Appendix 8: Summary of Construction Methodologies

The following sections provide high level overviews of how each of the major construction activities will be completed, maps and drawings are provided for illustrative purposes and are subject to alteration following final design and planning. MCD uses a system of Construction Execution Procedures (CEPs) for each major activity and these methodologies will be fully documented in a step-by-step process for use by the crew undertaking the works.

APP 8.1 SITE ESTABLISHMENT

Site establishment will cover the activities needed to allow temporary accommodation to be provided all personnel involved with the delivery of the New Bridgewater bridge. Three office compounds are identified for the project as illustrated below.

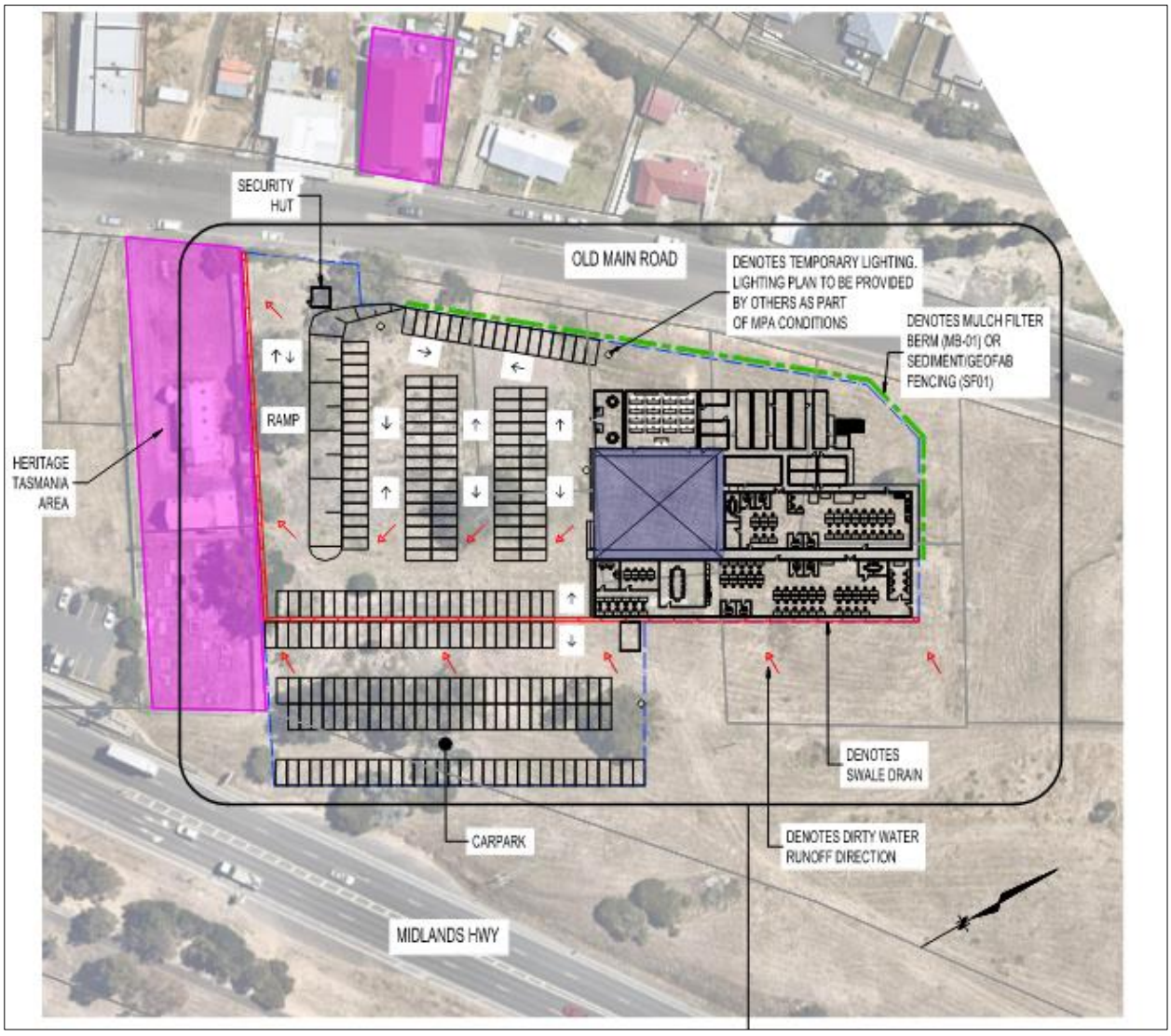


Figure 10 - Main Site Office and Northern Civil Construction Facility

Main site office is located along Old Main Road Bridgewater. It will support the majority of the project staff including State and Independent Verifier Representatives and also the northern civil construction team.

Figure 11 - Northern Satellite Facility

The northern satellite office is located along Nielsen Esplanade Bridgewater. It will support the northern structures construction team and provide accommodation to the supporting staff for these activities.

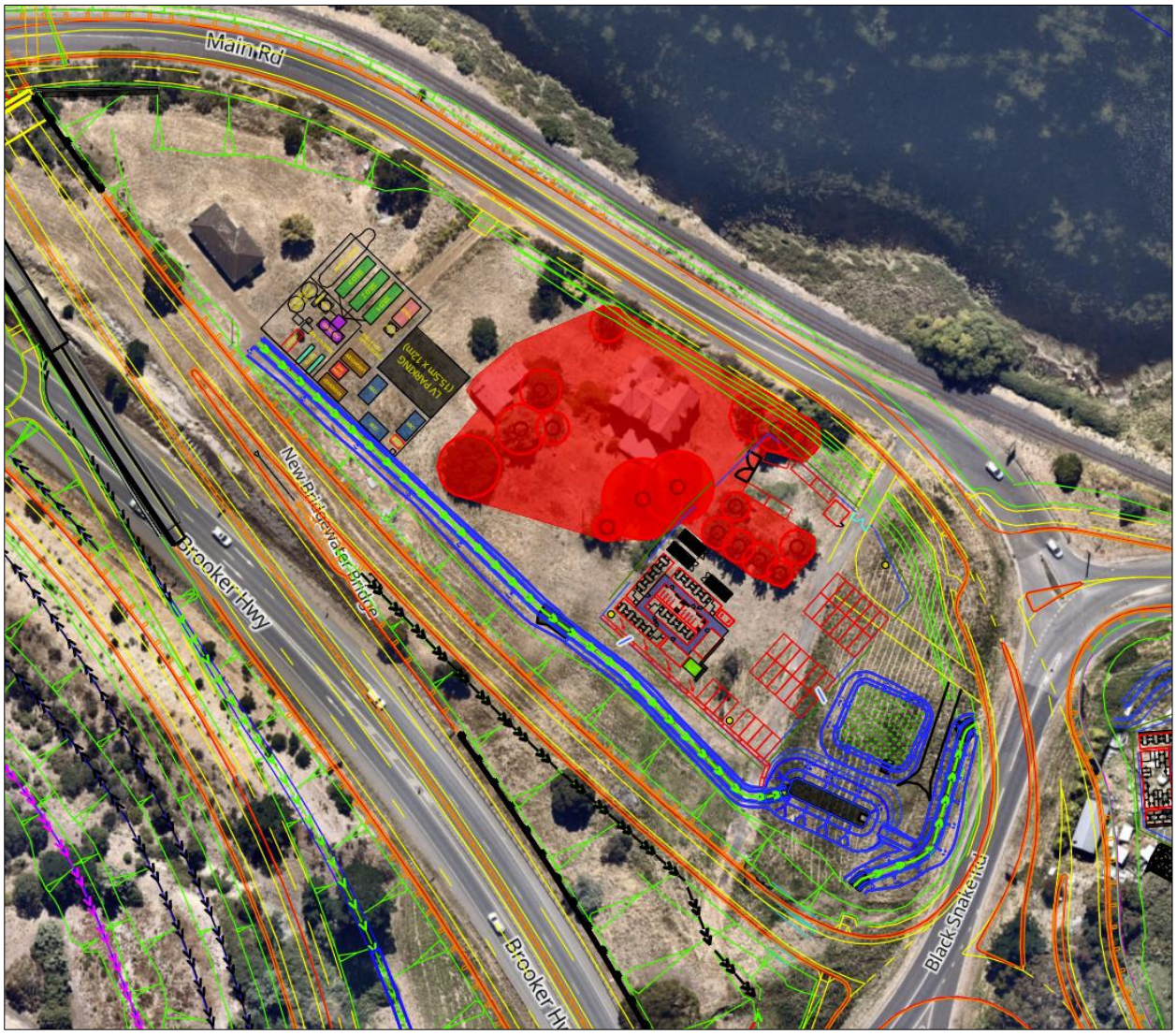


Figure 12 - Southern Office Facility

The southern satellite office is located along Main Road Granton. It will support the southern civil and structures construction team and provide accommodation to the supporting staff for these activities.

Each of the compound will provide office facilities, crib and lunchrooms, toilets, changing rooms with shower facilities, meeting and quiet rooms, emergency muster locations, car parks and storage facilities. Where deemed necessarily screening will be provided along fence lines.

The detailed CEP will include:

- Survey activities.
- Permits needed.
- Temporary works process to be followed.
- Engagement with Councils and service providers for provision of temporary water, power, sewage, and Internet connections.
- Engagement with consultants for any clearing works (as needed).
- Earthworks needed to construct the hardstand.
- General erection of the units and commissioning.

- Connection to utilities.
- Fencing and provision of security and commissioning.

High risk safety and environmental activities will be identified and addressed via a Construction Risk Assessment Workshops (CRAWs). Controls identified will be implemented in working SWMS that will be used in the field.

APP 8.2 SOUTHERN LAND RECLAMATION

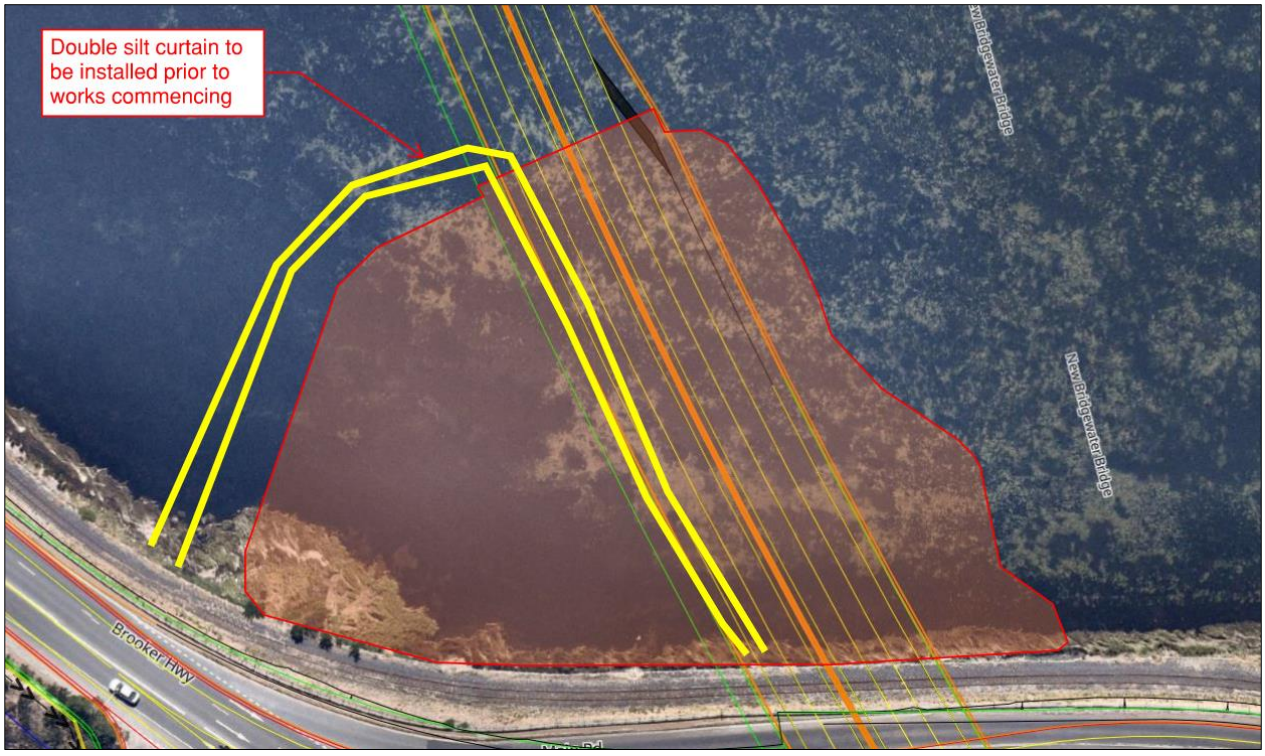
The land reclamation works is in the vicinity of the south abutment of the bridge span. It is intended to provide access, hardstand and storage areas for heavy construction equipment needed for the bridge works. Temporary and permanent design engineers will develop the design in consultation with the construction team. Specialist construction subcontractors will be engaged for the construction of the following activities:

- Civil and earthworks for the construction of the access roads, conventional land reclamation area, scour protection, rolling platform and capping working platform.
- Mass soil mixing (MSM) will involve setting up of a grout batch plant, mobilisation of 50t excavators with a mixing attachment, mixing the estuarine mud and cement, management and control of sediments into the environment.

High risk safety and environmental activities will be identified and addressed via a Construction Risk Assessment Workshops (CRAWs). Controls identified will be implemented in working SWMS that will be used in the field.

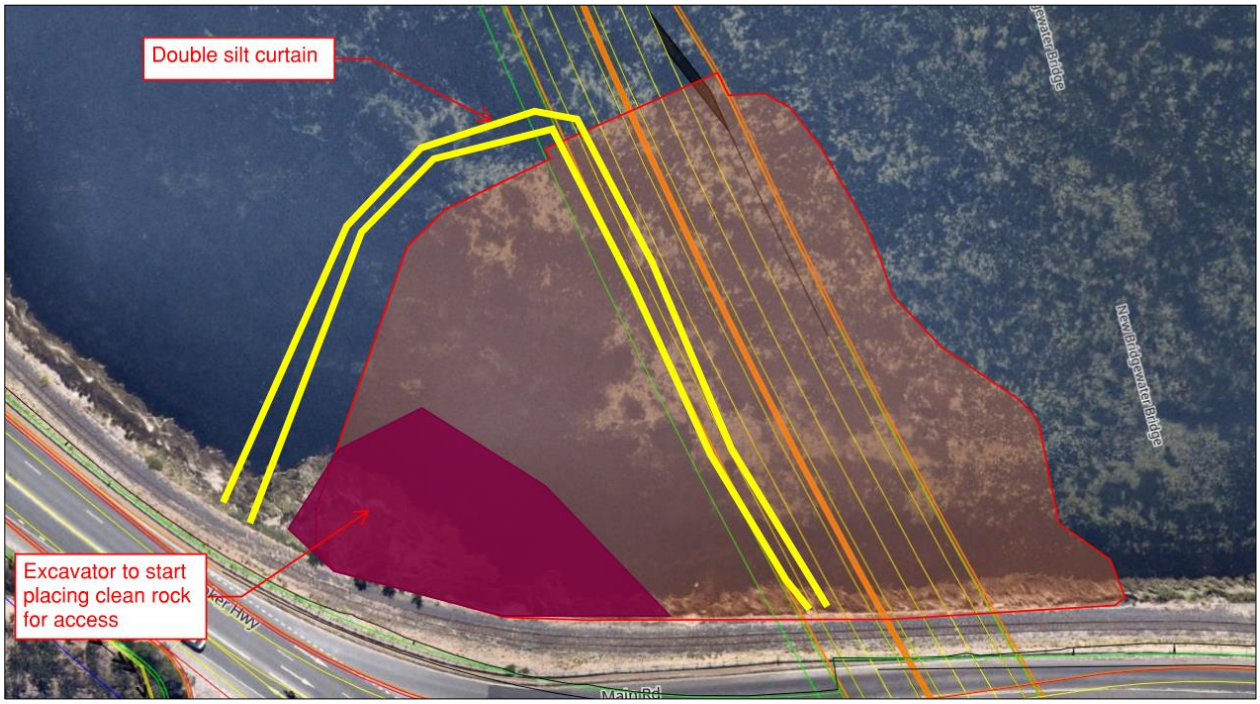
The follow provides an overall summary of the stages associated with the construction of the land reclamation area.

Stage 1: Provision of Environmental Control



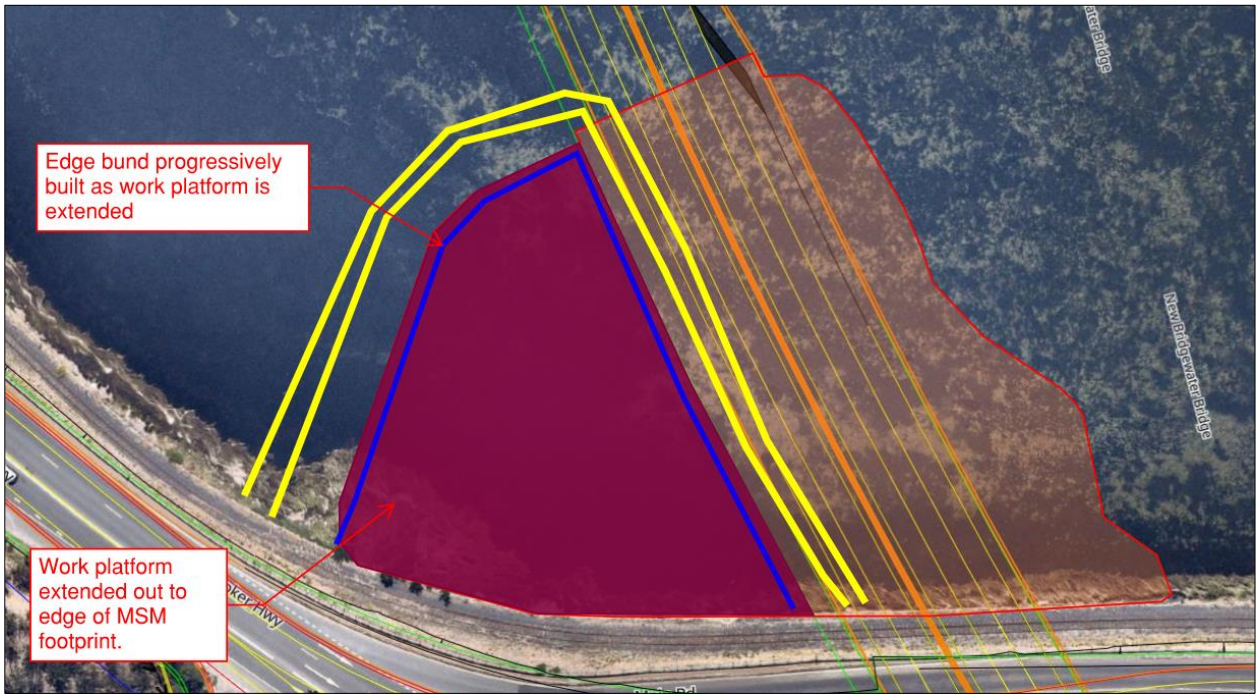
A silt curtain will be secured around the boundary of the Southern foreshore.

Stage 2: Provision of preliminary access into site



A preliminary access will be provided using clean rock fill material to allow safe access into the reclamation area away from general traffic. Controlled placement method will be using excavator is preferred to limit disturbance of sediments into the marine environment. This area is chosen as preferred as it provides a firm working platform for placement of clean rocks and fill to start advancing the reclamation area.

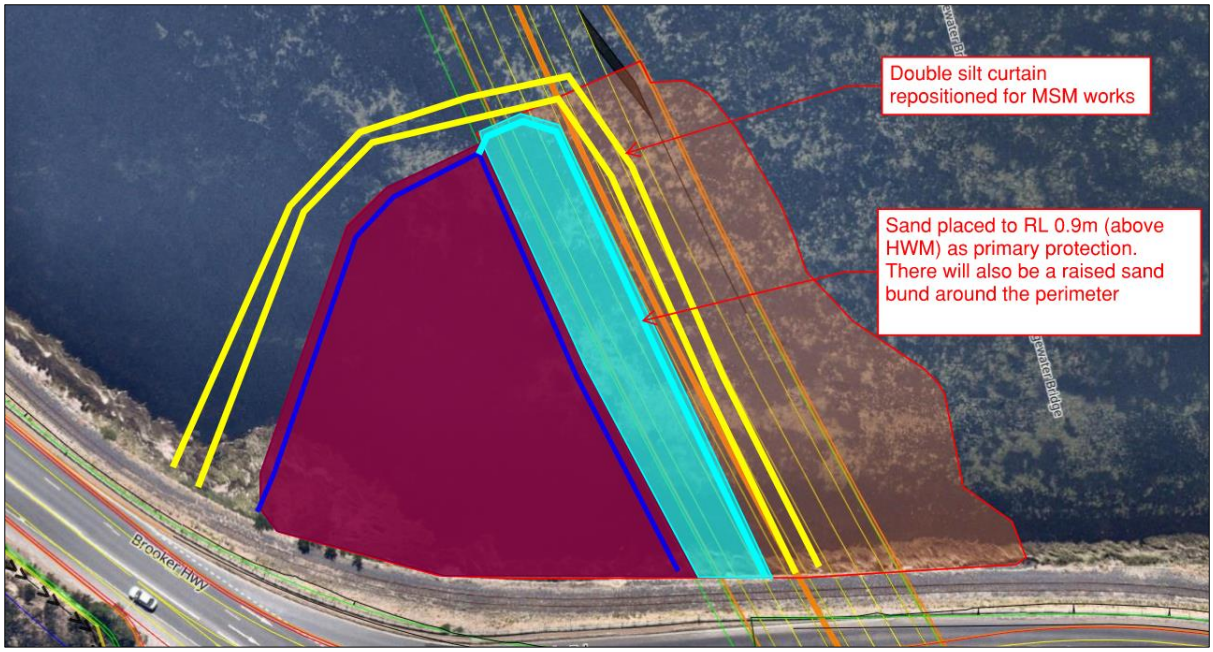
Stage 3: Construction of conventional land reclamation platform



This is a platform consist of control placement of clean rock and fill material into the estuarine mud using excavators. This platform will be progressed slowly towards the MSM boundary. High strength geofabric

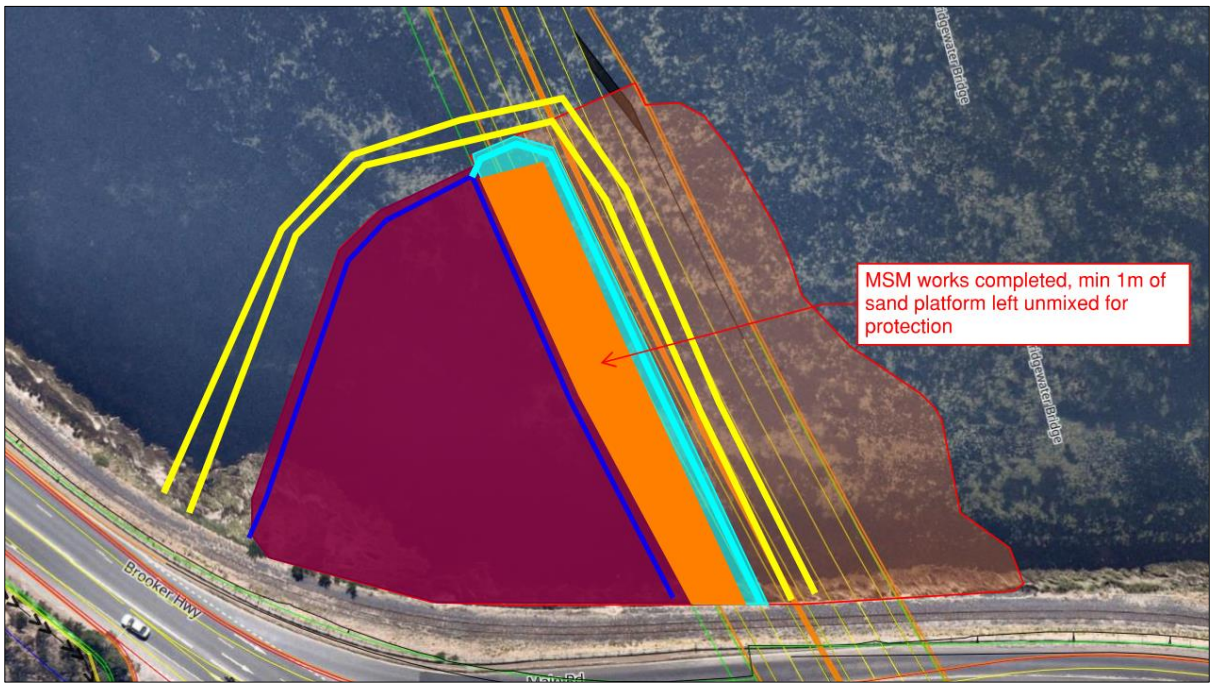
material will be utilised along with terra mesh or similar for scour protection. A temporary edge bund to be provided to control water within the platform.

Stage 4: Provision of sand mixing platform



A clean sand mixing platform including a protective berm is being considered at the interface of the conventional land reclamation and the mass soil mixing. The purpose of the platform is to provide the initial material to start the mass soil mixing. A protective berm sitting slighting higher than the high-water mark will be constructed using similar sand product. The purpose is to control contain the cement and estuarine mud from dispersing into the marine environment. Controlled placement of the sand material into the mud is intended here using long reach excavator.

Stage 5: Mass Soil Mixing



A specialised experienced mass soil mixing is engaged (Figure 13), responsible to perform the mass soil mixing scope. This involves mixing cement with the estuarine mud and sand material to achieve a high strength platform. Mixing equipment will stay away from the edge of the platform to contain the disturbed cement and mud slurry.

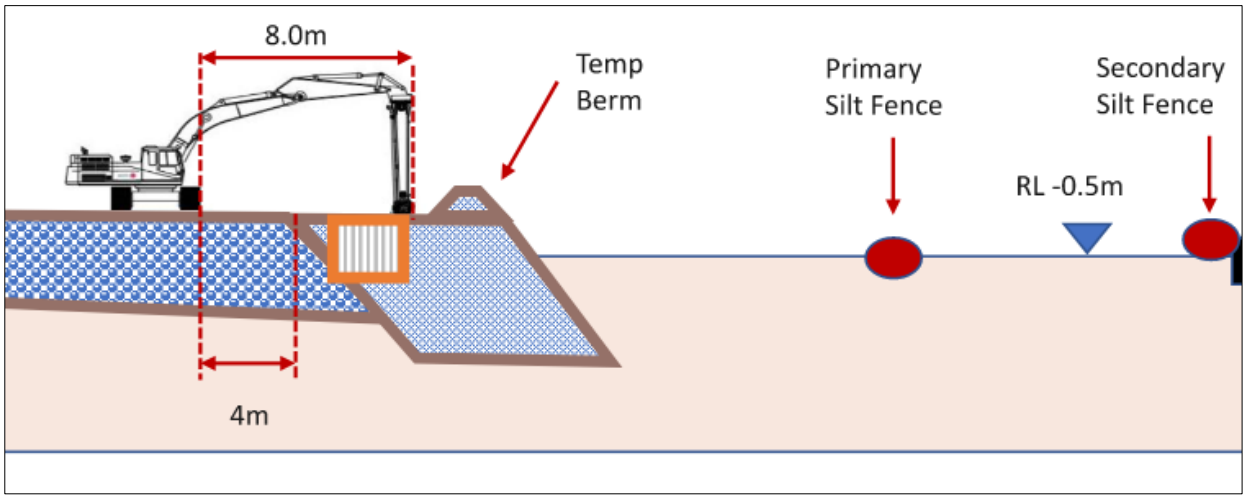
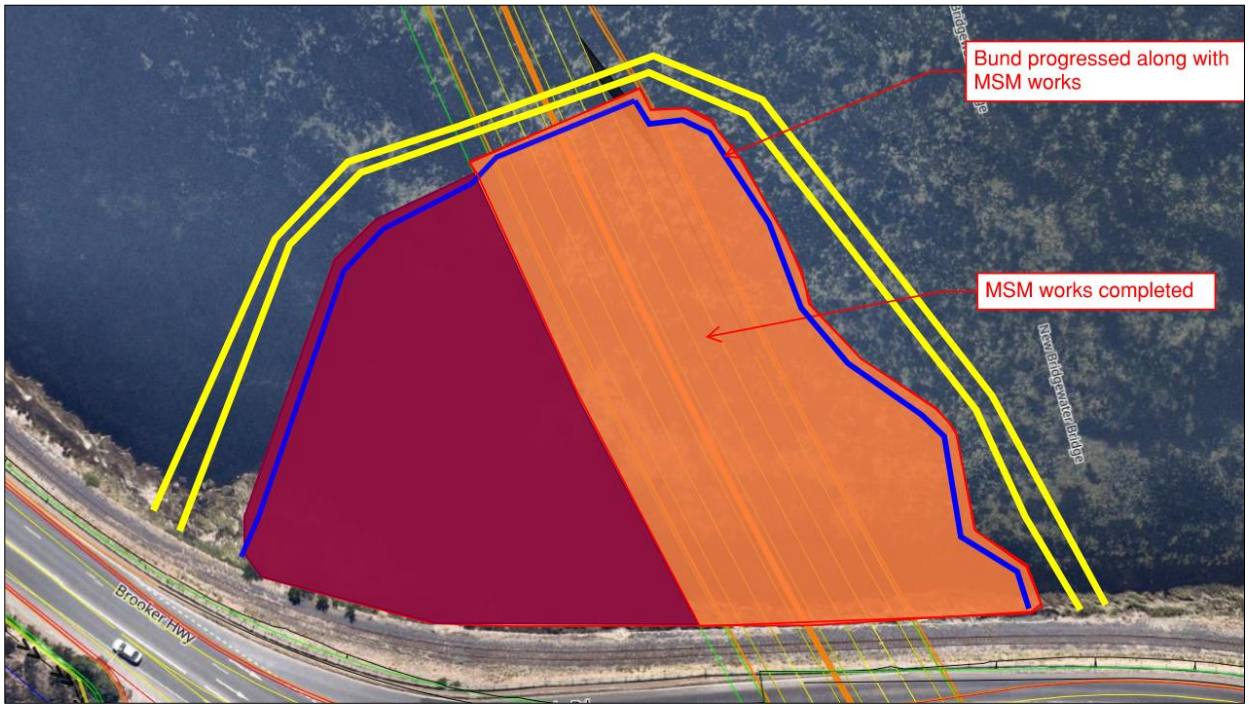


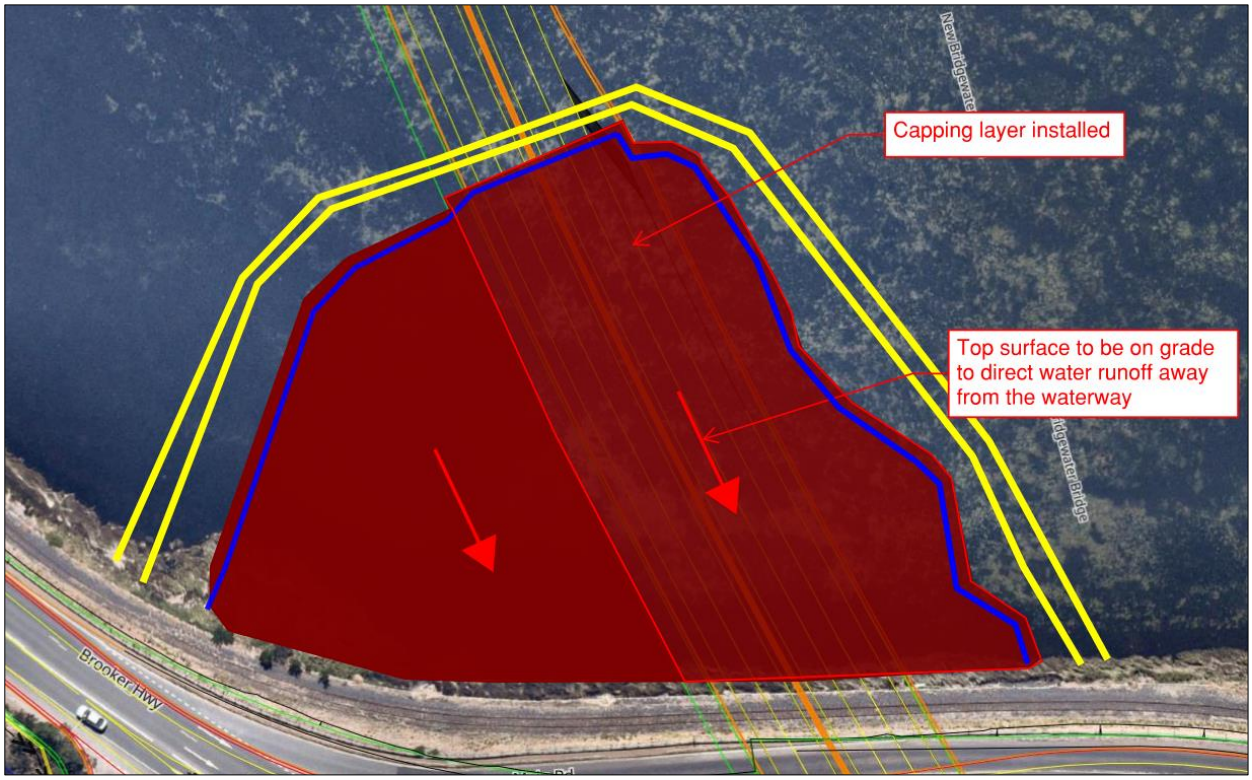
Figure 13 - Section View of Initial MSM

Stage 6: Completion of Mass Soil Mixing



Soil mixing will continue in the same staged manner. The work front will advance towards the eastern boundary with the mixing equipment carefully mixing cement with the estuarine mud. After the initial stage sand will be added as needed to the mixing material. Containment of the mix will be provided as needed by advancing the berm with a long reach excavator using sand material until the eastern limit of the MSM is reached.

Stage 7: Construction of Capping Platform



Structural fill material will be placed with an excavator/bobcat to prevent material from escaping into the marine environment. Area will be capped with road base or type A material or similar and bunded to control water run-off and fines leaving and or penetrating the platform. Falls will be provided to prevent surface run-off into the marine environment.

APP 8.3 NORTHERN RECLAMATION AREA

The figure below shows the northern land reclamation indicatively shown over an aerial image captured in February 2022.

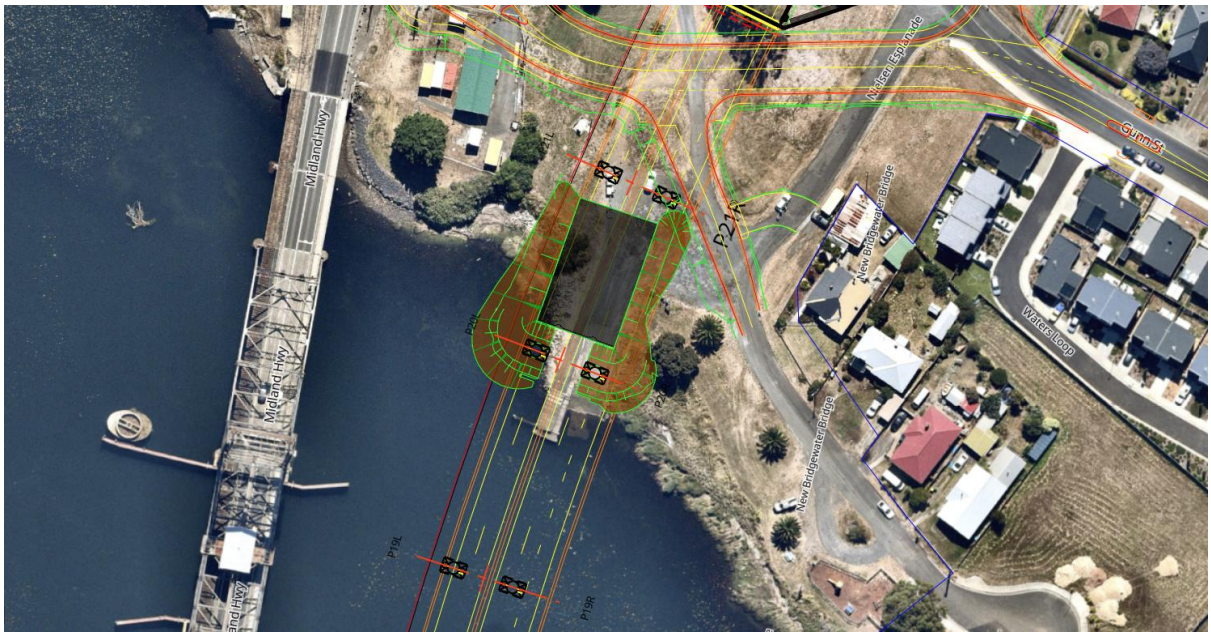


Figure 14 – Extent of Northern Land Reclamation

The key dimensions for the northern land reclamation are:

- Length along bridge centreline – 45m.
- Maximum width – 45m
- Gross area – 1,616 m^2
- Total area of land reclaimed above the high water mark is 614 m^2 (this is less than the maximum 2,500 m^2 allowed by Permit Condition 6.13).

The construction sequence intended is as described below and illustrated in Figure 155.

- Stage 1: Excavate soft topsoil material from the existing surface transport off site or provide temporary stockpile on site. Silt fencing will be provided around the stockpile if retained on site.
- Stage 2: Lay geofabric material on the prepared surface down to the HAT using excavator
- Stage 3: Place clean rock or granular fill material on the geotextile material. At the batter edge provide rock bags or clean scour rocks to prevent erosion of the fines and sediment. For placement of the material this will be controlled gradually using excavator towards the existing surface rather than dumping to prevent disturbance of fines into the marine environment. Rock bags will consist of clean rock and placed using excavator or franna.
- Stage 4: Continue filling up to meet the existing natural surface in the area with layers for geofabric, clean rock or granular fill and rock bags/scour rocks at the exposed edges
- Stage 5: Cap the surface with clean road base material or type A. Provide fall towards the existing natural surface away from the water.

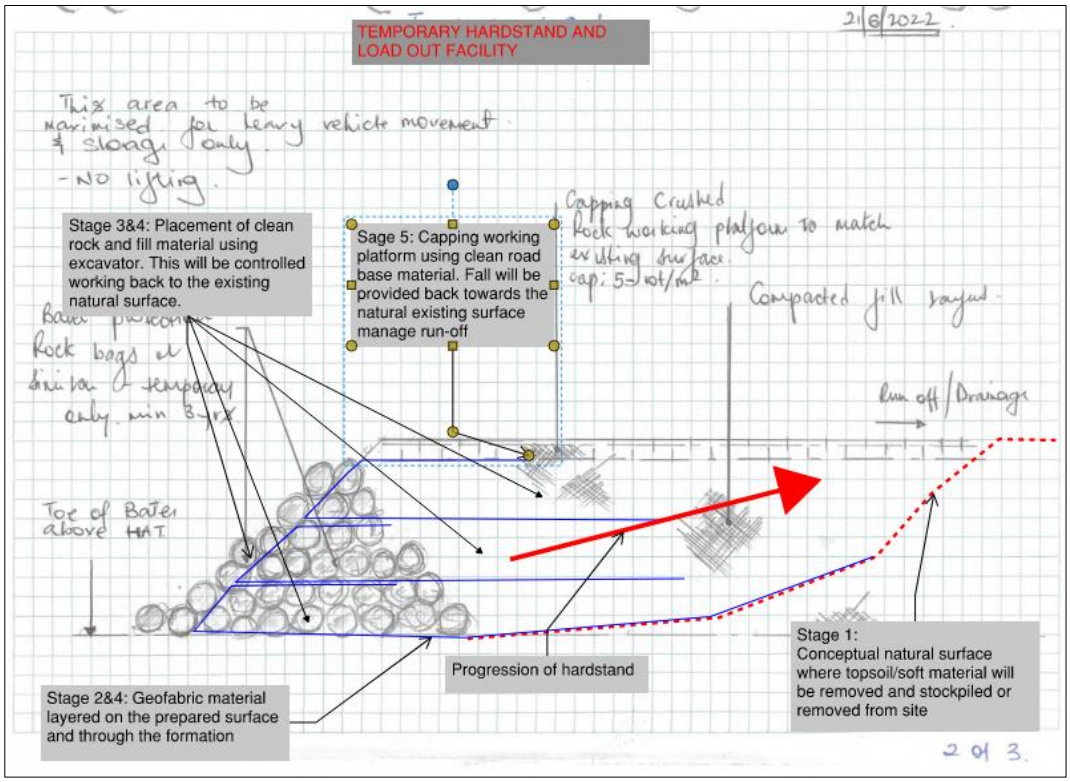


Figure 15 - Construction Staging Northern Load Out Facility

Note the scour rock and geofabric formation will extend through to the behind the land pier of the temporary bridge.

For removal of the platform and excavator will be used from the existing surface to remove all construction material and place in truck and trailers and taken offsite to a licenced facility. The geofabric material will be removed and placed in bins. Rock bags will be carefully lifted out and placed in awaiting truck and trailers and taken offsite to a licenced facility.

APP 8.4 WORKS ON THE EXISTING CAUSEWAY

No permanent works are currently proposed on the existing causeway.

APP 8.5 BRIDGE WORKS (WITHIN THE DERWENT RIVER)

Temporary Bridge

A temporary bridge structure will be constructed from the North shore of the River Derwent adjacent to the existing Bridgewater Bridge to provide construction access for the project. The utilisation of temporary bridge on the northern deeper side of the river across the navigational channel will ensure permanent safe access during construction and minimise the impact on the navigational channel. The temporary bridge will be constructed end over end with 12m spans commencing from the existing boat ramp to the proposed Pier 14 at Chainage 2098.5.

Construction of the temporary bridge will be built out from land with all materials received direct to the work front on truck. As each span is constructed, precast deck planks will be installed to enable the crane to walk forward to construct the next span. A support barge will be moved forward as the works progress containing piling gate, crib rooms, generators & ancillary equipment to assist the works. Spill kits and spill booms will

be located on support barge and adjacent to crane on bridge deck for quick response if required. All refuelling works will be conducted from the temporary bridge deck either via fuel cell or fuel truck, a contained bund will be put under refuelling area to contain any drips/leaks.

The construction method for the temporary bridge will be as follows:

- Piles received on truck and unloaded by crawler crane.
- Pile lifted into barge mounted piling gate for holding in position whilst driving.
- Crane unhook from pile and lift on vibratory driver for initially setting pile.
- Crane remove vibratory driver and lift hydraulic impact hammer HHX10 or equivalent and drive pile to refusal/set.
- Excess pile will be cut to final height from barge platform and removed from pile top with crane.
- Adjacent pile at span then installed via same process.
- Steel headstock received on truck and lifted into position onto pile tops.
- Bracing connected to previous headstock group.
- Longitudinal girders received on truck and placed onto headstocks and bolted in place.
- Precast deck planks received on truck and placed onto girders.
- Crane walk forward to complete next deck span.

Once constructed, the temporary bridge will be 10m wide to provide crane working bays alongside the main access at every pier location (Figure 16). The bays provide crane working platforms and storage space for plant and material necessary for the works without blocking access along the bridge.

In order to minimise impact to river traffic the temporary bridge vertical navigational clearance will be equal or larger than the existing bridge and will incorporate a ‘Lift Span’ at the navigation channel to provide scheduled passage coordinated with operation of existing bridge lift span.

Figure 16 - Extent of Temporary Bridge

Temporary Barge Bridge

Along the shallow section of the River Derwent, the temporary bridge will transition to barge platforms embedded within the mud flats to connect the South shore (Figure 17). The barge platforms comprise of 12 interlinked barges, 18.3m wide and either 54m or 45m in length, each barge length has been designed to suit the permanent bridge spans with a ramp spanning between adjacent barges. An engineering assessment has been conducted for the barges to be flooded with water to ballast down and remain embedded within the mud-flats to create a stable working platform for all construction and crane loads. In addition to the ballast, each barge will be anchored in place using spud piles driven down into the sediment.

Positioning of the barges will be done on a high tide with shallow draft tugs to minimise the disturbance of the mud flats. Each barge will be accurately surveyed prior to setting in final position. Once barges are in position, they will be flooded with water to embed them within the mud flats. A water supply point will be installed adjacent to the Southern Reclamation from water main.

Link bridges will be installed to provide access from the temporary bridge and between barges to allow passage and movement of plant and materials to the work fronts.

Figure 17 - Alignment of Barge Platforms

Piling

The proposed Bridgewater Bridge pile foundations comprise of a total 42 Piers and 2 main abutments either side of the Derwent River. Each Pier and abutment consist of two large diameter bored piles socketed into seabed. The bored piles comprise of a 2500mm diameter tubular steel casing driven down to rock substrate, with a 2380mm diameter pile socket drilled below steel casing into the deeper bed rock layers.

The steel pile casings will be installed by a crawler crane either from the land, temporary bridge platform or from the grounded barge system. The casings will be driven to depth into the rock substrate. The steel casings will prevent ground collapse in the softer layers above bedrock level and retain the ground particularly in the mudflats, silty and cobbles level. The top (softer) soil layers within the steel pile casing will be removed using a hydraulic grab or fly drill. The advantage of this method is that differing materials can be placed directly into specialised containers and disposed of accordingly.

The deeper, harder soil layers will be drilled with a drilling rig. There will be two piling drilling methodologies utilised for the project: drilling with a Reverse Circulation Drilling rig (RCD) and/or with a conventional drilling rig.

Piling methodology will be typically as follows:

- Piling gate fitted at pile location either supported from temporary works or held in place with drill rig if conventional drill rig is used (Figure 18, left).
- Pile casing received on truck and unloaded by crawler crane at pile location.

- Pile lifted and pitched into piling gate for holding in position whilst driving (Figure 18, right).
- Crane unhook from pile and lift on vibratory driver for initially setting pile.
- Crane remove vibratory driver and lift hydraulic impact hammer and drive pile to design toe level.
- Temporary access platform will be installed on pile casing for marine piles with catch platform to capture any material falling from bucket during overburden removal.
- Overburden material in pile casing will be removed down to top of rock level either with hydraulic grab or fly drill and disposed into bins adjacent to pile for removal offsite.
- Drill rig mobilised to pile casing for drilling rock socket (see either RCD or conventional piling section).
- Pile socket will be scanned & base inspected as per project technical requirements.
- Reinforcement then received at pile location and installed into pile casing by pitching and lowering into the pile.
- Additional length of reinforcement will be spliced over the pile casing for deep piles.
- Once reinforcement is placed the concrete pour will commence via tremie pour mix, with pour duration expected up to 12hrs for deep piles. Split shifts will be implemented on long pour days.
- Concrete will be poured to 400mm above pile cut-off height as per project specification for concrete cut-back the next day to clean concrete.
- During concrete placement the water within pile will be displaced via submersible pump in the top of pile and transferred to storage tanks on land for required treatment prior to discharge back into the River.
- Excess concrete will be removed the day after concrete pour with breakback method and lifted from the pile for disposal offsite.

Figure 18 - Left: Crane position on temporary bridge receiving pile casing from truck. Right: Piling gate support attachment on piling rig

Reverse Circulation Drilling (RCD)

The RCD drilling system is a commonly used drilling methodology for marine and offshore piling works (Figure 19). It is a closed loop method of drilling which uses dual wall drill rods that consist of an outer drill rod with an inner tube. These hollow inner tubes allow the drill cuttings to be transported back to the surface in a continuous, steady flow. The drilling head is used to cut the rock cuttings which are pushed through the machine with compressed air. When air is blown down the annulus of the rod, the pressure shift creates a reverse circulation, bringing the cuttings and water up the inner tube. When the cuttings arise, they will be pumped directly from drill to separation storage facility on shore. The separation plant is purposed to remove rock cuttings and suspended solids within the water for recirculating back to the RCD to maintain a sufficient level of water head in the pile. At completion of the rock socket drilling the water will remain in the pile until concrete placement. Solids during the RCD process will be discharged into bins through the separation plant that will be continually emptied into trucks for disposal.

Although the RCD process requires a large footprint, the movement of the plant from one pier to the other is minimal and soil cuttings are pumped via pipelines. Truck movements within the temporary access to transport the excavated material will be limited, allowing multiple activities to be carried out along the access bridge.

Once geotechnical data is in hand from ground investigation at every pier location as required in the PSTR, the drilling tooling will be selected. In the event there is significant socket collapse encountered when drilling the deep sockets and there is no advancement of the drill, the drill bit will be retracted, and grout will be pumped in. The purpose of the grout is to stabilise the shaft/pile wall preventing collapse. As the grout is cured, the level where the grout was applied will be redrilled to the designed pile diameter leaving a thick grout wall thereby stabilising the hole.

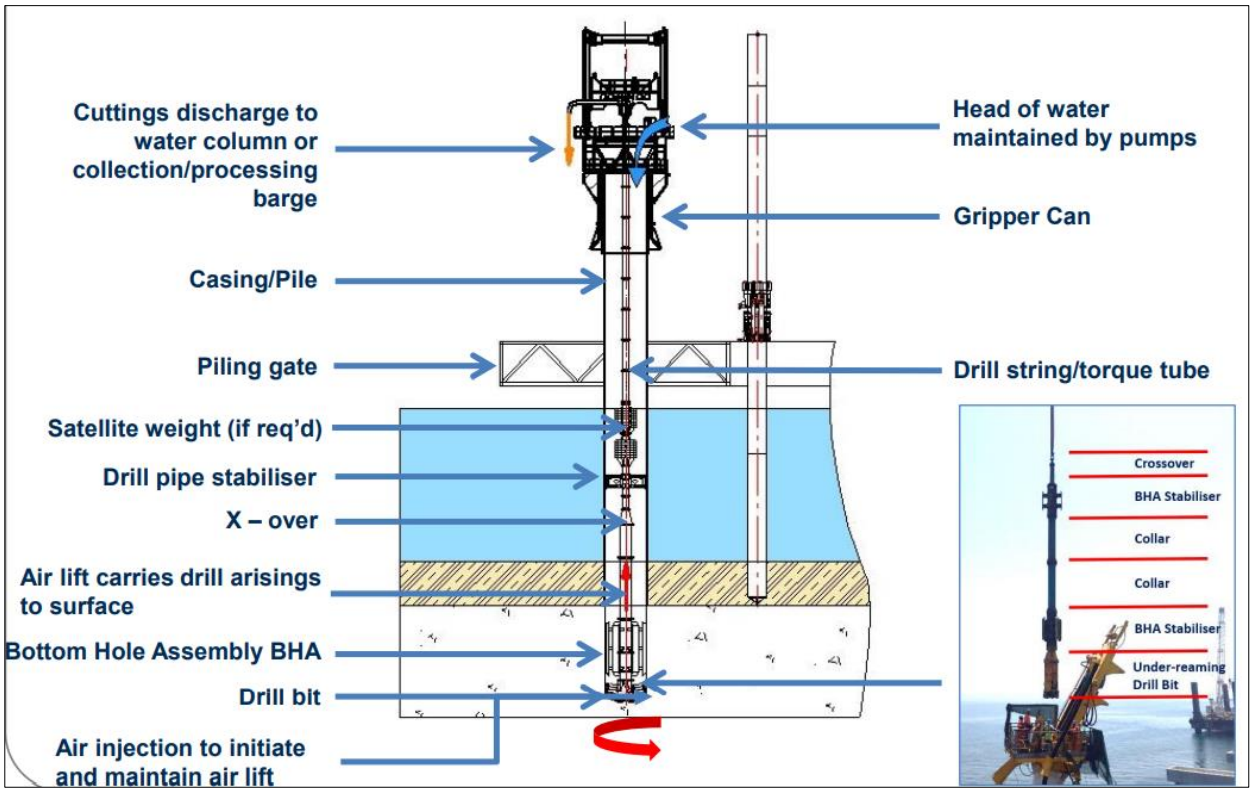


Figure 19 - Reverse Circulation Drilling Process

Conventional Piling

A conventional drilling rig (Figure 20) will be used on the land-based piles and for a number of marine piles via the temporary access structure. The flexibility of this method with favourable ground can increase production rates. This will be further assessed once full geotechnical data has been received from bore logs during the Early Activities Phase. Conventional drilling method excavates the material directly from the pile socket and places adjacent to the work front by retracting the Kelly bar, slewing the machine to the side and emptying the material from the auger.

For the land-based piles, the excavated material will be stockpiled adjacent to the pile location and loaded into trucks with an excavator. Along the temporary structure, large containers/skips will be utilised for placement of pile material excavated. The skips will be removed from piling front via truck on rotation to dispose offsite.

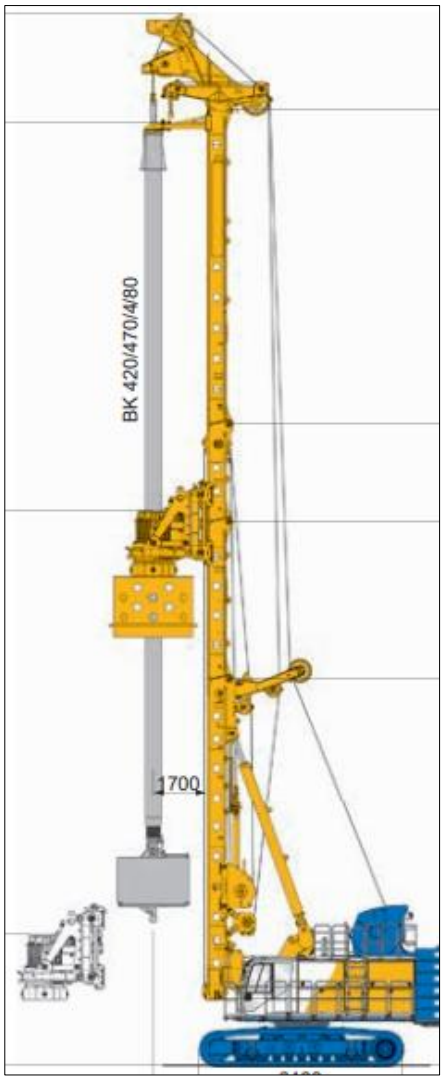


Figure 20 - Conventional Drill Rig

Superstructure

The Superstructure construction involves two key elements: 1) pre-casting and delivery of superstructure segments to the bridge site and 2) construction of the bridge superstructure.

Pre-casting of the bridge superstructure segments involves:

- Casting of superstructure segments off site at a temporary concrete casting yard facility using steel formwork installation of steel reinforcement in the formwork.
- Pumping of concrete into formwork, setting and curing.
- Transporting precast segments from casting yard to site.
- Transport of precast segments from delivery truck to bridge locations using temporary platforms (barges/temporary bridge.

Construction of bridge superstructure involves:

- Lifting of all precast segments into position on the superstructure and securing.
- Progressive post-tensioning, grouting and joining of secured precast superstructure segments.
- Installation of bridge drainage and services as required.
- Installation of either precast or cast in situ concrete traffic barriers.
- Priming of bridge superstructure and placement of asphalt road pavement surface.
- Installation of other road furniture such as lighting, signs and safety rails.
- Line marking and other minor work.

APP 8.6 INTERSECTION WORKS

Clearing, Grubbing and Earthworks

Clearing and grubbing is the preparation of site prior to and to facilitate permanent works construction activities. This typically involved removal of trees and vegetation as required and also redundant assets including small dwellings. Earthworks is the process of land forming to achieve the new road formation levels as required by the design. It involves both excavation and spread & compact activities known as ‘cut’ and ‘fill’ works respectively. Typical earthwork equipment can include but is not limited to:

- Excavators.
- Trucks.
- Rollers and Compactors.
- Graders.
- Dozers.
- Scrapers.

Road Works

Road works covers all items required to finish the road on the newly constructed formation, the main item being pavement construction. This includes:

- Import of quarry materials (i.e. road base) in trucks.
- Spread and compact of materials via use of; graders, rollers and water trucks.
- Surfacing works; spray seals, asphalt works and concrete (i.e. footpaths and traffic islands).

Other items covered in road works can include:

- Drainage (surface, stormwater and subsurface).
- Edgings (i.e. kerb).
- Road furniture (concrete barriers, guardrail and signs etc).
- Line-marking.

Utilities

Utilities covers all aspects of service works such as identification, protection, design, installation / relocation and commissioning. The utilities themselves can include power, water, sewer, gas, communications, etc. This can be above ground, below ground or submarine (underwater).

Reinstatement

Reinstatement includes all finishing works to ensure the final condition is achieved. This can be replacing what has been altered, improving what has been impacted or replacing with new i.e. landscaping works.