Environmental Study for Proposed Land Reclamation at Keppel and Tanjong Pagar Terminals

Executive Summary

Housing & Development Board

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March 2026

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Prepared for Housing & Development Board

Project manager	Matthew Jury
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DHI Water & Environment (S) Pte Ltd • 2 Venture Drive • #18-18 Vision Exchange • Singapore• 608526
Telephone: +65 67776330 • Telefax: +65 67773537 • dhi@dhi.com.sg•

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The Housing and Development Board (HDB) intends to undertake land reclamation at the southern region of Singapore. The City Terminals—Keppel, Tanjong Pagar and Brani—are expected to be relocated to Tuas Port by end of 2027 and the proposed land reclamation will be carried out at the vacated Keppel and Tanjong Pagar terminals connecting the area with Marina Bay to support the area's overall redevelopment and coastal protection plans. This Project will be part of the Greater Southern Waterfront which extends from Pasir Panjang to Marina East which will be transformed for urban living along the southern coast.

The Project will comprise the construction of seawall (sloping seawall including revetments) and other marine and drainage facilities, including but not limited to soil improvement works, dredging of seabed, infilling of sand and/or other reclamation fill materials such as land-based excavated earth materials generated from the construction industry or dredged materials.

Construction activities for the Project are not confirmed at this stage but are likely to include sand key dredging and infilling, sand bund construction, seawall removal, demolition of existing piles and pile deck, and other drainage facilities within the Project site. As the construction methodology has not been firmed up, the worst-case scenarios in terms of potential impacts were identified and assessed within the study.

DHI used baseline surveys and available secondary data to establish the baseline conditions in the project area. The MIKE by DHI suite of fully calibrated and validated numerical models as well as expert judgement were used to quantify the potential impacts associated with the proposed development.

The following changes and impacts were predicted for the construction (process) phase:

- **Current**: Some changes to the existing eddies and shear zones in the project vicinity are predicted at the entrance to Tanjong Pagar Terminal (TPT), Keppel Terminal (KT), Brani Terminal (BT), Marina Bay Cruise Centre Singapore (MBCCS) and within the Eastern Anchorage (AEW). Small variations of around ±0.3 m/s current speed are observed in the vicinity of project sites as construction progresses, with no significant impact on current thresholds or severity. Slackwater duration shows slight to minor localised changes, but marine operations remain unaffected. Observations are consistent across both Northeast (NE) and Southwest (SW) monsoons. No other significant changes in the flow field outside the project area are observed.

- **Waves**: Reduced mean and 95th percentile significant wave height within the project work area and Keppel Harbour are predicted due to the sheltering effect of the Phase 1 and Phase 2 bunds, which shield the area from the prevailing waves coming from the east and southeast. No change in wave conditions in the surrounding anchorage areas.

- **Sediment plume**: Increased suspended sediments (exceedance of 5 mg/L of 5% – 60% of the time) and sedimentation (1.7–35 mm/14 days) is predicted within the project site and nearby areas, including MBCCS (exceedance of 5 mg/L for up to 20% of the time), Keppel Harbour (exceedance of 5 mg/L for up to 60% of the time) and near the eastern and northern shore of Sentosa (exceedance of 5 mg/L for up to 5% of the time). Increased sedimentation of up to 35 mm/14 days is expected at MBCCS and Keppel Harbour. Annual sedimentation is predicted to be generally confined within the project area.

- **Morphology**: Reduced current flow leads to a decrease in suspended sediment concentration (SSC) by 2–6 mg/L around the project area, with smaller changes during the inter-monsoon. Exceedances of 5 mg/L are reduced near Phase 1, while changes in higher exceedances (10–25 mg/L) remain minimal. Sedimentation decreases by up to 17.5 mm/14 days to the east of Phase 1 and increases similarly to the west, with changes of ±7 mm observed in AEW and Marina East Staging Gound (MESG). Erosion changes are predicted, with changes of no more than ±7 mm over 14 days and annual changes within ±0.15 m for both sedimentation and erosion. These results reflect natural processes, excluding vessel impacts like propeller wash.

- **Water quality**: Small localised nutrient retention within the project construction area (north of Phase 1) is observed but no significant changes and no change in compliance with ASEAN Marine Water Quality Criteria (MWQC) is observed beyond construction area. No increase in risk of algae bloom is expected.

- **Air quality**: In general, contributions of up to 25% of the Singapore Ambient Air Quality Targets (SAAQTs) are predicted at sensitive receptors beyond the project boundary NO_x and NO_2 while contributions of up to 10% of the SAAQTs are anticipated for other criteria pollutants at receptors located beyond the project boundary during the construction phase.

- **Airborne noise**: Minimal exceedances of the National Environment Agency (NEA) limits are predicted at a simulated cruise ship receptor docked at MBCCS during Phase 1 and Phase 2 construction works. No exceedances are predicted for other Public Amenity receptors, Avifauna and Terrestrial Ecology and Biodiversity receptors.

- **Underwater noise**: The effect on marine fauna including fish, cetaceans and smooth-coated otters in the vicinity of the project due to the noise generated from the construction works is predicted to be localised to the immediate work area.

- **Waste and hazardous materials management**: The potential for an uncontrolled release of oil from a collision at sea requires careful management and mitigation in order to avoid impacts on nearby seawater intakes, marine ecology, recreational and aquaculture receptors. The risk of oil spills can be minimised through the application of navigational controls as part of a Formal Safety Assessment (FSA) and a Major Accident Prevention Plan (MAPP); and in the unlikely event that they occur, they will be managed by using dedicated spill response and emergency response procedures.

- **Maritime facilities**: Slight Positive Impact to Slight Negative Impact on navigation, anchorage and marine jetties are generally predicted in the study area. Minor Negative Impact from increased sedimentation is predicted at Eastern Keppel Harbour due to its close proximity to the Project site.

- **Marine infrastructure**: No Impact on submarine cables and pipelines in terms of changes in erosion rate due to sediment transport changes. Slight Negative Impact on the rock revetments in terms of changes in erosion rate due to medium-term sediment transport changes are expected. No Impact on marine intakes in terms of suspended sediment and water quality changes or the change in risk of oil spills due to vessel collisions.

- **Drainage and flooding**: All drainages in the study area are assessed to have no change in sedimentation and water level due to construction works.

- **Aquaculture**: No Impacts are predicted to the nearby aquaculture facility and Marine Aquaculture Centre intake as a result of current changes, increased suspended sediments, water quality changes, bioaccumulation, algal cyst resuspension, pollutant release or the change in risk of oil spills due to vessel collisions.

- **Marine ecology and biodiversity**: Increased SSC and sedimentation during construction are predicted to have up to a Minor Negative Impact on coral and seagrass at the nearby Sentosa shoreline and Marina South due to construction works and sediment transport, with Slight Negative or No Impact predicted at other receptors. Slight Negative Impacts are associated with construction disturbances (underwater noise and vibration, physical disturbances and light pollution) and deterioration of environmental quality during the construction, while the change in risk of oil spills due to vessel collisions is assessed as a No Impact through suitable implementation of mitigating measures. No other impacts are predicted for the relevant receptors.

- **Terrestrial ecology and biodiversity**: The predicted changes—such as the clearing of terrestrial flora, air pollution from dust, and airborne noise pollution—are expected to have a Slight Negative Impact on terrestrial species and habitats.

- **Social-recreational**: Potential impacts on social and recreational receptors in the study area may arise from changes in currents and waves, public health considerations, the visual aesthetic quality of the water, and alterations to the landscape resulting from the construction activities. It has been assessed that the construction works result in a Minor negative impact at MBCCS and No impact to Slight negative Impact at other receptors in terms of visual disamenity and visual aesthetic of the waters due to sediment plume, depending on the location of the receptors in relation to the source. In terms of air quality, No Impact to Slight Negative Impact is predicted at the sensitive receptors, based on the project contribution relative to SAAQTs. Noise from the reclamation works have potential to cause Slight negative Impact on the recreational receptors, while the change in risk of oil spills due to vessel collisions is assessed as a No Impact through suitable implementation of mitigating measures. No changes are predicted in current speed and significant wave height at the identified receptors.

- **Cross-border**: No cross-border impacts are identified.

During the post-construction (project) phase, the following changes and impacts were predicted:

- **Current**: Some changes to the existing eddies and shear zones in the project vicinity are predicted at the entrance to TPT, KT, BT, MBCCS and within AEW. Small variations of around ±0.3 m/s current speed are observed in the vicinity of project sites as construction progresses, with no significant impact on current thresholds or severity. Slackwater duration shows slight to minor localised changes, but marine operations remain unaffected. Observations are consistent across both NE and SW monsoons. No other significant changes in the flow field outside the project area are observed.

- **Waves**: Reduced mean and 95th percentile significant wave height within the project work area and Keppel Harbour due to the sheltering effect of the Final Reclamation Profile, which shields the area from the prevailing waves coming from the east and southeast. No change in wave conditions in the surrounding anchorage areas.

- **Morphology**: Reduced current flow leads to a decrease in SSC by 2–6 mg/L around the project area, with smaller changes during the inter-monsoon. Exceedances of 5 mg/L are reduced near Phase 1, while changes in higher exceedances (10–25 mg/L) remain minimal. Sedimentation decreases by up to 17.5 mm to the east of Phase 1 and increases similarly to the west, with changes of ±7 mm observed in AEW and MESG. An increase in erosion of up to 17.5 mm/14 days is predicted near Selat Sengkir entrance, in AEW to the east and west of the tip of current training wall, as well as to the west of Marina Barrage, with annual changes within ±0.15 m for both sedimentation and erosion. These results reflect natural processes, excluding vessel impacts like propeller wash.

- **Water quality**: Minor salinity fluctuation in this area is predicted (±0.3 PSU) due to some trapping of the freshwater discharge from Marina Barrage. No significant changes in chlorophyll-a and no changes in risk of algae bloom are expected.
- **Air quality**: Contributions of less than 5% of the SAAQTs are predicted at sensitive receptors beyond the project boundary for annual average and 24-hour average PM_{10} and $PM_{2.5}$ concentrations with the implementation of suitable surface-protection measures over exposed reclaimed land.
- **Maritime facilities**: Slight Negative Impact to Slight Positive Impact due to current is predicted at Eastern Anchorage and Eastern Keppel Harbour. Minor Negative Impact to Minor Positive Impact from sedimentation is predicted at Eastern Keppel Harbour. Slight Positive Impact on MBCCS berths are predicted. No Impact on other navigation, anchorage and marine jetties are predicted in the study area.
- **Marine infrastructure**: No Impact on submarine cables and pipelines in terms of changes in erosion rate due to sediment transport changes. Slight Negative Impact on rock revetments are predicted, due to the increased erosion rates associated with sediment transport changes. No Impact on marine intakes in terms of suspended sediment and water quality changes.
- **Drainage and flooding**: All drainages in the study area are assessed to have no change in sedimentation and water level due to the Final Reclamation Profile.
- **Aquaculture**: No Impacts are predicted on aquaculture receptors (aquaculture farm and fish farm intake) as a result of current changes, increased suspended sediments or water quality changes.
- **Marine ecology and biodiversity**: The main long-term impacts to marine ecology are related to the direct impact of the project, given that habitats including coral habitats, macrobenthos and filter feeders on the existing concrete piles, within the physical footprint of the development will be permanently removed. The overall impact is assessed as a Moderate Negative Impact for corals and a Slight Negative Impact for the filter feeders and soft seabed habitat in terms of the lost habitat, and a Minor Positive Impact in terms of the potential new habitat created along the sloped rock revetment of the new reclamation. Minor Negative Impacts from suspended sediments are predicted for corals at Sentosa and Marina South, and Slight Negative Impacts for seagrass at Sentosa and Marina East. Additionally, localised Slight Negative Impact for corals at the eastern side of Sentosa, Marina South and Marina East due to sedimentation caused by localised seabed redistribution are also predicted. However, these localised effects are expected to be temporary as an initial seabed response to the predicted current changes in these areas, and are expected to reduce over time as a new equilibrium is reached. Note also that these changes are expected to start once Phase 1 of the reclamation is completed, so the model results for the Final profile are considered to be conservative. No Impacts are predicted to other marine habitats.
- **Social-recreational**: Potential impacts on social and recreational receptors in the study area may arise from changes in currents and waves, public health considerations, the visual aesthetic quality of the water, and alterations to the landscape resulting from the introduction of the Final Reclamation Profile. However, no change is assessed at the identified receptors.
- **Cross-border**: No cross-border impacts are identified.

The Environmental Study has recommended the requirements for an Environmental Monitoring and Management Plan (EMMP) for the project, as well as providing comprehensive mitigation measures within each of the relevant assessments. Overall, it is considered the project does not pose any significant negative or unacceptable impacts given the suitable application of mitigation, management, and recommendations provided in the Environmental Study.