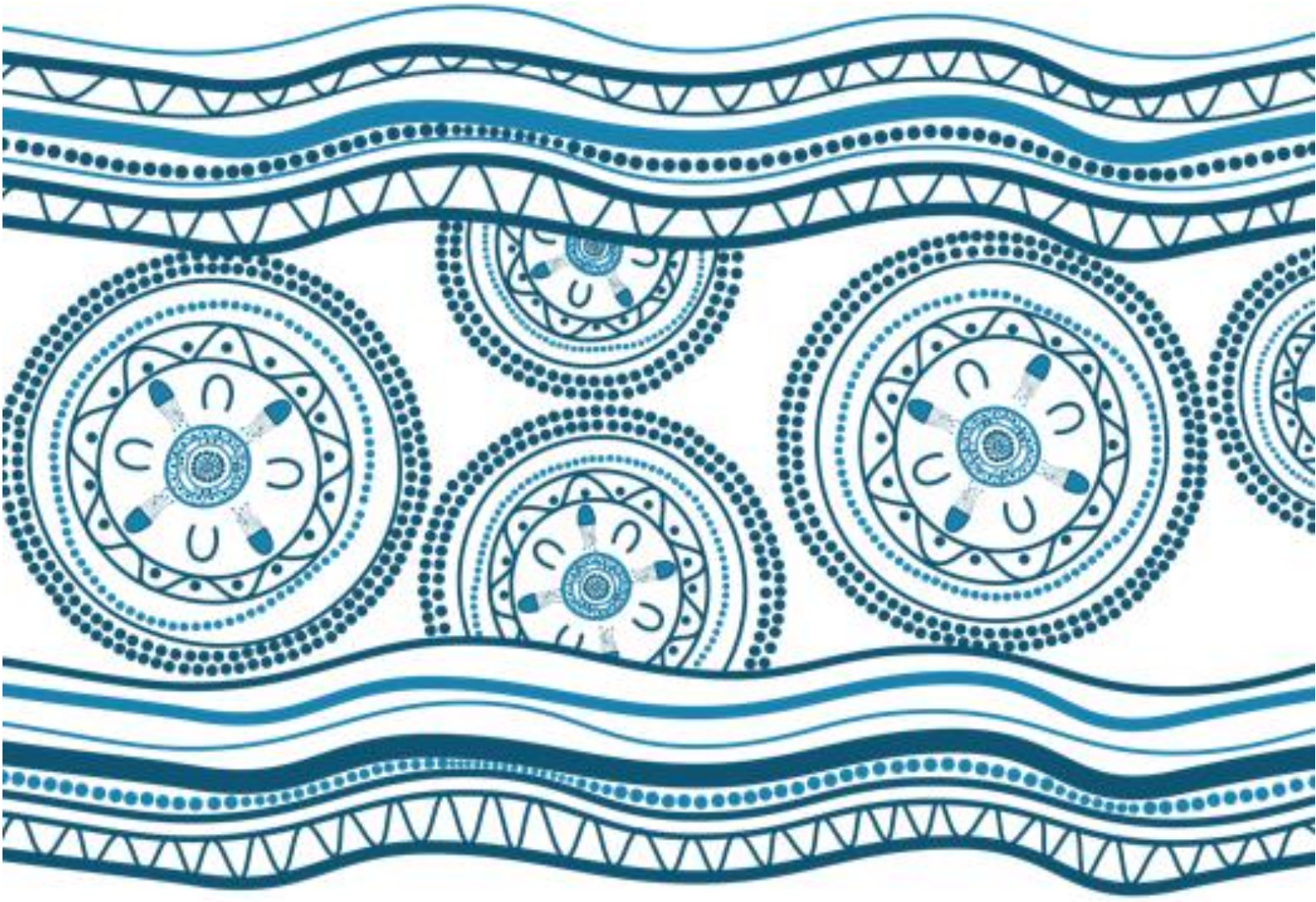
Chapter 18

Coastal processes



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18 Coastal processes

This chapter assesses the project's impacts on coastal processes and identifies mitigation and management measures to minimise and reduce these impacts.

The assessment draws on information from Appendix T (Coastal Processes Memorandum).

18.1 Assessment methodology

The coastal processes assessment method involved:

- Identifying the existing coastal processes considering the existing wave climate, water levels, currents, and wind speed and direction. Various calculations and modelling were carried out to predict the sediment dispersion, depositional and shoreline impacts, as described in Appendix T (Coastal Processes Memorandum). A case study review of Manly East ferry wharf was also carried out to assess potential scour hole impacts.
- Assessing the potential impacts on coastal processes including:
  - Shoreline impacts at Kurnell from the temporary causeway
  - Sediment plumes dispersion and deposition from constructing and operating the wharves
  - Scour impacts from ferry vessels
  - Impacts to public safety from coastal inundation and wave overtopping
- Recommending relevant mitigation and monitoring measures.

The modelling used in the Coastal Modelling Report in Appendix T (Coastal Processes Memorandum) combined wave data recorded at the Port Authority of NSW Botany Bay Waverider Buoy (located offshore in a depth of about 80 metres); the Manly Hydraulics Laboratory Long Reef Buoy (located at Long Reef, north of Botany Bay); and data from Cardno's NSW coastal wave model.

18.1.1 Policy framework

The project area is within the coastal environment area and coastal use area as defined under the *Coastal Management Act 2016* (NSW) (CMA). State Environmental Planning Policy (Coastal Management) 2018 (the Coastal Management SEPP) gives effect to the objectives of the CMA and specifies assessment criteria for carrying out development in each coastal management area. Clause 14 of the Coastal Management SEPP states that development must not be granted consent or approval if it causes adverse impacts on access (see Chapter 12 (Traffic and transport)), views and visual amenity (see Chapter 13 (Landscape character and visual amenity)), Aboriginal cultural heritage and practices (see Chapter 7 (Aboriginal heritage)), places or cultural and built environment heritage (see Chapter 8 (Non-Aboriginal heritage) and Chapter 9 (Underwater heritage)).

Local environmental plans give effect to the Coastal Management SEPP by specific zoning and development restrictions in coastal management areas. Councils can also prepare Coastal Management Programs (CMP) to give effect to the objectives of the CMA. Although, these zoning and development restrictions do not apply to SSI.

The following coastal hazards studies are documented for La Perouse as part of the Scoping Study for establishing a CMP for Woollahra Municipal Council, Waverley Council and Randwick City Council. No existing coastal hazard studies for Kurnell have been prepared to date.

Table 18-1: Coastal hazards identified within Botany Bay (in the vicinity of La Perouse)

Document	Coastal hazard	Description
Eastern Beaches Coastal Management Program Stage 1 Scoping Study, June 2020 (BMT Commercial Australia Pty Ltd, 2020)	Coastal and tidal inundation	This coastal hazard risk is low for all low-lying infrastructure within the Randwick local government area (LGA). The proposed wharf at La Perouse would be considered low-lying infrastructure.
	Beach erosion and shoreline recession	The Randwick LGA is classed as being at medium-to-high risk from beach erosion and shoreline recession. All of Botany Bay frontage are stated to be at high risk due to sea level rise.
	Coastal cliff or slope instability	The Randwick LGA is classed as being at medium-to-high risk from coastal cliff or slope instability. The project area at La Perouse is not listed as a key location impacted by this hazard.

The project does not require the adjustment of boundaries, road adjustments or recategorisation of land under the *National Parks and Wildlife Act 1974* (NSW) and therefore the provisions of Revocation, Recategorization and Road Adjustment Policy (NSW Office of Environment and Heritage, 2012) would not apply.

As the project is State significant infrastructure, it does not require approval under the *Water Management Act 2000* (NSW), pursuant to section 5.23 of the *Environment Planning and Assessment Act 1979* (NSW). However, it is recognised that what would be controlled activities under the *Water Management Act 2000* are required (including the erection of a building (wharves), carrying out work, removing and depositing material form waterfront land). These activities would be managed in accordance with the Guidelines for controlled activities on waterfront land (NSW Office of Water, 2012).

The SEARs reference the Guidelines for development adjoining land and water managed by Environment, Department of Climate Change and Water (DECCW, 2010e). These guidelines apply to projects which adjoin land under the *National Parks and Wildlife Act 1974* and require an assessment of potential impacts to the adjoining land. The EIS inherently assesses the matters listed under this legacy guideline.

18.2 Existing environment

This section outlines the existing coastal environment in Botany Bay.

18.2.1 General conditions

Botany Bay has a catchment of approximately 55 square kilometres and is relatively shallow with most of Botany Bay being less than five metres deep. The navigation channel is an exception. It runs between Port Botany, the Kurnell Port and Berthing Facility Terminal, and the harbour entrance.

Botany Bay is fed by Georges River from the west and Cooks River from the north, and a tidal flow in and out of the heads. The nearshore environment at La Perouse and Kurnell are tidally affected. Figure 18-1 shows the marine chart for Botany Bay including the shipping channel and typical water depths.

With respect to environmentally sensitive lands, there are no marine parks or aquatic reserves (as defined under the *Marine Estate Management Act 2014* (NSW)) within the construction boundaries. Towra Point Aquatic Reserve and Towra Point Nature Reserve (a wetland that is protected under the *National Parks and Wildlife Act 1974*) are located two kilometres to the west of the Kurnell construction boundary. Cape Banks Aquatic Reserve is located 1.5 kilometres to the south of the construction boundary at La Perouse. Due to the distance from the construction boundaries, there would be no indirect impacts on these reserves.

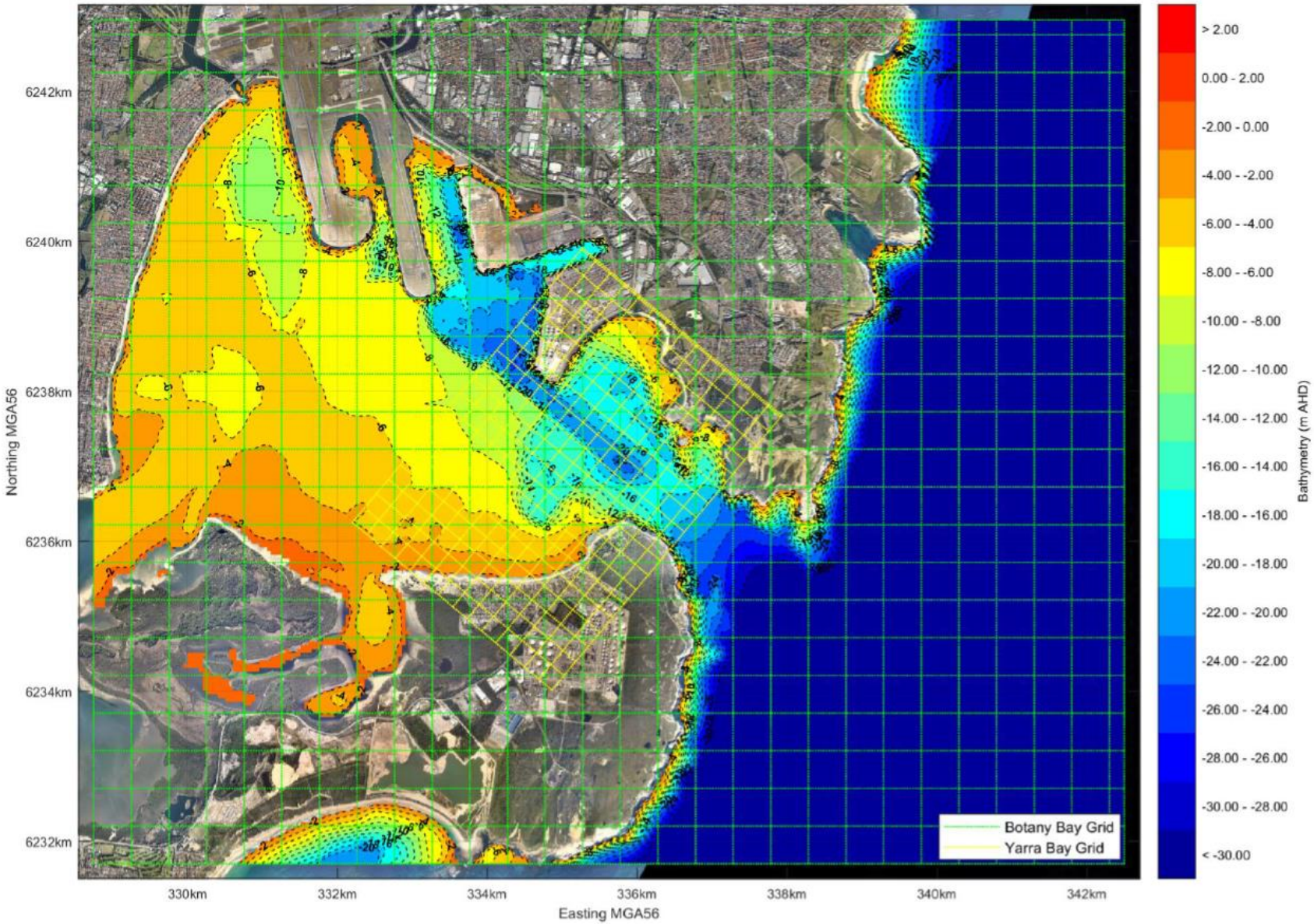

Figure 18-1: Botany Bay bathymetry (Figure 6-1 in the Coastal Modelling Report of Appendix T (Coastal Processes Memorandum))

18.2.2 Wave climate

The existing wave climate in Botany Bay is largely influenced by both swell and sea waves. Swell waves are defined as offshore waves that are generated by storms or large low pressure events outside Botany Bay. Sea waves are defined as waves generated by the local wind climate within Botany Bay.

Waves

Botany Bay is sheltered. This means that the waters are generally calm and any swell created from the ocean only results in waves that are around 0.2 metres high on average.

For about 85 per cent of the time the waves mainly come from the west at La Perouse, while at Kurnell they mainly come from the north/north-east for around 90 per cent of the time. Peak wave periods (time between two waves passing a stationary point) vary between two and 20 seconds. Typically, they are between seven and 13 seconds apart.

Figure 18-2 and Figure 18-3 below show the swell conditions at La Perouse and Kurnell. Each bar shows the main direction the swell waves come from. The different colours show the various wave heights that occur in that direction. It shows that waves up to 0.2 metres occur for most of the time in these directions as they make up most of the spoke's overall colours. It is also calm for about 16 per cent of the time in La Perouse and about 12 per cent of the time in Kurnell.

While bad weather offshore can also affect the waves in Botany Bay it has limited impact. Typically, the waves remain below 0.5 metres. Even under the most extreme cases, the waves are not predicted to be any higher than one metre during a storm that would occur once every 200 years (see Appendix T (Coastal Processes Memorandum)).

Strong winds can also affect the waves in Botany Bay. They blow across the open expanse of Botany Bay from the west. This only happens occasionally where the waves at both locations come from the west. Figure 3 and Figure 4 in Appendix T (Coastal Processes Memorandum) show the change in wave direction and height on the rare occasion the wind creates waves in Botany Bay.

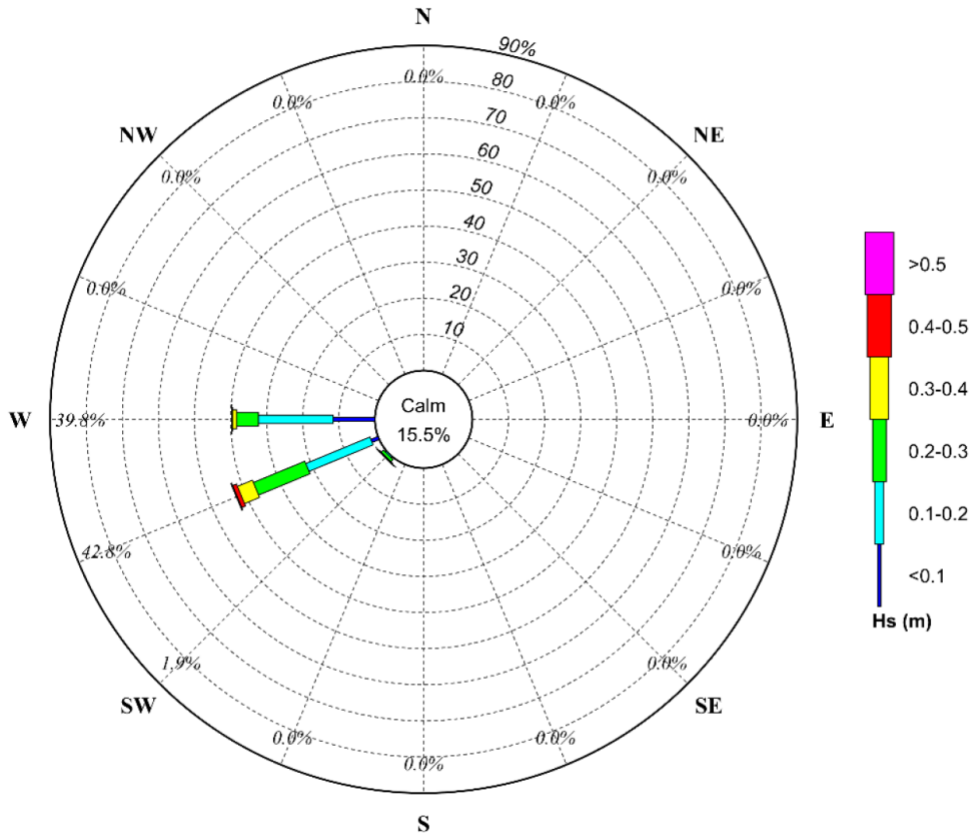

Figure 18-2: Swell wave direction and height at La Perouse (Appendix T (Coastal Processes Memorandum)).

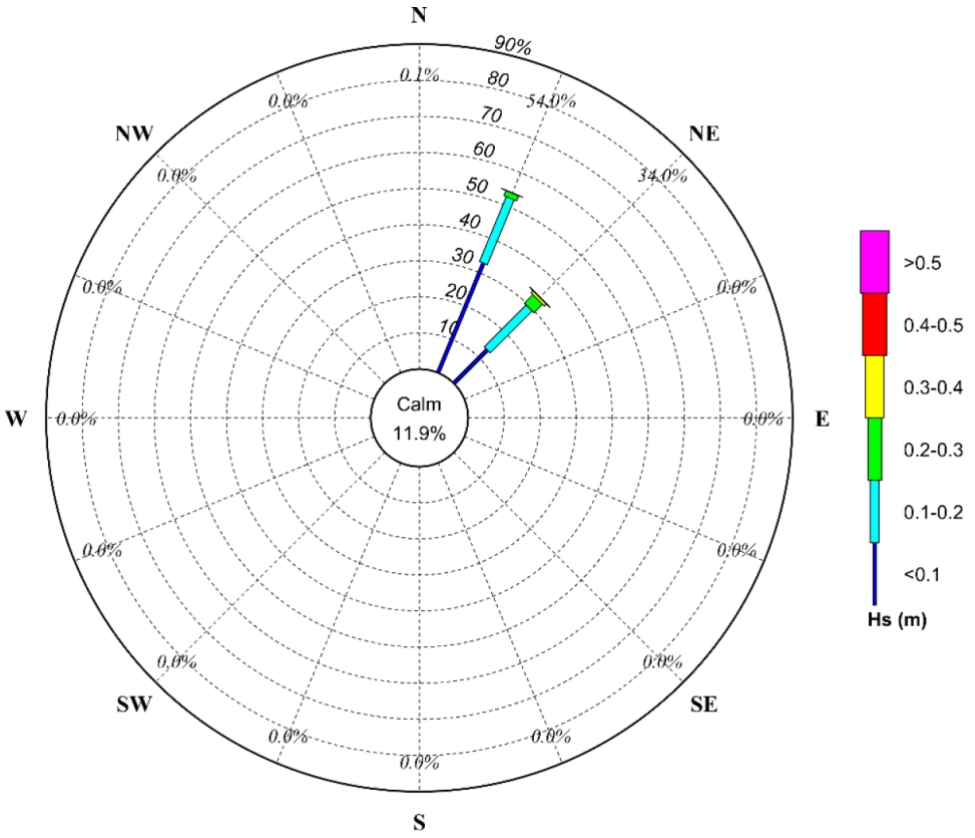

Figure 18-3: Swell wave direction and height at Kurnell (Appendix T (Coastal Processes Memorandum)).

Water levels in Botany Bay change as result of the tides, the wind, atmospheric pressure, stormwater discharge via the Georges and Cooks Rivers, and runoff from the surrounding land. Climate change is also having its effect, with more extreme weather potentially increasing (more severe storms and rainfall) or decreasing (more prolonged dry and drought periods) water levels.

The astronomical tide levels within Botany Bay are shown in Table 18-2. They show a spring tidal range of 1.33 metres and a neap tidal range of 0.95 metres. The tidal range typically will fall between these values. The extreme offshore water levels are presented in Table A-1 and A-2 of the Coastal Modelling Report in Appendix T (Coastal Processes Memorandum). The water level is expressed in metres above Australian Height Datum (mAHD).

Table 18-2: Tidal planes for Botany Bay

Tidal plane	Typical water level (mAHD)
Mean High Water Springs	0.69
Mean High Water Neaps	0.56
Mean Sea Level	0.01
Mean Low Water Neaps	-0.39
Mean Low Water Springs	-0.64

18.2.3 Currents

The currents in Botany Bay are not very strong. At La Perouse they are around 0.25 metres per second (m/s) while at Kurnell they are only 0.05 m/s (see Figure 18-4 and Figure 18-5). The currents are created by the tides most of the time, however they can increase slightly during or shortly after a storm due to high winds or catchment flows from the Georges and Cooks River.

Currents close to the shoreline can also be generated by nearshore wave processes. The waves break near the shore due to the reduced water depth. When combined with waves approaching the shoreline at an angle, this process may lead to the development of currents parallel to the shoreline (longshore currents). This can increase the currents speeds along the shoreline to around 0.1 m/s at La Perouse and 0.3 m/s at Kurnell (see the Coastal Modelling Report in Appendix T (Coastal Processes Memorandum)).

There would also be localised current effects (commonly known as wake) from regular shipping movements in Botany Bay.

Figure 18-4 and Figure 18-5 show how the current direction and strength changes with the tides. In Kurnell the currents are mainly west to east reflecting the change in tide. They are slightly stronger on the ebb tide (as water leaves Botany Bay) because of the increased volume of water. The same trend is true at La Perouse, however the orientation is slightly different consistent with the wave conditions. For about six per cent of the time there is effectively no current at Kurnell while there is no current at La Perouse for about 18 per cent of the time. The difference reflects the more exposed nature of Kurnell and sheltered nature of La Perouse.

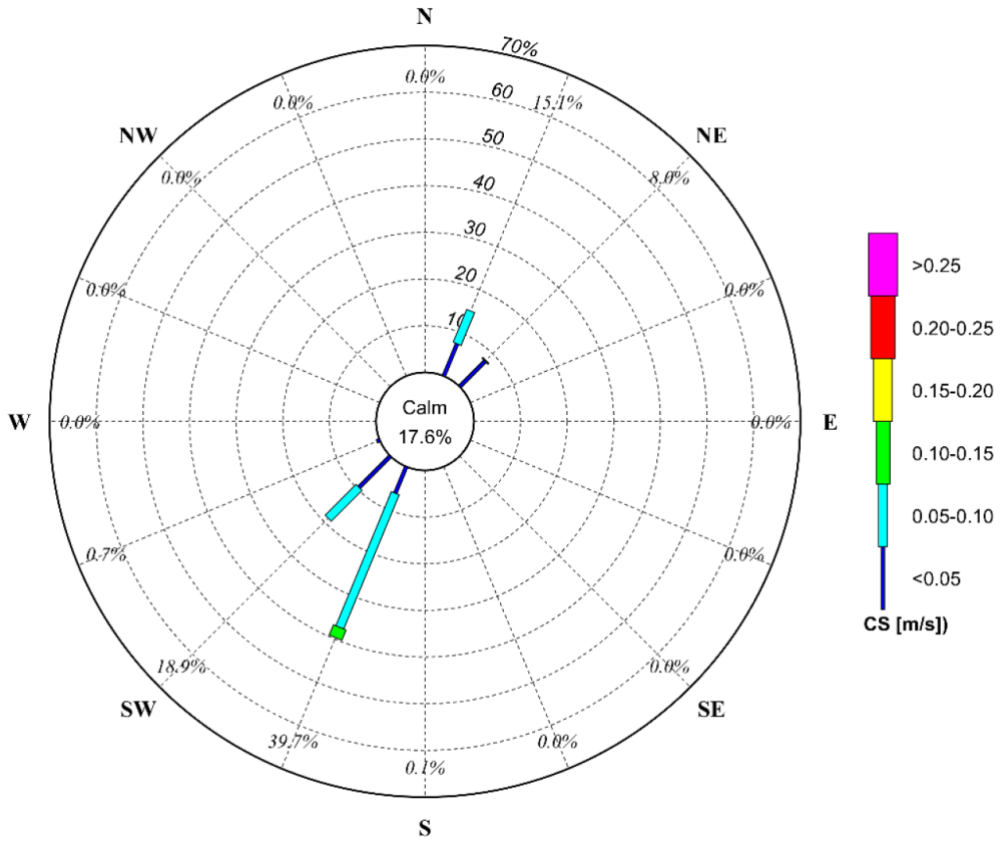

Figure 18-4: Current strength and direction at La Perouse (Appendix T (Coastal Processes Memorandum)).

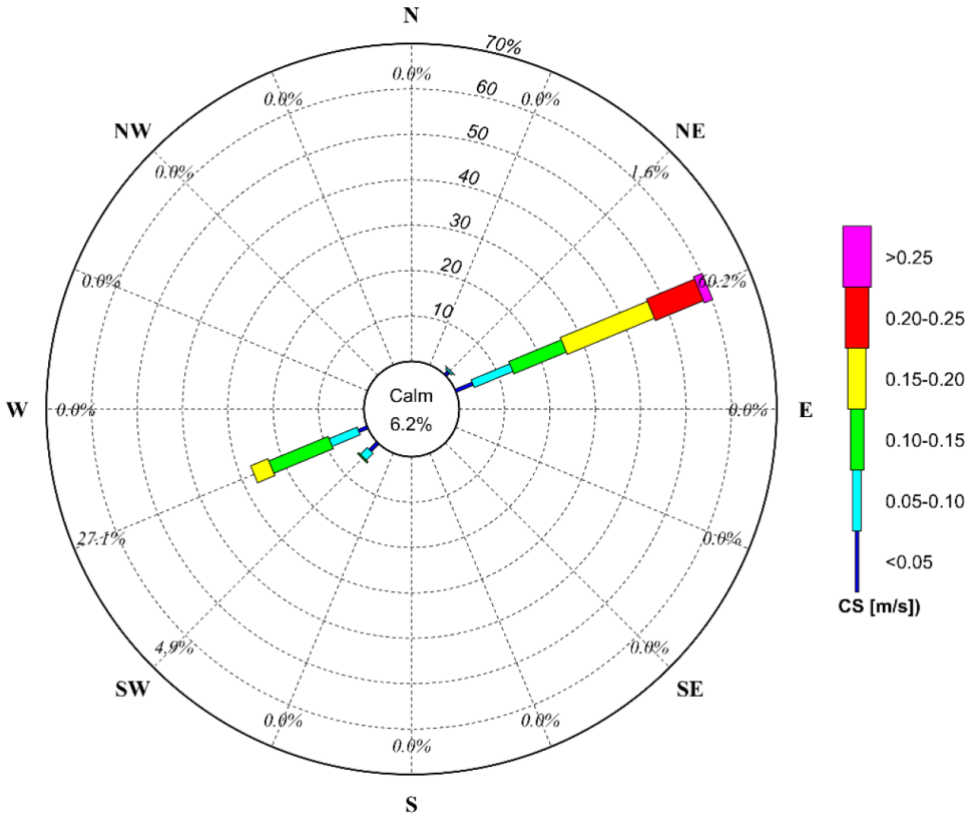

Figure 18-5: Current strength and direction at Kurnell (Appendix T (Coastal Processes Memorandum)).

18.2.4 Sediment transport

Sediment transport is the movement of sediment by water in the coastal environment. Therefore, the stronger the waves and currents the greater the sediment transport because there is more 'energy' available to move the sediment. This means there is less sediment mobilisation and movement in La Perouse compared to Kurnell as described below.

La Perouse

There is limited sediment transport at Frenchmans Bay next to the north of the proposed wharf at La Perouse due to the low energy. This means there is little sediment erosion or accretion (build-up). Frenchmans Beach is not adversely impacted by storm erosion (Cardno, 2012). While Yarra Bay is also not affected by storm erosion it did suffer from beach erosion when the third airport runway and Port Botany were built due to the change in water movement (hydrodynamics) in Botany Bay. As a result, rock armouring and groyne protection were installed on Yarra Bay beach.

Kurnell

The existing sediment transport processes at Kurnell were determined via a comparison of historic aerial imagery from 2009 to 2020. Vegetation lines along the shoreline from 2009 to 2016 show a five-metre change in some places (see Figure 1-9 in the Shoreline Impact Assessment in Appendix T (Coastal Processes Memorandum)). This is relatively low compared to many ocean-facing beaches along NSW's coast. This demonstrates how stable the shoreline has been over the past seven years.

There is the potential for erosion either side of the existing Kurnell viewing platform from cross-shore processes (sediment moving perpendicular to the shore) during large storm events. This is where sediment is taken into Botany Bay by the combined action of tides, waves, and wind. There is evidence of recession of the vegetation line by three to six metres between April 2016 and June 2016 because of a major storm in June 2016 (see Figure 1-10 in the Shoreline Impact Assessment of Appendix T (Coastal Processes Memorandum)). This was the most severe storm since 1974, which caused the previous wharves to be washed away. The shoreline has since recovered, albeit at a slow rate, reaching its pre-2016 east coast low position.

Geotextile sand containers or sandbags have also been installed to the northeast of the existing viewing platform to protect the shoreline. This has reduced the risk of shoreline erosion at this location. These sandbags stop short of the existing viewing platform and do not continue to the south (refer section 1.2 in the Shoreline Impact Assessment of Appendix T (Coastal Processes Memorandum) for site photos).

There is limited longshore sediment transport at Kurnell which is clear from visual observations. The nearshore rock shelf and seagrass beds would not survive close to the shore if there was much sediment transport as they need clear water to survive (see Chapter 10 (Marine biodiversity)). There have also been minor shoreline changes due to the groynes on Silver Beach, between the Kurnell Port and Berthing Facility and viewing platform. Any longshore sediment movement is currently hindered by the remaining rubble of the historical causeway beneath the existing viewing platform. This is acting as a barrier to longshore sediment transport.

18.2.5 Suspended sediments (turbidity)

Suspended sediment (turbidity) concentrations in Botany Bay vary naturally. For around 85 per cent of the time, the suspended sediment concentration is around 5 mg/L (Cardno, Lawson and Treloar, 2007). Higher sediment loads would enter Botany Bay from the Georges and Cooks Rivers and as runoff from the land after major storms. While this causes suspended sediment concentrations to vary across Botany Bay, they reach about 25 mg/L on average (Lawson and Treloar, 2003). While there is no localised data, the suspended sediment concentrations in La Perouse will be lower given the sheltered and low energy conditions as compared to Kurnell, which is likely to be typical of Botany Bay area. Turbidity is also created locally from the propeller wash (disturbance) and wake generated from passing ships. This tends to quickly settle out of

suspension, and is a localised effect. This is reflected in the fact that the suspended sediment concentrations Botany Bay are low despite the high number of vessels.

18.3 Assessment of potential impacts

Potential impacts from construction and operation of the project are assessed below and include impacts on the shoreline, erosion and scour, sediment dispersion and deposition, wave overtopping, and inundation.

18.3.1 Assessment of construction impacts

Shoreline impacts

A temporary causeway is proposed to allow for land-side construction of the wharf at Kurnell. The temporary causeway would be a raised accessway formed of earth or other fill material. It would be about 85 metres long and be 8 to 12 metres wide at the base (refer to Figure 5-16, Chapter 5 (Project description)). The construction of the causeway would take about one and a half months and it would be in place for about four months.

The temporary causeway would reflect the waves. The scale of reflection would depend on the causeway material.

As noted above, photographic evidence from the 1970s onwards shows that there is very low transport of sediment along the shoreline near Kurnell. This is supported by the lack of sediment accumulation around the Kurnell Port and Berthing Facility Wharf, which was also built in the mid-1970s. As the temporary causeway is much smaller than the Kurnell Port and Berthing Facility Wharf, and located sufficiently far to the east for the two structures not to cause an interactive impact on sediment movement, then it is unlikely to have any sediment transport impact along the shoreline.

More locally, the causeway would affect how the waves would propagate (spread) near the shoreline. This may cause a temporary change in the alignment of the shore on both sides of the causeway. This is predicted to be no more than 0.05 degrees (see section 1.4 in the Shoreline Impact Assessment of Appendix T (Coastal Processes Memorandum). This change would slightly reduce onshore sediment transport while the temporary causeway is installed. These impacts would occur shortly after the causeway is built but the beach would return to its original alignment after the causeway is removed, as evidenced from similar projects in similar environments, such as the construction of the Yarra Bay breakwater (see Appendix T (Coastal Processes Memorandum)).

The temporary causeway would also act as a barrier to the movement of sediment along the shore. This could cause a build-up of sediment to the east of the causeway, and minor erosion in the immediate vicinity to the west of the causeway. However, as the existing longshore sediment transport rates are low (see section 18.2 above), and the existing rubble beneath the viewing platform already acts as a barrier, the temporary causeway is not likely to change the longshore sediment transport to the west along Silver Beach. Once the causeway is removed, the shoreline would gradually return to its previous state.

During construction public access within the construction boundaries (particularly along the shoreline) would be restricted (see Chapter 12 (Traffic and transport) and Chapter 14 (Socioeconomic)). The impacts to shoreline processes would not affect the public's access to beaches and the foreshore outside of the construction boundary.

There are no expected to be any impacts on dune stability. At La Perouse, there are no sand dunes located in the immediate vicinity of the proposed construction activities. The sand dunes along Frenchmans Beach are too far from the construction activities to be impacted by the works.

At Kurnell, the sand dunes are protected by an existing geotextile sand-filled bag wall to the east of the existing viewing platform, and a rock wall to the west. With these existing protection measures in place the construction of the project would not dune stability at Kurnell.

Erosion and scour (propeller wash)

Despite there being a 13-month construction program, any vessels would move over the entire boundary with no set path or regular pattern. Therefore, while the propellers may be sufficiently powerful to create a wash, the disturbance would not be sufficient to create a scour hole. The amount of sediment wash from the propellers would be consistent with all other vessels that operate in Botany Bay. As described in Chapter 10 (Marine biodiversity), measures would be used to prevent the use of propellers in shallow water depths over the seagrass to avoid loss or damage.

Sediment dispersion and deposition impacts

The proposed piling work and temporary causeway would generate sediment. The amount of sediment generated would depend on the:

- Method used to construct the temporary causeway and its footprint
- Piling method and rate
- Sediment make-up and composition.

Sediment dispersion is affected by the above factors along with; water movement and energy, water depth, and whether the sediment is generated just at the seafloor or throughout the water column.

Sediment deposition is affected by the above factors along with the rate of settlement and resuspension, total length and footprint of works, and other natural processes that can affect sediment patterns.

Appendix T (Coastal Processes Memorandum) describes how these factors were used to predict sediment dispersion and deposition impacts.

Sediment dispersion (temporary causeway)

Appendix T (Coastal Processes Memorandum) predicts that around 0.2 kilograms of fine sediment would be generated every second when placing the materials in Botany Bay to build the temporary causeway. Unlike piling, the material would fall through the water column. This would affect sediment suspension and dispersion. This would create a sediment plume at the surface. The plume would be visible up to 50 metres from the work depending on the tidal, wave and current conditions.

While this is the case, the sediment concentration near the surface is only predicted to reach around 2.2 mg/L. The sediment concentrations below the surface and close to the seabed would be higher.

The concentrations below the surface would be uniform near to where the work is taking place. They would then decrease more quickly closer to the surface due to the increased water movement helping improve dispersion. Within 20 metres, the sediment concentrations are predicted to be around 20 to 22 mg/L. For reference, the EIS prepared in 2013 to support the dredging that was carried out at the Kurnell Port and Berthing Facility (URS Australia Pty Ltd, 2013) predicted that the sediment concentrations would be over 50 mg/L up to 160 metres from the site. Concentrations are predicted to decrease to below 5 mg/L around:

- 60 metres from the works three metres from the seabed
- 100 metres from the works two metres from the seabed
- 140 metres from the works one metre from the seabed
- 160 metres from the works 0.5 metres from the seabed.

The modelling predicts a worst case where it assumes sediment would be generated continuously and the plumes would build up over time to the maximum concentration above. In reality, material would be deposited by truckloads with respite periods in between. While this cannot be modelled, the sediment from one load would have time to disperse before the next load arrives. This would reduce the concentrations described above.

The maximum predicted concentrations (20 to 22 mg/L) are no higher than the concentrations that occur naturally in Botany Bay, which can reach 25 mg/L as described above. Also, as the sediment would have time to settle between truck loads, and the proposal is to only carry out the work during the day, then these concentrations would only ever be reached for a short period over a small area.

In the absence of local standards, data prepared by the United States Environmental Protection Agency (USEPA) is often used. The USEPA recommends that suspended sediment concentrations should not exceed background levels by more than 25 mg/L during any 24-hour period to prevent water quality and associated ecological impacts. Also, the average concentration over 30 days should not exceed 5 mg/L (USPEA, 2003). While the peak conditions would never be reached, the average period may be exceeded from time to time within 160 metres of the planned works.

Sediment deposition (temporary causeway)

The limited sediment dispersion and scale of works means that during construction the project would only deposit up to one millimetre of additional sediment on the seabed on average. Deposition would decrease away from the temporary causeway, with any high spots being less than 10 millimetres near where the work takes place. Natural processes would resuspend and mobilise the sediment more widely over Botany Bay, meaning that any deposition would be negligible. Also, the deposition is based on worst case assumptions adopted in the dispersion modelling.

Similar patterns of deposition and remobilisation occur over Botany Bay. The deposition from the temporary causeway would be indistinguishable from the natural processes that occur elsewhere in Botany Bay.

Sediment dispersion (piling)

The sediments would mainly suspend and disperse near the seafloor over 80 metres in Kurnell and 40 metres in La Perouse. The highest sediment concentrations would be in Kurnell near the surface. Here, the sediment concentration is predicted to be around 4mg/L within 20 metres. Beyond this distance, the sediment would have fully dispersed. These concentrations are well below the concentrations that occur naturally and the USPEA limits described above.

Sediment deposition (piling)

There is not precited to be any measurable sediment deposition from piling given the sediment concentrations are expected to be around 10 per cent of those generated from the temporary causeway.

Impacts from construction sediment dispersion and deposition on marine biodiversity is assessed in Chapter 10 (Marine biodiversity).

18.3.2 Assessment of operational impacts

Shoreline impacts

There is expected to be negligible shoreline impacts including on wave direction, dune stability and sediment movement once the wharf is open and the ferry service is operational for the following reasons.

Wharf infrastructure

The proposed wharves would be constructed as deck-on-pile structures. Therefore, the open structure would not affect tidal movement into and out of Botany Bay at a regional scale meaning the wharves would have no effect on coastal processes in the area. This is because sediment transport onshore and along the shoreline would not be impacted. Also, the structure would have no impact on the angle at which the waves would propagate near the shore.

The abutments would be installed into rock. Scour protection would be installed if required, after monitoring the actual scour during wharf operation. There would still be some minor erosion or sediment build-up as this cannot be entirely avoided even with the protection measures. The low energy environment (see section 18.2 above) means any impacts would be local to the wharves. This would have no impact on coastal processes. This would also have no impact on public access to coastal areas, beaches, headlands and foreshores. Refer to Chapter 14 (Socioeconomic) for impacts on access to coastal areas.

Propeller effects and wake

The size and speed of the ferries would be too small to cause any erosion or scour around the shoreline of Botany Bay.

While the wake effects on Botany Bay from shipping are not very well understood, it is clear that the current traffic in Botany Bay would cause most of the wake in the area. This is due to their being an average of nine shipping vessel movements per day to or from Port Botany or the Kurnell Port and Berthing Facility, and various high-powered commercial and recreational boats being used near the shoreline around Botany Bay. The operation of the ferry vessels would generate wake when berthing and de-berthing. There was concern raised during community consultation that the operation of the ferries would cause excessive wake and wave action on the nearby beaches (Frenchmans Beach, La Perouse and Silver Beach, Kurnell).

The ferry berths are located about 200 metres offshore because of the shallow nature of the nearshore environment and the need to reach deeper water for ferries to berth. The swept path for ferries to turnaround and approach the berths may require ferries to come about 100 metres from the shoreline. The chosen vessel path for arriving/departing would depend on several factors, such as current speed/direction, wind speed/direction, tide level, and wave climate.

This 100 metre distance from the shoreline is intended to provide sufficient depth and energy to disperse the wake and ensure would not impact the seabed. Ferries would be slowing as they approach the wharves, meaning their wake would be less significant than when travelling between the wharves.

Erosion and scour (propeller wash)

The movement of ferries berthing and departing at the wharves could cause scour of the seabed from the propeller wash and sediment plumes. Appendix T (Coastal Processes Memorandum) looked at a case study looking at Manly East wharves to assess the likely scour impacts from the proposed operation of the Kamay wharves. This provides real evidence of how scour is likely to occur at the proposed wharves.

Site investigations at Manly East in 2018 confirmed that the maximum disturbance from the operational Sydney Ferries is at the surface within 10 metres of the propellers. This quickly decreases, with there being virtually no effect after around 70 metres. The disturbance near the seabed, which is around 4.5 metres below the surface at Manly East is between around 20 to 40 metres behind the propellers, with limited effects after around 70 metres. It was predicted that the wash from ferries was sufficient to create a scour hole of around one to two metres, which over time was moving towards the land. This appears to be a slow process as the propeller wash only occurs in short bursts (eg when a ferry arrives and leaves).

The conditions in Botany Bay are not dissimilar to those at Manly East. The ferries at La Perouse and Kurnell would berth in water about 3.5 to 4.5 metres deep. It is therefore likely that the propeller wash from the ferries (and to a lesser extent the commercial vessels and recreational boats) would create a scour hole. The extent of the hole would depend on the final ferry specifications, the frequency of the ferry service and the local conditions.

Due to the shallow water depths in Botany Bay scour is unavoidable. The wharves are designed at a length to ensure a balance between the necessary depth to provide a safe berth for ferry vessels and avoiding excessive length into Botany Bay.

While the ferries would travel between La Perouse and Kurnell along a specific path, the water depth means that no scour hole or track would be formed across Botany Bay. This is supported by the fact that the commercial traffic that uses Botany Bay is notably larger and it has not created a scour hole along the shipping channel, appreciating its increased depths.

As the propeller wash creates the scour hole, there would be sediment dispersion causing small sediment plumes around the ferry berths. This sediment would disperse and settle quicky to the seabed. The sediment plume would reduce over time as the scour hole is created. The dispersion and deposition of the sediment would not cause a measurable impact on the water column or seabed beyond what already exists from the natural coastal processes in Botany Bay.

Wave overtopping and coastal inundation

The wharves at La Perouse and Kurnell have been designed to avoid coastal inundation and wave overtopping for typical coastal conditions based on the assessment in the Coastal Modelling Report of Appendix T (Coastal Processes Memorandum). This would ensure safe public access for wharf users. The wharves are designed to accommodate a ferry service in all-weather except extreme storm events; namely those that would only statistically occur once a year or less. During these storms, the ferry service would stop. This is standard practice and would ensure that only safe public access is provided.

18.4 Environmental management measures

The wharves have been designed to avoid impacts on coastal processes and to withstand storm events. With any modelling predictions, they include various limitations and assumptions. Therefore, these would need validating during construction through monitoring. Also, it is not practical to include a silt curtain around the equipment for operational and safety reasons when installing and removing the temporary causeway. This is another reason why monitoring would be needed as it could allow adjustments to be made while carrying out the work to reduce sediment disturbance in line with Australian and international standards.

The following environmental management measures are proposed to further avoid and mitigate impacts to coastal processes from the construction and operation of the project.

Table 18-3: Environmental management measures for coastal processes

Impact	ID	Environmental management measure	Responsibility	Timing
Wave climate and the increased risk of erosion and reduced longshore drift west of the temporary causeway at Kurnell.	CP1	If a temporary causeway is constructed at Kurnell, temporary causeway armour (ie sandbags, rock) will be selected to account for and withstand the local wave climate.	Contractor	Construction

Impact	ID	Environmental management measure	Responsibility	Timing
Turbidity impacts for the temporary causeway	CP2	If construction of the temporary causeway at Kurnell is to occur, a turbidity monitoring specification will be developed and implemented to achieve the limits in the Turbidity Water Quality Standards Criteria Summaries; A Compilation of State/Federal Criteria (USEPA, 1988) and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1 (ANZECC& ARMCANZ, 2000). Should the monitoring record an exceedance, measures such as stopping work and rectifying the exceedances will be carried out.	Contractor	Pre-construction and construction
Scour of the seabed	CP3	Operational restrictions to control approaching, berthing and departing from the wharves will be enforced for all vessels using the wharves to limit scour. These measures will be agreed in consultation with Port Authority NSW (including Harbour Master).	Transport for NSW	Operation