Interpreted depth to bedrock along two NW-SE oriented seismic profiles (adapted from Andrews et al. 1979). The locations of the interpreted sections are shown in Figure 5.
As with the lobe, the sediment data (Figure 6) indicates the spoil grounds dominantly comprise medium to medium coarse sand. However, the presence of fine-grained sediment will require additional sampling to quantify the amount of this fine-grained sediment.

Suitability of sand for beach renourishment

Assessing sources of sand for the Stockton Beach renourishment project requires comparing the existing beach sand with potential sources. The native beach material is a medium to medium–coarse sand with a mean grain size of 0.40 mm ().

Multiple generations of sediment sampling in Stockton Bight show that the Newcastle ISSS, to the north of the Pinnacles, appears to be composed of medium–coarse sands (Figure 6). A recent core sample (ISSS North, Table 1) by WorleyParsons (2012) showed the sand is medium–coarse grained, with a mean grain size of 0.50 mm.

MEG concurs with the conclusion of WorleyParsons (2012) that the sand of the ISSS is suitable for beach renourishment at Stockton. However, a program of sediment grab sampling and coring is recommended to map and fully characterise the volume and properties of the sand resource. If the 1970s seismic data cannot be located, a further seismic survey would also be advisable.

The Newcastle ISSS was identified as a potential aggregate resource for construction material in the 1970s. In 1977, the Public Works Department indicated that based on a surface area of 6 x 30 km and a thickness of 3 m, that the area hosted a potential aggregate resource of 500 million m³ (WorleyParsons 2012). However, this would appear to be an over-estimate of the resource available for extraction, given that ISSSs are generally up to 1.5 m thick (Whitehouse 2007) and that trailer suction dredges extract material to depths less than 0.5 m.

WorleyParsons (2012) also concluded that the lobe and dredge spoils are also suitable for beach renourishment. A sand resource of 32 million m³ was estimated for the lobe, of which 80% is expected to comprise nearshore marine sands and 20% dumped material. This sand lobe is estimated to accumulate at a rate of approximately 5000 m³ per annum (WorleyParsons 2012). However, the historic sediment data indicated that there is finer sand around the mouth of the harbour than is present to the area north of the Pinnacles. More sampling is required to assess the suitability of the material to be used for beach renourishment.

Future investigations, including sampling and geophysical surveys, should initially focus on the inner shelf plain in NSW state waters (Figure 8). To avoid unnecessary regulatory complexity, the portion of the inner shelf plain located in Commonwealth waters would only be investigated if the sand of the Newcastle ISSS in NSW state waters is unsuitable for beach renourishment.
Table 1. Summary of physical characteristics of Stockton Beach sands and offshore samples (WorleyParsons, 2012).

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Av grain size (mm)</th>
<th>Fine % (&lt;75 µm)</th>
<th>Sand % (&gt;75 µm)</th>
<th>Gravel % (&gt;2 mm)</th>
<th>Sorting</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockton Beach</td>
<td>Medium–coarse sand with shell (6%)</td>
<td>0.4</td>
<td>1.46</td>
<td>97</td>
<td>2.63</td>
<td>Moderate to well</td>
<td>T1-T3</td>
</tr>
<tr>
<td>Sand Lobe Peak</td>
<td>Medium–coarse sand and shell</td>
<td>0.44</td>
<td>3</td>
<td>95</td>
<td>4</td>
<td>Poor to moderate</td>
<td>Core 2</td>
</tr>
<tr>
<td>Sand lobe (closer to spoil grounds)</td>
<td>Medium–coarse sand and shell with some gravel</td>
<td>0.45</td>
<td>1</td>
<td>91</td>
<td>8</td>
<td>Poor</td>
<td>Core 3</td>
</tr>
<tr>
<td>ISSS North</td>
<td>Medium–coarse sand and shell with some gravel</td>
<td>0.5</td>
<td>&lt;1</td>
<td>90</td>
<td>9</td>
<td>Poor to moderate</td>
<td>Core 1</td>
</tr>
<tr>
<td>ISSS South – close to Hunter River mouth</td>
<td>Medium–coarse sand and shell</td>
<td>0.38</td>
<td>&lt;1</td>
<td>99</td>
<td>1</td>
<td>Moderate</td>
<td>Core 4</td>
</tr>
</tbody>
</table>

Figure 8. Proposed investigation areas in Stockton Bight.
Recommendation 2

The available data indicate that sands on the inner shelf plain and lobe are suitable to renourish Stockton Beach. As noted by WorleyParsons (2012) a more comprehensive sediment source investigation is required, including contamination testing as well as detailed surveys of the proposed dredging site(s). Until Recommendation 1 is completed it is not possible to develop a sampling program that will meet the requirements of the project.

It is recommended that any program to characterise the sand resources focuses in NSW state waters and only moves to Commonwealth waters if sand resources suitable for beach renourishment cannot be located within state waters (Figure 8):

- **Inner shelf plain and sand lobe— NSW state waters**
  
  The initial focus should be on the portion of inner shelf plain that is located within NSW state waters and the sand lobe off Nobby's Head.

- **Inner shelf plain – Commonwealth waters**
  
  This stage may not be required if there is deemed to be sufficient sand within NSW state waters to satisfy the requirements of the project.

Other considerations

This review shows that the sand sources on the inner shelf plain are likely suitable for use to renourish Stockton Beach. However other factors also need to be considered as part of future investigations:

1. **Anthropogenic influences** – the two breakwaters at the entrance of the harbour and the eight marine archaeological sites in the Newcastle area including one declared shipwreck (the “Commodore”) and seven other reported wrecks.

2. **Environmental** – WorleyParsons (2012) identified numerous potential environmental impacts that may occur as a result of extraction of the marine sand, including:
   - Potential changes to coastal processes that may influence beach erosion and shoreline recession.
   - The release of contaminants affecting water quality and ecology. It should be noted that no elevated levels of contaminants were reported by WorleyParsons (2012). However, they stated that more comprehensive sediment source testing including contamination testing is required.
   - Increased levels of turbidity due to dredging, which may impact beach users and ecology.
   - Loss of habitat and mortality of benthic invertebrates.
   - Impacts on local fisheries.
   - Impact on marine mammals from noise associated with dredging operations.

An environmental impact assessment will be required prior to the extraction of sand being approved.

3. **Active beach zone** – it will be necessary to accurately determine the active beach zone prior to undertaking any offshore dredging, as any sand for beach renourishment should ideally be taken from outside this zone to minimise potential unexpected impacts on the near shore zone. For example:
• If the active beach zone extends from the shore to 30 m depth (Figure 8), then that leaves a sizeable area of the inner shelf plain within NSW waters (<3 nautical miles from shore) from which to extract sand.

• If the active beach zone extends to 40 m depth (Figure 8), then it potentially removes the majority of the inner shelf plain in NSW waters and the project may be required to look at dredging within Commonwealth waters.

This modelling will provide a minimum water depth from which the sand can be extracted. If this minimum water depth is not adhered to, then the extraction may result in:

• Beach drawdown – if extracted too close to the beach a hole is created that will be naturally filled by the movement of sand from the beach to the hole.

• Greater wave action – if near shore sediment is removed it may result in larger, higher energy waves reaching the beach causing additional erosion

• Changed local currents – extraction may impact near shore sediment transportation rates.

**Recommendation 3**

This project will require collaboration by experts from the relevant NSW government agencies to ensure a well designed and executed program. No single agency has all of the expertise required to undertake the different studies required. It is recommended to establish a collaborative project team comprising experts from the relevant government agencies.
Conclusions and summary of recommendations

Sand suitable for the renourishment of Stockton Beach is likely to occur on the inner shelf plain, the lobe and possibly the dredge spoil dumps in Stockton Bight.

The available data indicate that the sands of the Newcastle ISSS that are lying on the inner shelf plain appears to be relatively uniform in grain size and represent the largest potential sand resource in Stockton Bight. However, the full extent, continuity and thickness of the Newcastle ISSS is unclear and needs to be determined as part of any future investigations.

The lobe and spoil dumps off Nobbys Head also contain sand that may be suitable. However, some data suggest the variability of the sand in these areas may not be as uniform as that on the inner shelf plain. Inner shelf sand should be extracted from outside of the active beach zone to minimise potential impacts to the beach.

More data will need to be acquired to properly assess and locate sufficient volumes of suitable sand for extraction while minimising environmental impact. This project will need to involve experts from various government agencies to ensure a successful outcome. No single agency has the expertise required to undertake the different studies required.

As detailed in the report, three recommendations are made:

1. That MEG continue its attempts to locate previous data.
2. That a comprehensive offshore sampling program is undertaken to identify and better characterise a suitable sediment source for Stockton beach renourishment.
3. That a collaborative project team comprising experts from the relevant government agencies is established to progress the offshore sampling program.
References


MHL 1977. Sediment movement in Newcastle Bight, Manly Hydraulics Laboratory Report No. 206, Public Works Department NSW.


WORLEYPARSONS 2012. Report for City of Newcastle on Stockton Beach sand scoping and funding feasibility study. WorleyParsons Services, North Sydney.
Appendix 1 – Data used in review

Three key types of data required to assess the location, size and quality of marine sand bodies.

1. Bathymetric data – provide information on the water depth and shape of the sea floor.
2. Sediment data – collected by sampling of the sea floor to characterise the nature of the sediments.
3. Geophysical data – primarily seismic data that allows for the depth of sand bodies and their lateral extent to be imaged below the sea floor. These are important data in estimating the volumes of sand bodies and modelling their 3D geometry.

Bathymetry survey

The bathymetry data (Figure A1) used in this report is a merge between contours generated from:

- 2009 bathymetric grid of Australia for water depths greater than 30 m, and
- 2018 LiDAR bathymetry for water depths up to 30 m.

New topographic (elevation) and bathymetric (depth) data were acquired for the NSW coast using Airborne LiDAR Bathymetry (ALB) from July to December 2018. This technique is a combination of Light Detection and Ranging (LiDAR) and Laser Airborne Depth Sounding (LADS) sensors). Data were acquired by Fugro Pty Ltd on behalf of NSW Office of Environment and Heritage (OEH) with funding from the NSW Coastal Reforms package.

These new data provide high-resolution 3–5 m spaced soundings (0.5 m spot spacing terrestrial; 3.4 m spot spacing marine) from the mean high-water mark to ~200 m inland, and from the shore, seaward (LADS - bathymetry) to the point of laser extinction (~20–40 m water depth depending on in-water conditions). The final data products are combined gridded terrestrial (elevation) and subtidal marine (bathymetry) data at 5 x 5 m (horizontal resolution). These new data cover an area of 6862 km².

A hydrographic survey is planned for Stockton Bight (Figure A2) for FY2019/2020 by the Australian Hydrographic Office on behalf of the Department of Defence under the HydroScheme 2020 program. According to the AHO website:

The survey area adjoins recent coastal Bathymetric LiDAR surveys undertaken on behalf of the NSW Department of Planning, Industry and Environment (formerly NSW Office of Environment and Heritage), and extends seawards to the 100 metre contour. This survey will include collection of bathymetric data by multi-beam echo sounder to improve navigational safety as well as backscatter data to facilitate habitat mapping and environmental monitoring.

This data will greatly assist in understanding the beach morphology and processes in water depths greater between 30 m and 100 m in the Stockton Bight area. For complete coverage of Stockton Bight, additional data should also be collected beyond the southwestern end of the proposed study area.
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Figure A1. Bathymetry data for Stockton Bight.

Figure A2. Approaches to Newcastle, Stockton Bight proposed hydrographic survey area (pink) (HydroScheme 2020) and possible extension for Stockton Beach renourishment project (orange).
Sediment data

Sediment data for Stockton Bight (Figure A3) were sourced from the AUSEaBed database (Jenkins 2001), MARine Sediments (MARS) database and a range of published reports (Shepard 1971; Roy & Crawford 1980; WorleyParsons 2012).

In 1980, Roy and Crawford published a paper on the Quaternary geology of the Newcastle Bight based on 261 sediment samples. The samples were collected along a series of transects that extended from the beach to the outer edge of the inner shelf plain.

The AUSEaBed database, produced by the University of Sydney Institute of Marine Science (Jenkins 2001), compiled over 275 000 samples, from various organisations, from around the Australian Continent. There are about 350 samples from the AUSEaBed database in the Stockton Bight.

In 2005, Geoscience Australia released the MARine Sediments (MARS) database as the framework for the ongoing collection and maintenance of marine sediment data in Australia. Twenty-two of the AUSEaBed samples have been included MARS database.

The Roy & Crawford (1980) and AUSEaBed datasets include a range of data on the sediments, including grain size, sorting, and carbonate content. Grain size has been the primary focus of this review. However, it is recommended that a full review of all the data is undertaken prior to commencing future sampling programs.
Geophysical data

There have been marine geophysical surveys done in Stockton Bight since 1964, however their quality and coverage vary. Most notable is the high resolution bathymetric, seismic and magnetic survey (Figure A4) carried out during the 1970s, in part for the NSW Department of Public Works to assist feasibility studies for the construction of a proposed new port (Andrews et al. 1979).

The results of the seismic survey were reported by Andrews et al. (1979) to show greater than 30 m of sand overlying the bedrock in the Stockton Bight in the area north of the Pinnacles. Unfortunately, at this time, the data for the 1970s survey has not been sourced by MEGG. If these data can be found, they will be interpreted to map the distribution of the different sand units in the bight prior to any sampling and coring being undertaken. This will ensure that the key units are sampled. If the data cannot be found, then it may be necessary to reacquire a part, or all, of the dataset.

Marine seismic studies from 1964 (Bruce 1964) and 1970 (Longreach Oil Ltd 1970) pass through the study area but they are poor quality and lacking the resolution required for detailed sand body mapping. Further studies were undertaken in 1993 and 1998 on the Fearnot and Franklin vessels respectively (Boyd et al. 1998). The seismic data from these surveys have relatively limited coverage in the bight and are only available as paper copy, that are not yet sourced.

In December 2019, Water, Wetlands and Coastal Science, Department of Planning Industry and Environment (DPIE) ran a trial sub-bottom profiling (SBP) survey in Stockton Bight using equipment from Geoscience Australia. Unfortunately, the survey was not successful as the SBP was not powerful enough to penetrate the hard sands on the sea floor. DPIE is looking to rerun the survey in late 2020 or early 2021 with a more powerful SBP. Depending on time frames, there may be an opportunity for MEG to work with DPIE to acquire subsurface data that will be critical to develop robust models of the sand bodies.
Figure A4. Track-lines of previous seismic surveys superimposed on Roy & Crawford (1980) sediment units.