Beneficial Reuse Assessment

MWPA Fishing Boat Harbour Maintenance Dredging 2025

Customer	Mid West Ports Authority
Project	003383
Deliverable	1
Version	0
	4 November 2024

Document Control

Document Identification

Title	Beneficial Reuse Assessment
Project No	003383
Deliverable No	1
Version No	0
Version Date	4 November 2024
Customer	Mid West Ports Authority
Classification	OFFICIAL

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Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
A	04 October 2024	Internal	.docx
0	06 November 2024	External	.docx

Executive Summary

The Mid-West Ports Authority (MWPA) plans to conduct a maintenance dredging campaign in 2025 for the Fishing Boat Harbour (FBH) entrance channel to maintain safe navigable depths. Sediment from the area accumulates due to eastward sand migration from Pages Beach, forming a pocket of sediment at Lives Beach that impacts both navigation and water intake operations for the local business. The last dredging in 2022 removed 22,300m³ of sediment for land reclamation behind Berth 7; however, with this disposal option no longer available, alternative locations or methods must be considered to ensure sustainable sediment management practices.

MWPA has implemented sand bypassing measures as part of the Northern Beaches Stabilisation Programme which removes sand from Pages Beach to decrease the volume being transported around into the entrance channel. Recent sediment analyses confirm the dredge materials as contaminant-free and suitable for onshore disposal, while metocean and coastal process studies highlight the seasonal challenges and sediment transport dynamics that influence dredging needs.

A comprehensive review of all potential dredging options was undertaken, followed by a fatal flaw assessment to screen out unsuitable alternatives. This resulted in a shortlist of eight viable options, which were evaluated and scored during the Multi-Criteria Assessment Stakeholder Workshop. During the workshop, a new option—hydraulically pumping sediment directly to Town Beach—emerged as a strong contender, achieving the highest score based on the established criteria. Following the workshop, MWPA identified an additional three hybrid options designed to enhance operational efficiency and better address specific project requirements. These twelve options were then rigorously assessed against newly defined criteria to ensure alignment with MWPA's objectives and stakeholder expectations, ultimately informing the selection of the preferred dredging strategy.

The preferred dredging option is to hydraulically pump 45,000m³ of material to a dewatering area at Pages Beach and then truck the sediment to erosion-prone northern beaches. This approach includes installing a short pipeline to the dewatering site where 80% of the sediment will be retained. While proven and low impact, this method requires significant truck traffic and double handling of sediment, necessitating close coordination with local authorities and public notifications due to road and beach impacts. Benefits include the permanent removal of sediment from the FBH system and the positive use of dredged material for beach nourishment, supporting economic and public value.

Future recommendations emphasise a strategic approach to sediment management, including increasing annual sand bypassing from Pages Beach and investigating a permanent sand bypass system. BMT proposes a deeper dredge pipeline route across the shipping channel and suggests further studies on erosion and sediment transport to refine placement strategies. A permanent sand bypass system, potentially incorporating a buried pipeline with automated pumping to northern beaches, could enhance coastal resilience and reduce dredging frequency. Continued engagement with stakeholders and exploration of funding options are advised to support long-term, cost-effective infrastructure that aligns with community and environmental objectives.

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1 Introduction

Mid-West Ports Authority (MWPA) are planning to complete a maintenance dredging campaign within the Fishing Boat Harbour (FBH) and associated entrance channel in 2025 to remove naturally accumulated sediment. These works are required on a routine basis to achieve safe navigable depths and allow for the continued operations throughout the FBH.

In 2022, MWPA successfully dredged 22,300m³ of material, which was repurposed for land reclamation behind Berth 7. As this disposal option is no longer available, it is now necessary to identify an alternative location or placement method to ensure MWPA's continued commitment to sustainable sediment management.

1.1 Project Background

In recent years, the area immediately west of the FBH entrance has experienced significant sediment accumulation due to the eastward migration of sand from Pages Beach. This has resulted in the development of a small pocket beach, known as Lives Beach, adjacent to the FBH entrance.

The accumulation of sand poses a risk of further shallowing within the FBH entrance channel, potentially compromising safe navigation. To address this issue, MWPA has been proactively managing sand bypassing from Pages Beach and Lives Beach to the beaches northeast of the port through beach excavation and trucking as part of the Northern Beaches Stabilisation Programme.

MWPA commissioned Wavelength in 2020 to develop a sand management strategy for the FBH (Wavelength, 2020), which provided recommendations for short, medium, and long-term sand management. The report recommended dredging activities in the short and medium term to address the shallowing of the FBH entrance channel. The 2022 dredging campaign successfully restored the entrance channel to its design widths, with projections indicating that further dredging would not be needed for another 18 to 24 months. Planning for the next dredging operation is currently underway, with the goal of completing the activities by early 2025.

1.2 Document Outline

MWPA has engaged BMT to undertake the following scope of work:

- Review previous documentation, studies, and key background information to inform the disposal option study.
- Conduct a pre-screening/fatal flaw assessment of proposed disposal options.
- Facilitate a multi-criteria analysis (MCA) with relevant stakeholders to identify the preferred disposal option for the 2025 dredging campaign.

Figure 1.1 highlights the process undertaken.

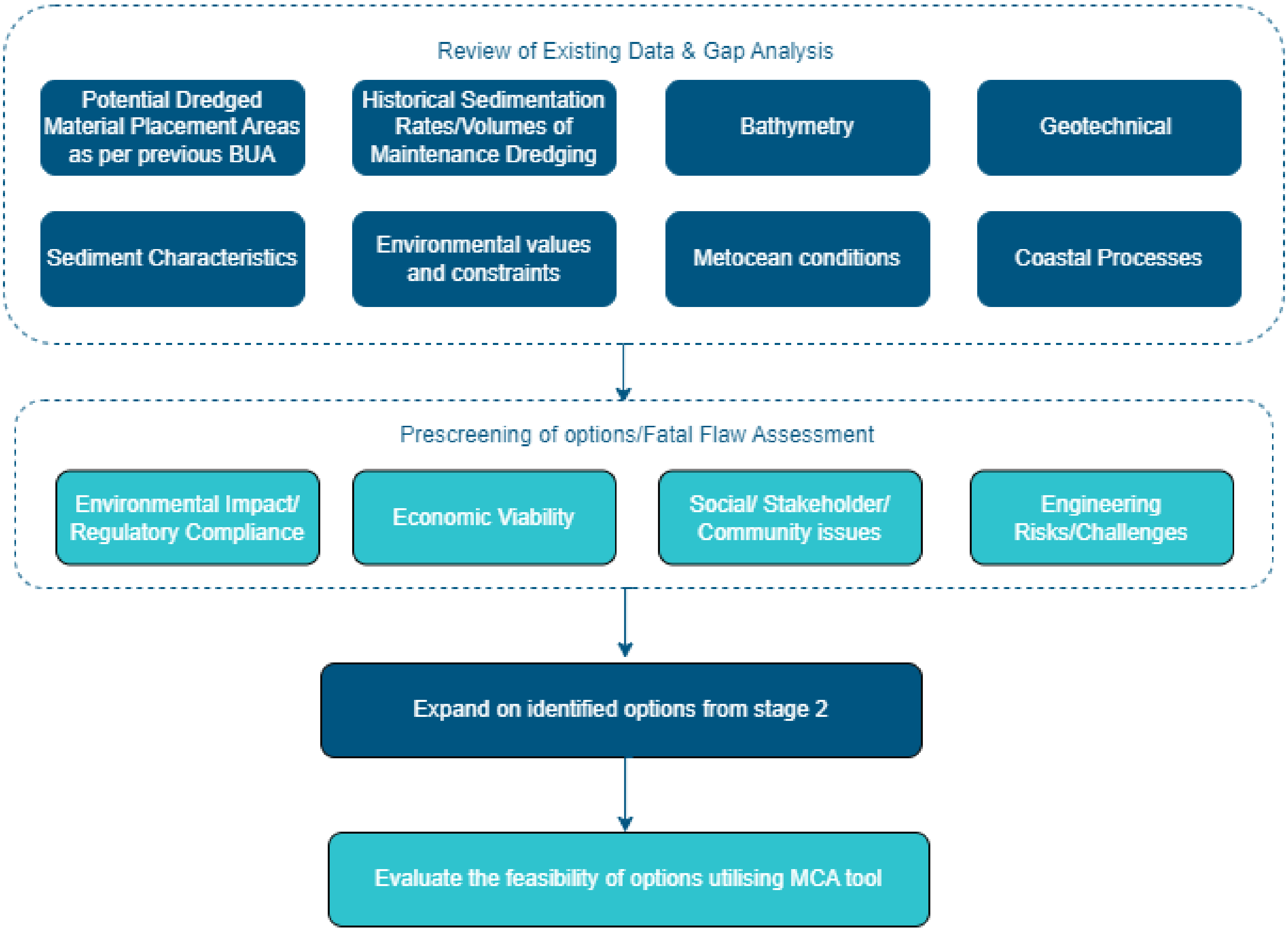

Figure 1.1 Options Selection Process

2 Desktop Review

2.1 Site Background

The Port of Geraldton (hereafter The Port) is located approximately 430 km north of Perth in the Mid-West region of Western Australia (Figure 2.1). The Port is administered by the Mid-West Ports Authority (MWPA) and presently consists of the following assets:

- Shipping channel,
- a seven-berth commercial harbour,
- a large fishing boat harbour (FBH), and
- a tug pen with associated land-based infrastructure.

The Port originally dates to 1931 when Berths 1 and 2 were constructed. More recently, The Port underwent a large upgrade as part of the Geraldton Port Enhancement Project (PEP) which included capital dredging of approximately 5 Mm^3 of predominately rock material from the entrance channel and basin. The most recent maintenance dredging campaign was completed (2022) within the FBH by CGC Dredging using a small Cutter Suction Dredge (CSD) removing ~22,300 m^3 of material which was used for reclamation works on Berth 7.

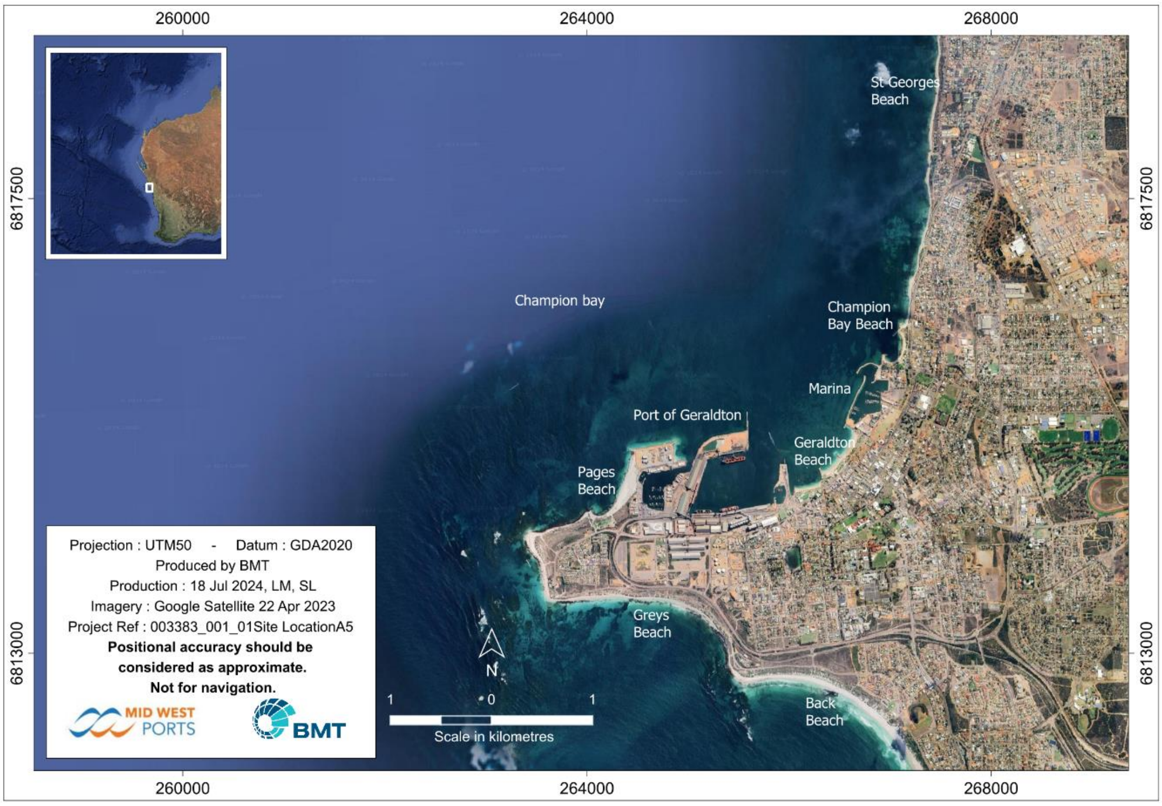

Figure 2.1 Port of Geraldton site location

The FBH typically facilitates commercial fishing vessels, recreational vessels and associated ancillary vessel services required for construction and maintenance. Facilities within the FBH includes approximately 147 vessel pens, service jetties, refuelling facilities, and heavy lift concrete reinforced docks. As part of the Northern Beaches Stabilisation Programme, MWPA has been mechanically bypassing material from Pages Beach and Lives Beach (which both experience annual accretion) to the beaches north-east of The Port. To date this has been predominately achieved via excavation and trucking. An aerial image of the FBH is provided in Figure 2.2.

Figure 2.2 Aerial Imagery of FBH (MWPA, 2022)

2.2 Site Characteristics

2.2.1 Metocean conditions

The metocean conditions in the Geraldton region exhibit marked seasonal variation, with distinct differences between the conditions observed in summer and those in winter. During the summer months, the area typically experiences calmer seas and more stable weather patterns, while the winter season is characterised by rougher seas and more dynamic oceanic conditions.

Waves

Wave conditions along Geraldton coastline, are shaped by both offshore and nearshore influences. The Metocean Summary Conditions Technical Memo (Wavelength, 2022) presented findings that the offshore locations are more exposed than the proposed dredging site but offer valuable long-term data on sea and swell conditions in the region. Significant wave heights (Hs) at three different sites were consistently below 0.6m. The complex bathymetry of nearshore reefs in Geraldton creates long waves with periods exceeding 25 seconds when swell waves interact with them. These long waves, typically associated with large swell events (Figure 2.3), propagate across the reefs and reach the FBH entrance, where they are likely to cause sediment movement in the dredging area.

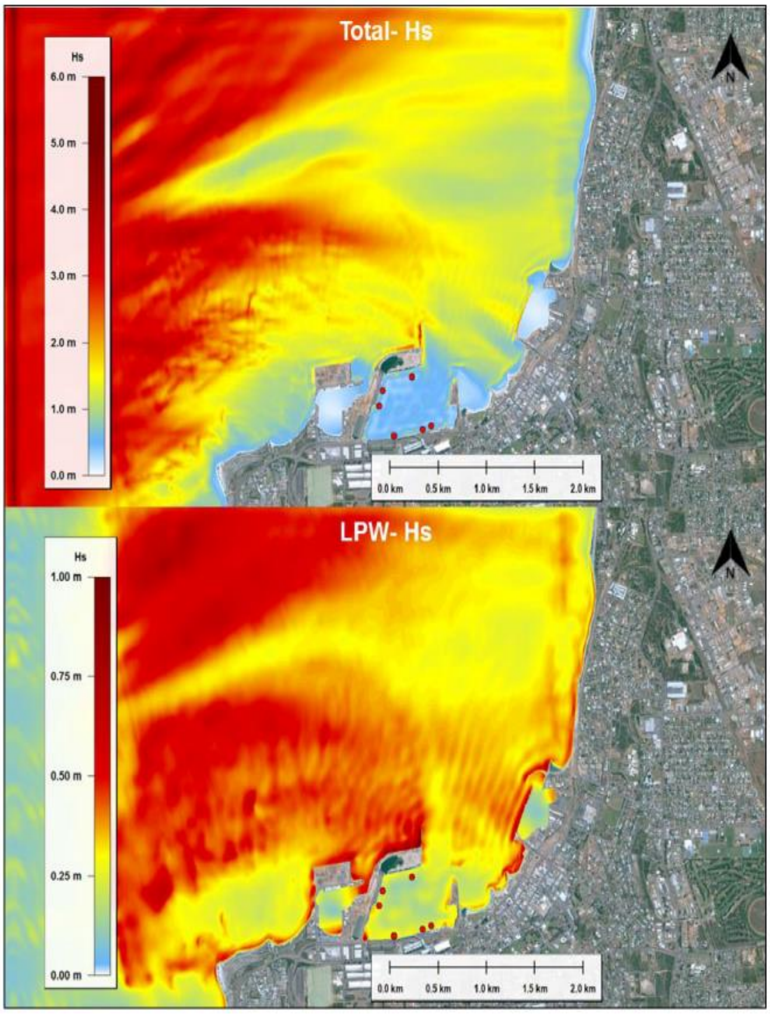

Figure 2.3 Long Period Wave penetration modelling (MetoceanSolutions, 2016)

Wave data from a buoy in the outer channel, recorded at a depth of 13m and presented in wave roses from March 2004 to 2009 (Figure 2.4), shows that waves predominantly come from the south-westerly direction. Cardno's 2012 wave modelling observed minimal seasonal variation, with nearshore environments having a slight impact on wave conditions close to shore. Additionally, a wave buoy installed off Greys Beach from June to September 2020 recorded significant wave heights typically ranging from 0.6 to 1.2m, with peaks up to 1.7m during storm events. The wave climate during this period was bimodal, featuring swell peak periods around 16 seconds and locally generated wind wave periods of 6-8 seconds, both coinciding from the south-west.

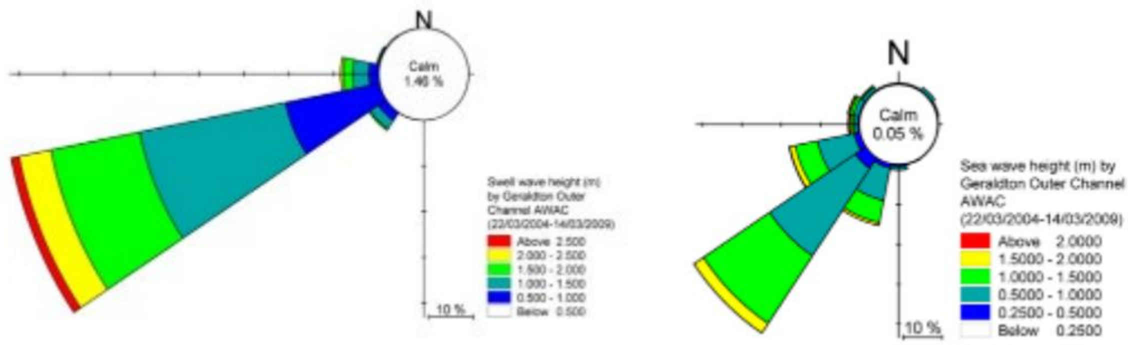

Figure 2.4 Wave Roses for Geraldton Outer Channel (MRA, 2023)

Water Levels

Water levels in the area are influenced by a combination of tides, storm surges, sea level rise, and other factors. The tidal regime at Geraldton is predominantly diurnal, with a spring tidal range of approximately 0.6m. Key tidal events are summarized in Table 2.1.

Table 2.1 Tidal levels at Geraldton

Tidal Plane	Prefix	Chart Datum (mCD)	Australian Height Datum (mAHD)
Highest Astronomical Plane	HAT	1.20	0.65
Mean Higher High Water	MHHW	0.82	0.27
Mean Lower High Water	MLHW	0.6	0.05
Mean Sea Level	MSL	0.57	0.02
Mean Higher Low Water	MHLW	0.48	-0.07
Mean Lower Low Water	MLLW	0.33	-0.22
Lowest Astronomical Tide	LAT	0.0	-0.55

The region can experience extreme water levels during storms or cyclones due to low barometric pressures and strong winds. For instance, Cyclone Seroja, which affected the area in April 2021, caused water levels to peak at 1.9m AHD (2.45m LAT). Detailed cyclone modeling conducted by MRA has determined these extreme water levels, which are summarised in Table 2.2 below.

Table 2.2 Extreme Water Levels

Annual Recurrence Interval (years)	Static Water Level (mAHD)
20	2.0
100	2.2
500	3.0

Source: MRA 2017

The impact of climate change was not factored into the previous water level estimates. However, historical trends indicate a rate of sea level rise of 1.8mm per year (IPCC 2007). Recommendations from the Department of Transport regarding allowances for sea level rise are illustrated in Figure 2.5.

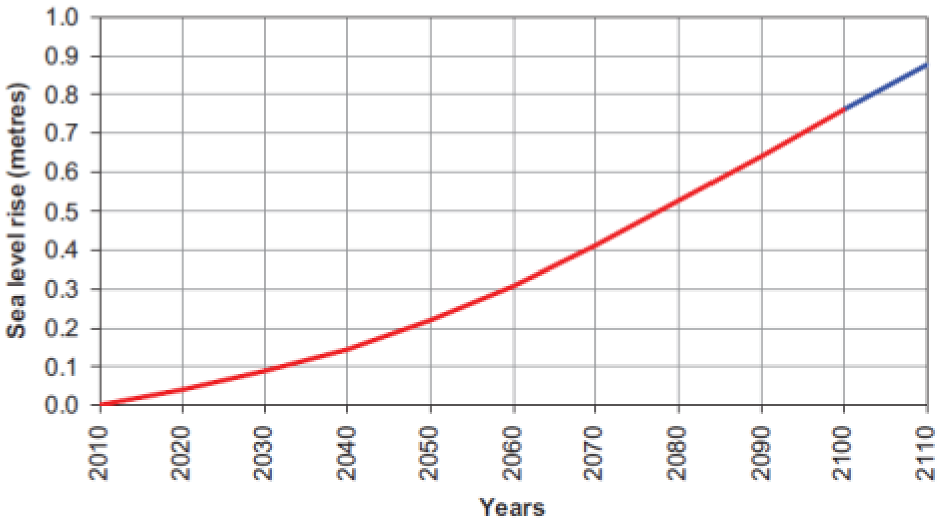

Figure 2.5 Recommended Allowance for Sea Level Rise (DoT 2010)

Wind

At Geraldton, wind patterns exhibit a distinct daily cycle. In the morning, the region experiences a prevalence of offshore winds with an easterly component, which generally provides calm conditions. As the day progresses, the wind shifts to predominantly onshore or alongshore directions, coming from the south to south-west as shown in the wind roses in Figure 2.6.

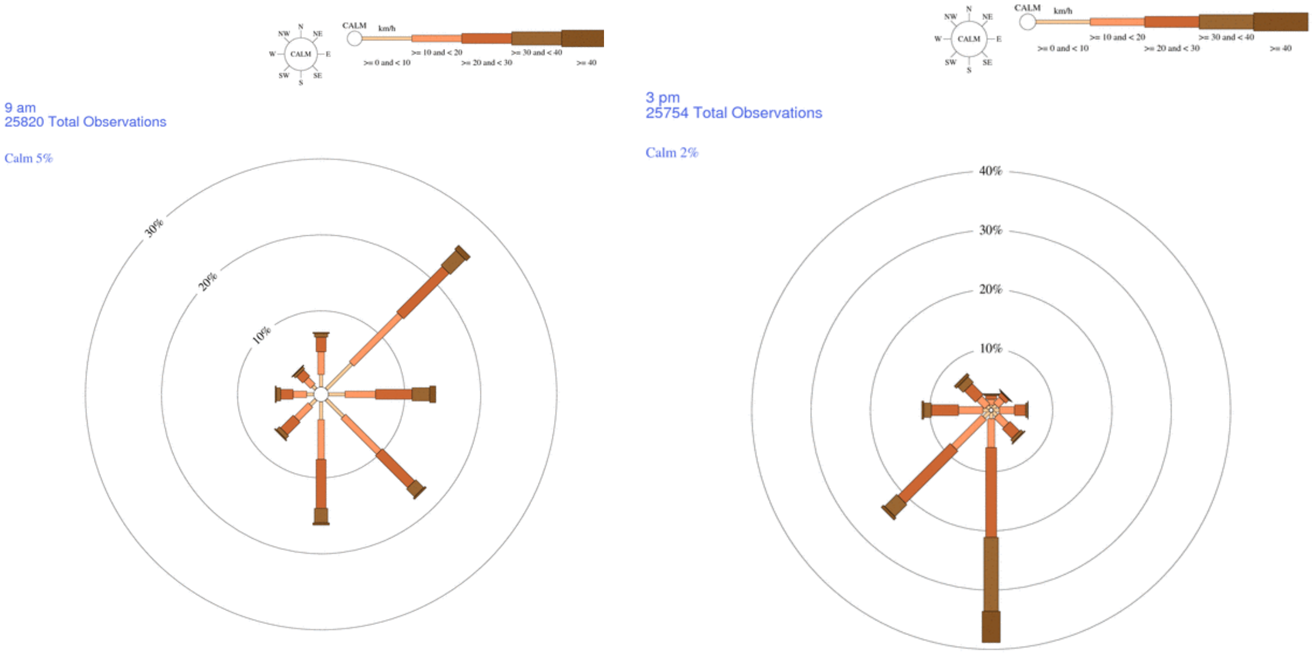

Figure 2.6 Geraldton average annual wind roses for 9am (left) and 3pm (right) from 1941 to 2014 (BOM, 2019)

Coastal Processes

Sediment movement around the Port and FBH is heavily influenced by onshore and alongshore winds from the south to south-west, resulting in a predominantly northerly net sediment transport. The key sources of sediment in this coastal system include seagrass meadows, Southgate's dunes, littoral drift from southern sources, and minor inputs from the Greenough and Chapman Rivers (RHDHV, 2021). However, significant infrastructure such as the Port, Pages Beach, Lives Beach and the Fishing Boat Harbour (FBH) disrupts natural sediment pathways. These structures act as sediment capture points, significantly affecting sediment transport dynamics in the area.

Historically, Pages Beach has accumulated between 17,000 and 28,000 m³ of sediment annually (MRA, 2023). This sediment has contributed to the formation of Lives Beach as sand bypasses holding structures and moves eastward along the northern edge of the FBH reclamation area. The accumulation at Lives Beach and the Harbour entrance has recently impacted navigation in the FBH entrance channel. The indicative annual sediment budget estimates that around 14,000 m³ of sediment accumulates at Lives Beach and the Harbour entrance each year, with ongoing sediment removal from Lives Beach necessary to manage this buildup.

Figure 2.7 Indicative Sediment Budgets (Wavelength, 2020)

In response to the disruption caused by coastal infrastructure, MWPA implements a sand bypassing strategy to transport sediment from Pages Beach to the northern beaches. This process, which involves mechanical sand bypassing and periodic "top-ups" with clean dredged material, aims to replicate natural sediment transport patterns and alleviate erosion. In late 2022, maintenance dredging removed approximately 22,000 m³ of sediment from the FBH entrance and Lives Beach, which was then reused for the Geraldton Port Berth 7 Reclamation Area. This approach helps to maintain sediment supply and stabilise the coastal environment.

Sediment transport patterns in the region are influenced by sediment cells, there have been 5 cells in the region as recorded in the Coastal processes study (RHDHV, 2021). Despite significant volumes of sediment being removed from Pages Beach for nourishment of nearby areas (i.e. Town Beach, Beresford and St Georges Beach), the beach has steadily accreted, particularly since it has reached the northern edge of land reclamation behind the FBH. The presence of breakwater structures and land reclamation has altered sediment pathways, emphasizing the need for ongoing monitoring and strategic sediment management to address erosion and maintain coastal stability.

The Geraldton region, particularly greys beach faces significant risks from coastal hazards, as detailed in the CHRMAP (Baird, 2019) . The Beachlands unit, which includes Greys Beach, is especially vulnerable to erosion, with impacts projected to worsen over various timeframes. Figure 2.8 illustrates the erosion impacts across different periods, highlighting areas that are most at risk of shoreline retreat.

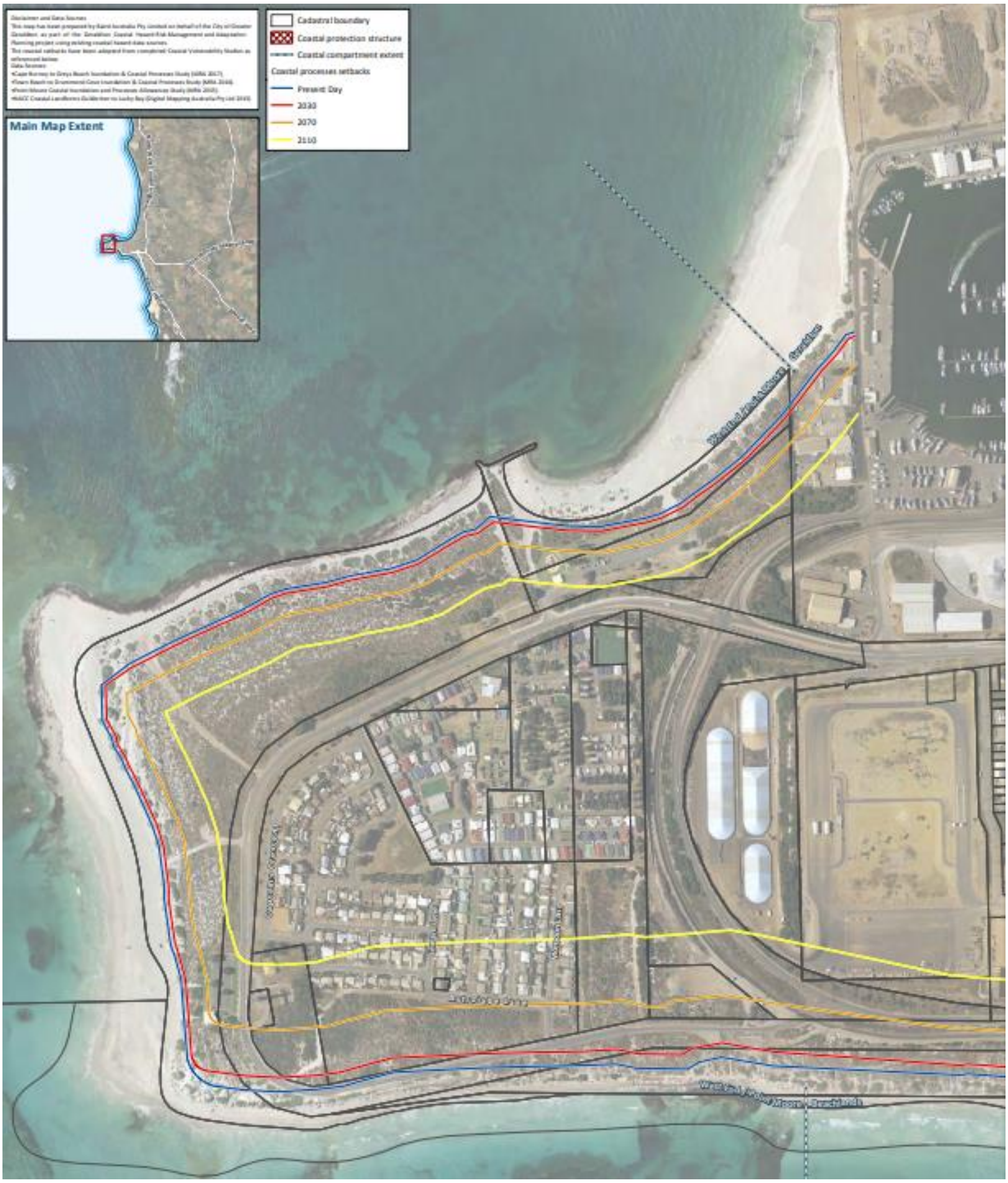

Figure 2.8 Coastal Hazard Mapping, Erosion Setback (Baird, 2019)

In addition to erosion, inundation poses a substantial threat to the region, particularly during extreme weather events. The potential for widespread inundation is highlighted in the Baird report, which identifies significant areas that could be affected by rising water levels and storm surges. Figure 2.9 provides a visual representation of the potential inundation zones, showing the extensive impact across the entire coastal area.

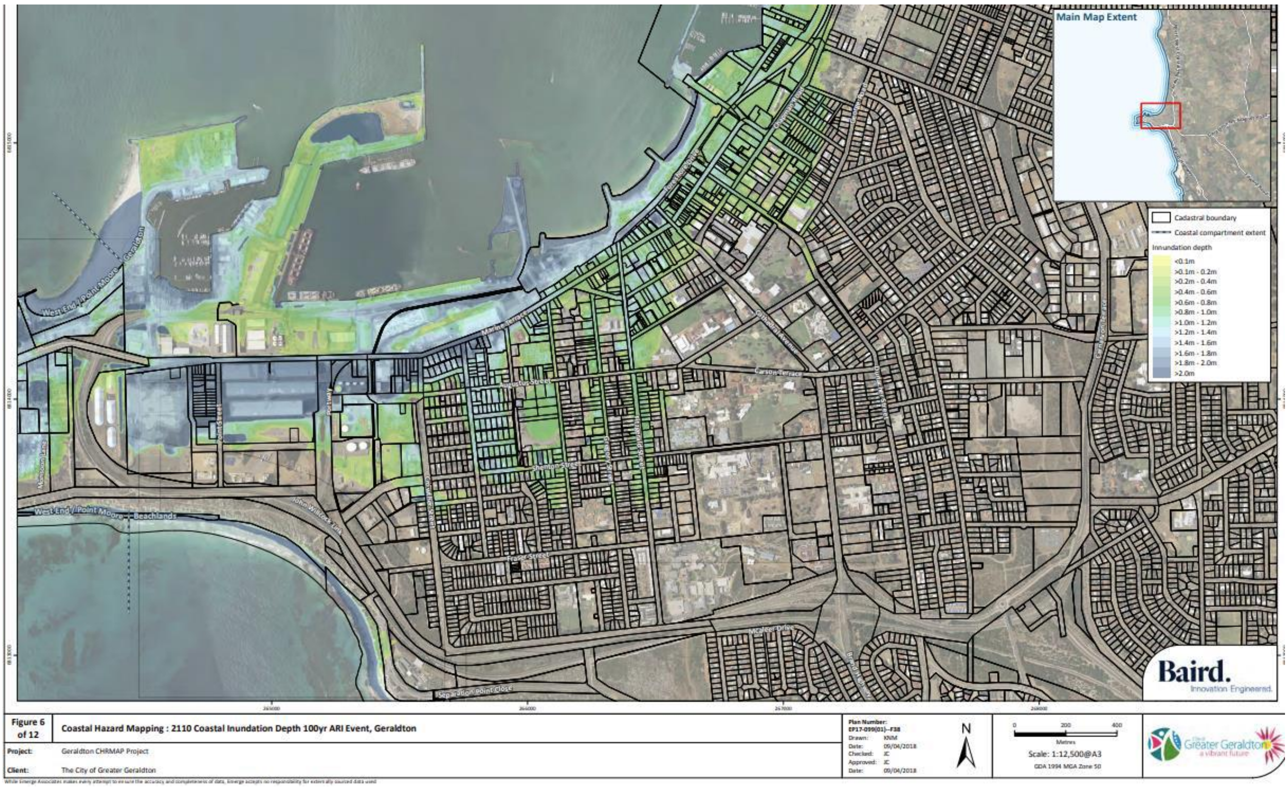

Figure 2.9 Inundation of the study area (Baird, 2019)

2.2.2 Environmental characteristics

Contamination

All sediments within and adjacent to the defined dredge area were assessed as contaminant-free, consistent with previous annual routine sediment assessments. The physical properties and contaminants across the site showed low variability both vertically and horizontally, suggesting that the accreted material originates from the same natural source and is continuously redistributed within the area. Additionally, a review of the DWER Contaminated Sites Database identified a Registered Contaminated Site north of the John Wilcock Link, classified as "Remediated for restricted use," where groundwater monitoring has detected hydrocarbons, PFAS, nutrients, and metals typical of old landfill sites. Contamination is also suspected in the dunes at the western end of Greys Beach and south of the Point Moore Lighthouse, where asbestos and old building materials such as brick, concrete, steel, and wall sheets have been found, with the presence of these materials confirmed by MRA during a site inspection.

Aboriginal Heritage

The MRA **(2023)** report revealed that an online search identified one Registered Aboriginal Site (#20853) within the project area, known as the Geraldton Southern Transport Corridor Field Site. This site may contain sub-surface cultural material, and any ground-disturbing works will require Aboriginal heritage approval.

Benthic Mapping

Benthic habitat mapping was completed by AECOM (2020) and covered the area of interest (Figure 2.10).

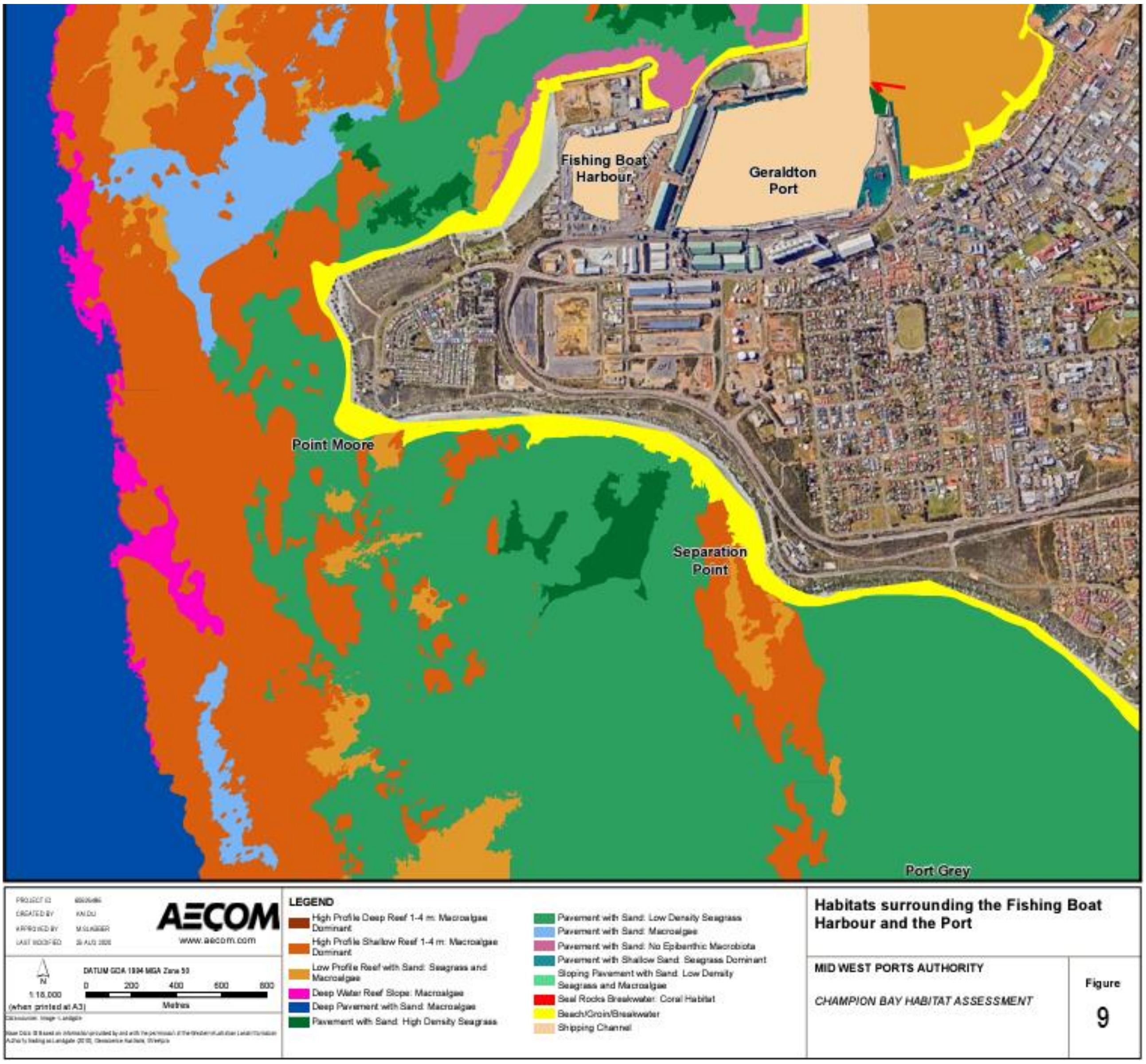

Figure 2.10 Habitats surrounding the Fishing Boat Harbour (AECOM, 2020)

2.2.3 Sediment characteristics

Sediment sampling conducted by O2 Marine in 2022 (O2Marine, 2022), prior to the dredging campaign, revealed that sediments within the study area are predominantly medium to fine-grained, grey sands of natural origin. These sediments, primarily composed of coastal silicate sands transported by local northern longshore drift and marine carbonate sediments brought in by oceanic currents and swells, were found to be clean and contaminant-free. The sediment assessments showed minimal vertical and horizontal variability, indicating that the material originated from the same natural sources and has been consistently redistributed within the defined study area. Notably, the presence of organic nitrogen and phosphorus suggested natural nutrient sources, such as seagrass wrack, with inorganic nutrients like ammonia being detected at low levels due to slight ammonification under anoxic conditions.

Figure 2.11 Fishing Boat Harbour Sediment Sampling locations (O2Marine, 2022)

The sediment analysis across seven sampled sites displayed a high degree of uniformity, with the majority of sediments classified as fine to medium sands. Minor variations were observed at specific sites, such as LB5, where surficial sediments contained more coarse sands, and LB8, where silts were more prominent in both sediment layers. Slight hydrogen sulphide odours were detected during processing, indicating the presence of naturally occurring gases, although the potential impact during dredging, particularly on the adjacent Live Cray processing facility, remains undetermined.

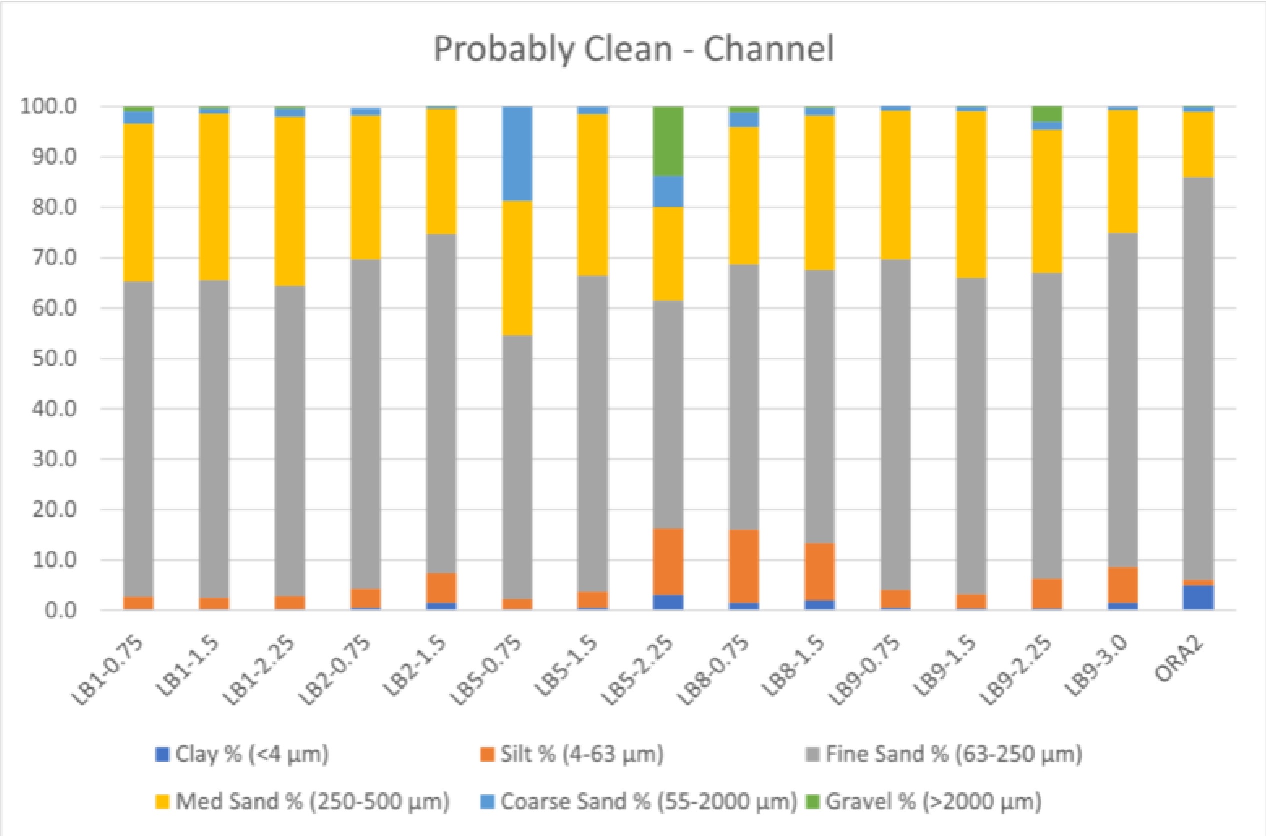

Figure 2.12 Sediment classification for particle size sediment (O2Marine, 2022)

O2 Marine recommended that the dredged material, classified as uncontaminated and similar to typical beach sands, are suitable for onshore disposal with no risk of human or ecological harm. The sediments are also not acid sulfate soils, so there is no risk of acidification. While tailwater return should be managed for turbidity, no contamination or nutrient impacts are expected in discharge to the ocean.

2.3 Bathymetry and Navigational Requirements

2.3.1 Bathymetry

The bathymetry and topography of the Geraldton Port region, particularly around the Fishing Boat Harbour, exhibit a diverse range of underwater and terrestrial features. The seafloor demonstrates significant variability, with shallow, sandy substrates near the coast transitioning to deeper, more irregular depths offshore. The adjacent landforms include gently sloping coastal plains interspersed with occasional rocky formations. The 2016 Department of Transport LIDAR data, presented in Figure 2.13, offers a detailed representation of both the elevation contours and bathymetric profiles, enhancing the understanding of the spatial and depth-related characteristics of the region.

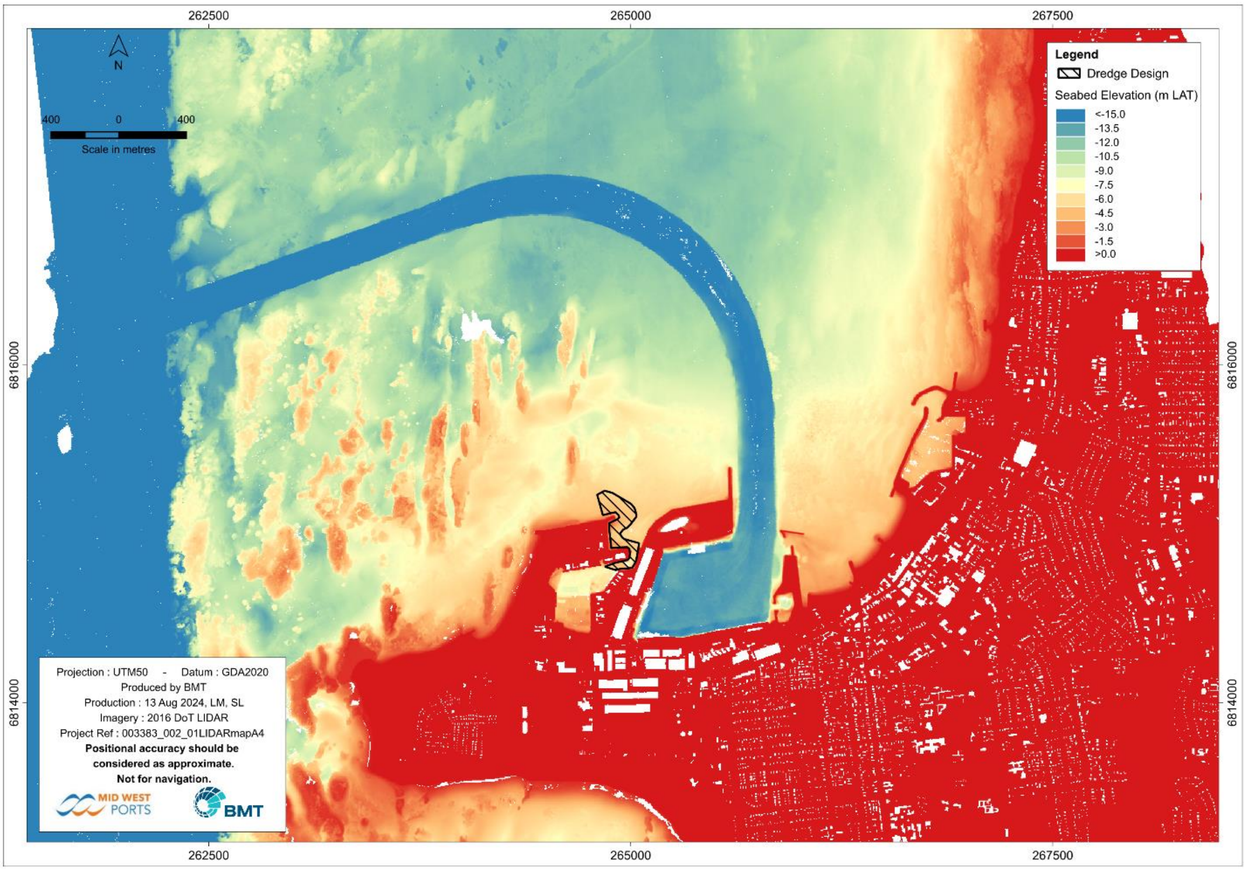

Figure 2.13 Lidar data for the Geraldton Port region (DoT, 2016)

2.3.2 Declared Channel Depths

The current declared depths as advised on the 17 July 2024 (Local Marine Notice 19/2024) for Berth 1 to 7 , basin, tug harbour, shipping channel (south and north) and fishing boat harbour are listed in Table 2.3 . This revision was based on the updated survey data provided to the Port. All vessels must maintain an under keel clearance required of 0.5m.

Table 2.3 Depth Declaration for Berths, Shipping Channel, Harbour Basin, Tug Harbour and Fishing Boat Harbour

Location	Declared Depths (m) As issued on 17th July
Berth 1 & 2	8.40m
Berth 3	12.60m
Berth 4	12.40m
Berth 5	12.70m
Berth 6	11.80m
Berth 7	12.40m
Harbour Basin	12.10m
Tug Harbour (tug manoeuvring area)	6.60m

Location	Declared Depths (m) As issued on 17th July
Shipping Channel (Southern)	12.40*m ~ 14.27*m
Shipping Channel (Northern)	8.30m
Fishing Boat Harbour (Entrance)	2.95m

***The Southern Shipping Channel is charted from 12.40m to 14.27m**

2.4 Historical Dredging campaigns

Table 2.4 summarises the two most recent maintenance dredging campaigns completed by the Port.

Table 2.4 Recent Dredging Campaigns in the Area

Year	Dredged Volume (m3)	Disposal Location
2022	30,000 (FBH)	Berth 7 Reclamation Area
2021	140,000 (Commercial Harbour & Main Shipping Channel) Seabed levelling ~4,000m3 relocated to deeper areas immediately north of the FBH entrance	Berth 7 Reclamation Area (Inner Harbour) Nearshore Location (adjacent to Bluff Point)

The objective of this upcoming dredging project is to restore navigable depths by removing approximately 40,000 cubic meters of accumulated sediment within the three areas in Figure 2.14. This will create a sedimentation buffer for ~ 18-24months while a long-term solution is developed. The dredging methodology assumed for the remainder of the MCA involves a small-to-medium cutter suction dredge, with material piped to either the disposal site or a temporary storage location.

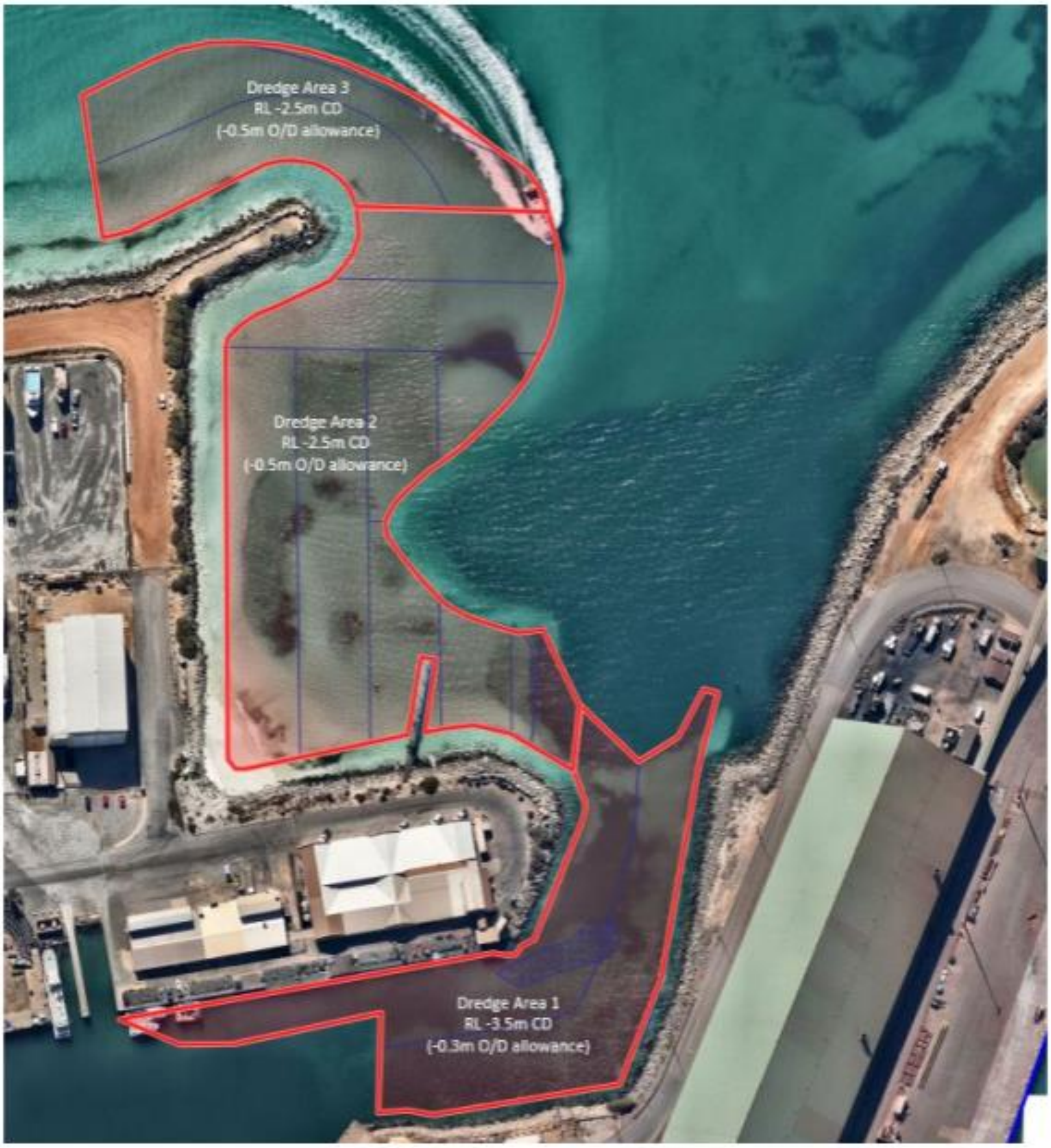

Figure 2.14 FBH Entrance Channel Dredging Areas

3 Fatal Flaw Assessment of Options

This is the third Beneficial Reuse assessment conducted for MWPA. The first assessment, completed in 2021, focused on the main channel and harbour dredging program, while the second, completed in 2022 by Wavelength and MWPA, addressed the FBH.

This initial assessment included a pre-screening process to identify any fatal flaws associated with potential methods or options. Beneficial reuse options were developed through consultations with MWPA, Wavelength, and other key stakeholders. Eleven potential methods were evaluated for engineering and environmental viability. Table 3.1 summarises the 2022 options and introduces additional options identified by BMT for consideration, detailing each option's status and rationale.

Table 3.1 Summary of Long List Disposal Methods

Method ID*	Method	Status	Reasoning**
T1	Utilise in concrete aggregate	Rejected	Rejected due to specific sand grain requirements for concrete, which cannot be guaranteed.
T2	Utilise in lime products	Rejected	Rejected due to low levels of $CaCO_3$ compared to that of alternative sources. Additionally, mix of silts and sands in the sediment may impact usability.
T3	Utilise in agricultural lime	Rejected	Rejected due to low levels of $CaCO_3$ compared to that of alternative sources. Additionally, mix of silts and sands in the sediment may impact usability.
T4	Utilise in agricultural soil conditioner & composts	Rejected	Rejected due to dredge material being predominately sand, with very little organic content
T5	Utilise as engineered fill	Rejected	Rejected as dredge material does not comply with typical specifications for roads and foundations. Material is also expected to be challenging to compact
T6	Utilise as landscaping fill	Rejected	Limited demand, as material is not cost effective, nor high quality, when compared to existing landscaping fill.
T7	Utilise for land reclamation (i.e. duck pond)	Rejected	Rejected as no available reclamation spaces available at the Port currently. This was also rejected from the Port as it removes the sand out of the system and is not beneficially reusing it. Future development may allow for dredged material to be placed in new areas once the port has undertaken their port maximisation plan.
T8	No reuse landfill	Rejected	Rejected as this is not treating as a resource, and there are clear options more suited for beneficial reuse.

Method ID*	Method	Status	Reasoning**
T9***	Natural Habitat creation/ restoration	Rejected	There are no areas nearby that require additional sand material to restore for endangered species.
T10***	Exported to areas such as Perth where sand is a sought after commodity	Rejected	Travel time is too far for the material to travel for it to be cost effective or viable for the customer.
M1	Beach Placement	Accepted to MCA	Multiple locations that require nourishment around the region, useful for erosion protection.
M2	Nearshore Placement (i.e. seabed nourishment at main channel dredge location)	Accepted to MCA	The option is worth considering, but the logistics are complex and costly. Transporting the material involves using a bellyottom-dumping barge, which requires frequent dredge shutdowns for unloading and increases traffic in the FBH entrance area. Additionally, the distance makes pipeline pumping impractical.
M3	No reuse offshore disposal	Rejected	Rejected as this requires extensive transport, dumping permits and ongoing monitoring of the offshore spoil ground. There are methods identified that clearly offer better beneficial use.
M4***	Seabed Levelling	Rejected	Proposed Volume is too large and would not provide the 18-24 months sediment trap requirements.
M5***	Habitat Restoration /Creation - Seagrass	Rejected	Whilst there are numerous benefits (environmental, social and commercial) from habitat restoration / creation for seagrasses, research in this area is ongoing and uncertainties relate to whether placement of dredge material would increase seagrass meadows, or if other factors play critical roles.

***T stands for Terrestrial placement and M stands for Marine placement **Source: (Wavelength, 2022a)**

The primary disposal method identified as feasible is Beach Placement. Detailed options for this method are further elaborated in Section 4: Shortlisted Options .

4 Shortlisted Options

The following options were progressed into the MCA stage of the project.

Table 4.1 Summary of Shortlisted Options

Option Number	Option Description
1	Hydraulically pumped to Greys Beach and placed anywhere
2	Hydraulically pumped to Point Moore (Geotubes & Nourishment Hybrid)
3	Hydraulically pumped to Pages Beach and trucked to Greys Beach
4	Hydraulically pumped to Pages Beach and trucked to Point Moore
5	Hydraulically pumped to Pages Beach and trucked to the northern beaches
6	Hydraulically pumped to Pages Beach and trucked to the northern beaches (utilising Geotubes for dewatering)
7a	Hydraulically pumping to Beresford beach directly
11	Nearshore Disposal Area utilising Barge system
7b*	Pipe to Town Beach

***Added during the BUA Workshop by CGG Representative**

4.1 Hydraulically pumped to Greys Beach and placed anywhere

This dredging option aims to address the erosion issues at Greys Beach, a known hotspot requiring replenishment to protect the local transport corridor. By placing dredged material along the beach, the option enhances coastal protection and helps maintain the beach width, benefiting both environmental and community assets. However, this approach involves considerations related to equipment emissions, operational impacts, and environmental management requirements.

Methodology

The proposed method involves using a CSD to transport material from the FBH dredge area to Greys Beach via hydraulic pumping. The pipeline, approximately 3 km long, will be supported by two booster pumps to ensure adequate material flow to the disposal site. A front-end loader will assist with sand profiling on Greys Beach post-dredging, improving the beach's visual appeal and providing further stabilisation.

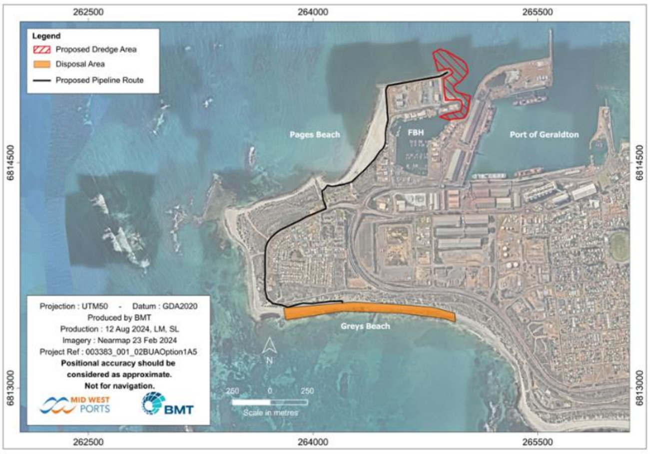

Figure 4.1 Option 1 schematic and example of pipeline placement

Advantages

- Supports erosion control and transport corridor protection by replenishing Greys Beach.
- Minimal operational impact to FBH and The Port.
- Streamlined setup with no double handling, reducing complexity and associated costs.

Disadvantages

- Diesel-powered booster pumps and dredging activities contribute to a high emissions footprint.
- Noise from booster pumps and other equipment may disturb nearby residents.
- Potential for turbid plumes impacting benthic habitats and minor material loss at Greys Beach without bunding.
- Possible vegetation clearing permit required for the placement of the pipeline and ongoing liaison with other agencies regarding pipeline route access.
- Does not conform to the sand bypassing strategy to permanently move the material outside of the system to the northern beaches.

Cost

Total Estimated Cost: $2,190,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $48.67/m^3

Key Cost Assumptions:

- Pumping distance ~3km, requirement for minimum of 2 booster pumps (+operator to manage during dredging)
- Incorporating expected inefficiencies when operating with multiple booster pumps
- Expected Hire of Front-End Loader at Greys Beach to assist with material distribution if required and complete profiling works post campaign
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the 'Mudlark I' CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.2 Hydraulically pumped to Point Moore (Geobags & Nourishment)

This dredging option is designed to provide erosion control at Point Moore, which has experienced significant coastal retreat, recently resulting in the demolition of the Marine Rescue building due to proximity issues. The option combines traditional beach nourishment with the use of Geobags, which are large, semi-permeable bags filled with dredged material that provide a semi-permanent erosion barrier. Although this method may have a larger emissions footprint due to diesel-powered booster pumps, it could offer a longer-term solution to coastal erosion in this area.

Methodology

The approach uses a CSD to pump dredged material as slurry from the FBH area to Point Moore, approximately 2.5 km away. The pipeline will require two booster pumps to maintain the necessary flow rates, with material delivered at a rate of around 300 m³ per hour. At the disposal site, a front-end loader will be used to profile and back-blade the sand, while Geobags may be installed as a trial for future erosion control solutions. The pipeline route will require approvals, including a vegetation clearing permit, and collaboration with local agencies to ensure beach access points are maintained during the project.

Figure 4.2 Option 2 Schematic and example of Geobags placement to trap sand

Advantages

- Minimal impact on FBH and Port operations, ensuring smoother project execution.
- Provides erosion protection at this location
- Geotubes offer a semi-permanent visual solution to manage material loss at the site.
- Offers opportunity to trial the use of Geobags as a semi-permanent erosion barrier.

Disadvantages

- High emissions due to diesel-powered booster pumps and dredging equipment.
- Vegetation clearing permit needed for pipeline installation, with potential delays from inter-agency coordination.
- Longer project timeframe to allow for Geobags installation, adding complexity to project management.
- Noise impacts for residents due to booster pumps and extended campaign duration.
- There is a lack of demand of erosion protection at this location as the City’s current strategy in their Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) is to retreat.
- Does not conform to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.

Cost

Total Estimated Cost: $2,280,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $50.67/m^3

Key Cost Assumptions:

- Pumping distance ~2.5km, requirement for minimum of 2 booster pumps (+operator to manage during dredging)
- Expected Hire of Front-End Loader at Point Moore to assist with material distribution if required and complete profiling works post campaign
- Incorporating expected inefficiencies when operating with multiple booster pumps and Geobags
- Assuming 160 Geobags to be used for trial (~600T of material) – quoted by Geofabrics Australia
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the 'Mudlark I' CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.3 Hydraulically pumped to Pages Beach and trucked to Greys Beach

This option aims to address erosion at Greys Beach by hydraulically pumping dredged material from the FBH area to Pages Beach, where it is dewatered, then transported by truck to Greys Beach. Greys Beach has been identified as a high-priority area for erosion mitigation. However, the project involves substantial logistics, including approximately 2,400 truckloads over a 4 km route. This method generates a notable CO2 footprint and requires careful management of both trucking routes and dewatering facilities to minimise environmental and community impacts.

Methodology

A CSD will pump material as a slurry from the FBH to Pages Beach, where a dewatering facility will be set up. Once dewatered, the material will be loaded onto trucks and transported approximately 4 km to Greys Beach. Given the erosion-prone nature of Greys Beach, the access points are limited, necessitating a longer trucking route and the use of civil plant equipment to distribute the material appropriately. Traffic management plans and environmental permits, including approvals for any required vegetation clearance, will be necessary.

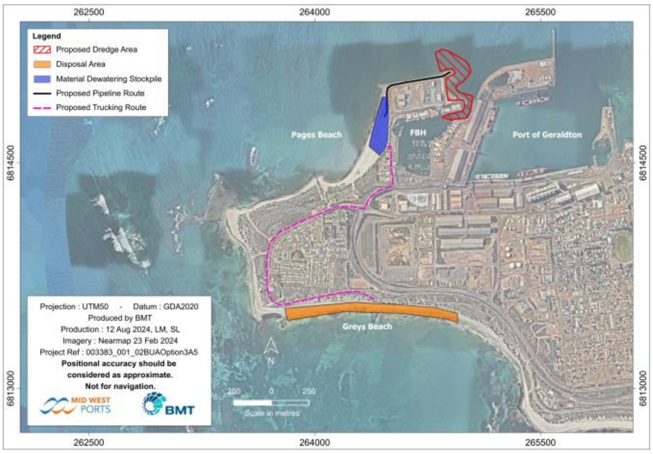

Figure 4.3 Option 3 schematic and example of a bunded area used for dewatering

Advantages

- Targets a known erosion hotspot at Greys Beach, providing sediment to the area.

- Established relationships with local contractors who have previously completed similar work, facilitating smoother project execution.

Disadvantages

- Increased emissions due to trucking, with ~2,400 truckloads generating an estimated 1.01 tonnes of CO_2.
- High dust risk from stockpiling material on Pages Beach, potentially exacerbating local environmental concerns.
- Traffic management plan for truck routes through residential areas.
- Limited access points at Greys Beach may necessitate alternative access routes, requiring vegetation clearance approvals.
- Known aboriginal heritage location at the disposal location, additional management would be required.
- The material is being double handled increasing the cost, time and risk to the project.
- Pages Beach is known to be inundated on large tide and swell events, there is a risk that any material placed here may be eroded if a large storm event was to occur.
- Does not conform to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.

Cost

Total Estimated Cost: $2,210,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $49.11/m^3

Key Cost Assumptions:

- Pumping distance ~1km, no booster pumps required
- Expected Hire of Front-End Loader/Excavator to assist with establishing/management of dewatering facility of Pages Beach and profiling/back-blading works at Greys Beach
- Trucking costs from previous MWP sand bypassing projects in March 2024
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the ‘Mudlark I’ CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.4 Hydraulically pumped to Pages Beach and trucked to Point Moore

This option involves hydraulically pumping dredged material from the FBH area to Pages Beach, where it is dewatered and then transported by truck to Point Moore. Point Moore has been identified as an erosion hotspot; however, with the recent removal of the marine rescue building, the urgency of demand has decreased. The project involves a significant volume of trucking, estimated at around 2,400 truckloads over a 4 km route, which will require thorough traffic management planning to mitigate impacts on the community.

Methodology

The dredging will be carried out using a CSD, which will pump material in a slurry form to Pages Beach. A dewatering facility will be set up at Pages Beach, where the material will be stored and then loaded onto trucks for transport to Point Moore. The area around the recently demolished marine rescue building can serve as a disposal location. While there are established access points, significant erosion has led to steep scarps, which may necessitate additional civil works to ensure safe placement of material. Approval for the trucking route, as well as traffic and dust management, will be key components of this option.

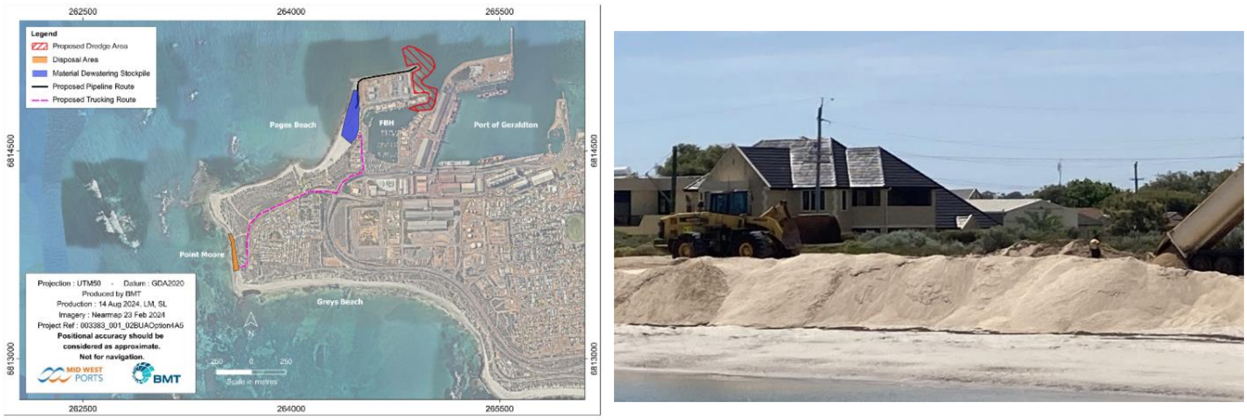

Figure 4.4 Option 4 schematic and example of sand placement via trucking

Advantages

- Utilises an area at Point Moore that already has existing access points, making transport and material placement more straightforward.
- The operation is unlikely to disrupt activities in the FBH and Port, reducing potential operational conflicts.
- Established relationships with local contractors who have experience with similar projects, facilitating smoother project execution.
- Targets an erosion hotspot at Point Moore, providing sediment to the area.

Disadvantages

- Emissions due to trucking are significant, with approximately 2,400 truckloads generating an estimated 1.01 tonnes of CO_2.
- Dust risk associated with stockpiling material at Pages Beach, this may impact the local environment and require additional mitigation strategies be implemented.
- Pages Beach is known to be inundated on large tide and swell events, there is a risk that any material placed here may be eroded if a large storm event was to occur.
- Trucking route through residential areas necessitates a traffic management plan, increasing project complexity and community impact.
- Demand for material at Point Moore is reduced since the asset at risk has already been removed.
- Does not conform to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.

Cost

Total Estimated Cost: $2,210,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $49.11/m^3

Key Cost Assumptions as per option 3.

4.5 Hydraulically pumped to Pages Beach and trucked to northern beaches

This option involves hydraulically pumping dredged material from the FBH area to Pages Beach for dewatering, followed by trucking the material to the northern beaches. There is a significant demand for material along these beaches, particularly at Beresford Beach, with a requirement beyond the typical annual allocation of approximately 12,500 m^3. However, the extended trucking distance will increase both turnaround time and project costs, necessitating careful traffic management and planning to minimise community impact.

Methodology

The dredging will be performed using a CSD, with material pumped as a slurry to Pages Beach. At Pages Beach, a dewatering facility will be established, after which the material will be transported by truck to the northern beaches. The logistics will mirror the biannual sand bypassing operations, with the duration and project timeline highly dependent on the number of trucks available. Traffic management plans will be essential for both Pages Beach and the northern beaches to manage impacts on residential areas and ensure safe transport.

Figure 4.5 Option 5 schematic and example of civil plant from previous MWPA works

Advantages

- High demand for material at the northern beaches, providing beneficial use and addressing coastal erosion needs.
- Conforms to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.
- Operation follows established processes similar to the current biannual sand bypassing, allowing for an efficient setup and familiar logistics.
- Local contractor availability to manage the trucking and disposal, building on experience with similar projects in the region.

Disadvantages

- Increased emissions and costs associated with the lengthy trucking route to the northern beaches.
- Dust risks from stockpiling material at Pages Beach, requiring environmental and community management measures.
- Pages Beach is known to be inundated on large tide and swell events, there is a risk that any material placed here may be eroded if a large storm event was to occur.
- Significant impact on the community due to trucking through residential areas, necessitating a comprehensive traffic management plan.
- Double handling of material, which increases project costs and campaign duration, particularly with the longer trucking distance.

Cost

Total Estimated Cost: $2,220,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $49.33/m^3

Key Cost Assumptions:

- Pumping distance ~1km, no booster pumps required
- Expected Hire of Front-End Loader/Excavator to assist with establishing/management of dewatering facility of Pages Beach and profiling/back-blading works at Northern beaches placement sites
- Trucking costs from previous MWP sand bypassing projects
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the 'Mudlark I' CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.6 Hydraulically pumped to Pages Beach and trucked to northern beaches (utilising geotubes for dewatering)

This option involves hydraulically pumping dredged material from the FBH area to Pages Beach, where it will be dewatered using Geotubes. Once the material is dewatered, it will be trucked to the northern beaches to meet the significant demand for sediment replenishment beyond the annual allocation of approximately 12,500 m^3. The use of Geotubes for dewatering could reduce dust and sediment loss; however, to account for the required amount of geotubes there would need to be a large area for placement and the cost could exceed $5 million, rendering this option unfeasible.

Methodology

The dredging will be conducted using a CSD, with the slurry pumped to Pages Beach for dewatering. Geotubes will be used to contain the sediment, reducing dust and allowing material to be stored until it is trucked to the northern beaches. Front-end loaders will assist in managing the Geotubes and profiling the sand once it reaches the disposal site. This setup mirrors existing biannual sand bypassing operations, although traffic management will be necessary due to the extended trucking distance through residential areas.

Figure 4.6 Option 6 Schematic and example of geotubes stockpile

Advantages

- Significant demand for material at the northern beaches, providing an effective use for the dredged material.
- Conforms to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.

- Utilisation of Geotubes for dewatering helps contain sediment and minimises dust, reducing environmental impact.

Disadvantages

- High costs associated with Geotubes, which could make this option economically unfeasible.
- Extended campaign duration due to double handling and long trucking distances, increasing both costs and logistical complexity.
- Community impact due to trucking routes through residential areas, necessitating a detailed traffic management plan.

Cost

Total Estimated Cost: $4,790,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $106.44/m^3

Key Cost Assumptions are as per options 2 & 5.

4.7 Hydraulically pumped to Beresford Beach directly

This option involves hydraulically pumping dredged material directly from the FBH area to Beresford Beach, eliminating the need for trucking. This option addresses material demand at Beresford Beach and simplifies logistics by not requiring secondary handling. However, the long pumping distance (~2-3 km) necessitates the use of two diesel-powered booster pumps (possibly 1 floating booster), which, along with the dredge, contribute to a significant emission footprint. Additionally, the pipeline route will need to be carefully planned to avoid sensitive areas, such as seagrass meadows, and may involve approvals related to environmental and heritage considerations.

Methodology

Dredging will be performed using a CSD, with slurry hydraulically pumped from the dredging site to Beresford Beach. A pipeline with both floating and submerged components will be used to accommodate vessel traffic, supplemented by two booster pumps to manage the extended pumping distance. A front-end loader will assist with sand profiling at the disposal site to maintain beach aesthetics. The pipeline route and pump placement will need to balance operational needs with minimising environmental impacts, particularly on seagrass meadows and near residential areas.

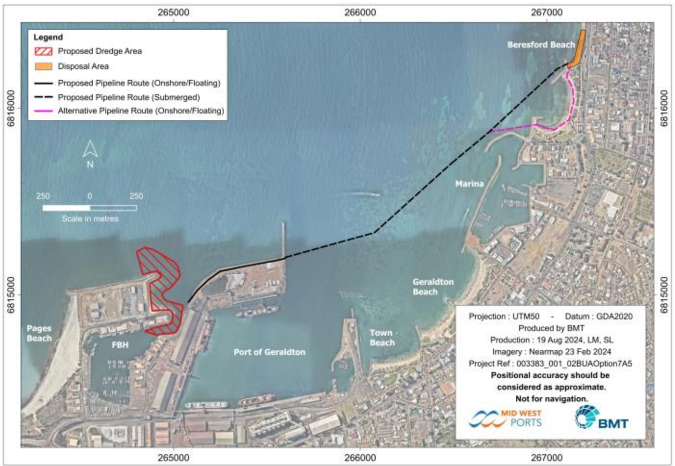

Figure 4.7 Option 7 schematic and example of pumping to the beach compartments directly

Advantages

- Directly addresses sediment demand at Beresford Beach without requiring trucking, reducing logistical complexity.
- Conforms to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.
- Single contractor setup, simplifying project management and reducing the need for coordination with multiple operators.
- Avoids double handling of material, decreasing the potential for sediment loss and reducing project costs compared to options requiring trucking.

Disadvantages

- Long pumping distance requires additional booster pumps, which increase noise and emissions, impacting nearby residential areas.
- Complex pipeline layout and route approvals, with the potential for environmental disturbance, particularly in sensitive habitats like seagrass meadows.
- Floating and submerged pipelines may pose navigational risks to FBH, The Port, and Marina users, requiring additional markers and buoys.
- Navigational risks associated with submerged pipeline sections across the Port's shipping channel, potentially affecting under-keel clearance.
- Larger dredge required to be able to appropriately make the pumping distance without significant drop in production

Cost

Total Estimated Cost: $2,380,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $52.89/m^3

Key Cost Assumptions:

- Pumping distance ~2.8km, requirement for minimum of 2 booster pumps (+operator to manage during dredging) One of the boosters may be floating which will require addditional marine support craft.
- Expected Hire of Front End Loader at Beresford Beach to assist with material distribution if required and complete profiling works post campaign
- Incorporating expected inefficiencies when operating with multiple booster pumps
- Additional costs for mobilisation/demobilisation associated with construction and positioning of pipeline
- Utilising a submerged pipeline with no standby included for uncoupling or coupling of a floating pipeline.
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the ‘Mudlark I’ CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.8 Nearshore Disposal Area utilising Barge system

This option involves utilising a Backhoe Dredge (BHD) with mechanical disposal via a barge system to transport dredged material to a designated nearshore disposal area approximately 4 km from the FBH. This approach avoids placing sediment on public beaches and eliminates truck routes, which can reduce social impacts. However, this method has a high carbon footprint due to the significant fuel consumption of the barge and tug operations. Additionally, the complex logistics, high financial costs, and potential for increased operational downtime pose challenges.

Methodology

The dredging will be conducted using a BHD, which will load dredged material directly onto a barge. For efficient operations, two bottom-dumping barges, supported by tug(s), would be required due to the sailing time between the dredge area and the disposal site. This setup would also involve additional support vessels for crew transfers and mooring arrangements during non-operational hours. The dredge areas are too narrow for a Trailer Hopper Suction dredge to enter. The dredging would have to be completed with a Backhoe Dredge (BHD) as dredging using a CSD and disposing in a barge for offshore disposal has not been completed by any local based Australian company and is high risk (Safety and Environmental).

Figure 4.8 Option 8 Schematic and example of loading a barge using a BHD

Advantages

- Minimal social impact, as the entire operation takes place offshore, avoiding interference with public beaches and roadways.
- Reduced dust and onshore disturbance since material is disposed directly offshore.
- Single disposal site minimises the complexity of handling multiple land-based disposal sites.
- Material is not double handled and will be permanently moved out of the system.

Disadvantages

- BHD production rates are based on bucket size, assuming 3-5m3 bucket it would be ~50m3/hr which is significantly slower than utilising a CSD.
- BHDs also have lower operability limits than CSD which would mean larger weather standby would be required if this option was selected which would extend the campaign further.
- Due to the extended sailing time to the nearshore disposal location, the BHD would experience significant downtime unless two barges are used.
- These bottom-dumping barges are not self-propelled, necessitating tug(s) to transport them to and from the disposal site. With 12-hour dredging shifts, all equipment would require protected mooring during non-operational hours.

- Currently, there is no known location within the FBH or Port capable of accommodating all the necessary vessels.
- There would also be increased vessel movements in the area which would impact both the FBH and the Port to some capacity.
- There are no BHDs of the required size currently available in Western Australia. Therefore, sourcing a suitable BHD from another state would be necessary, along with two bottom-dumping barges and tug(s). The mobilisation process would be costly and require additional lead time. In comparison, there are three CSDs available that could commence the works by September 2025.
- High emissions and large carbon footprint from barge and tug operations, which require continuous fuel use for transporting materials.
- Disposal at the nearshore site could create sediment plumes, potentially impacting nearby seagrass meadows and benthic habitats.

Cost

Total Estimated Cost: $3,330,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $74.00/m^3

Key Cost Assumptions:

- Costings estimates-based Pricing for Hopper barge (similar spec to TAMS North)
- Incorporating inefficiencies with dredge on stand down during barge transport to disposal
- Downtime included between barge transport to disposal (no dredging)
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

4.9 Hydraulically pumped to Town Beach directly

This option was raised during the BUA workshop by the City of Greater Geraldton (CGG). It involves using a CSD to transport dredged material as a slurry from the FBH to Town/Geraldton Beach via an approximately 1.5-2 km pipeline, with one diesel-powered booster pump to maintain the necessary pressure for the distance. This approach avoids the need for trucking, reducing social impacts, but it introduces environmental and navigational concerns due to the pipeline's potential interference with seagrass meadows, sea lion habitats, and port operations.

Methodology

A CSD would be used to pump dredged material through a pipeline running from the FBH to Town/Geraldton Beach. The pipeline, incorporating floating and submerged sections, would navigate sensitive marine habitats and busy port operations, necessitating careful layout and planning. One booster pump would be installed along the pipeline to support the flow, and a front-end loader would manage sand profiling on Town/Geraldton Beach to improve visual amenity.

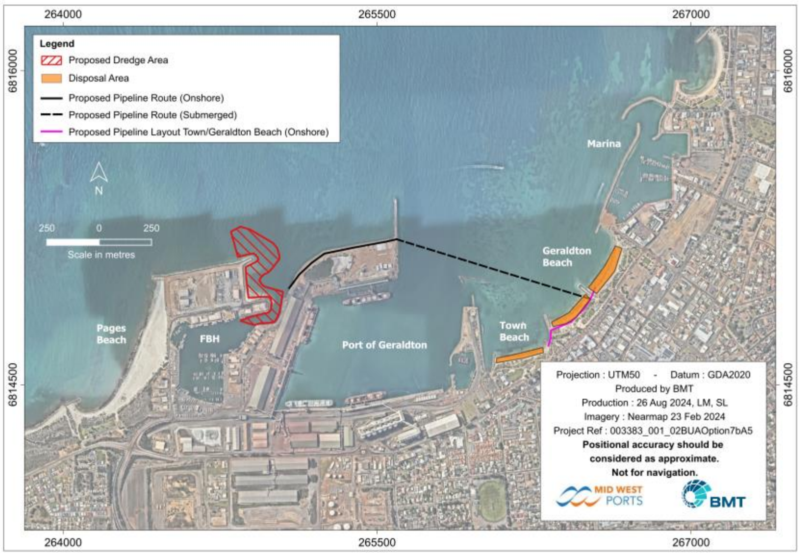

Figure 4.9 Option 9 Schematic

Advantages

- No double handling of material, as it is transported directly from the dredge to the disposal site, improving efficiency.
- Conforms to the sand bypassing strategy to permanently moving the material outside of the system to the northern beaches.
- Reduced social impacts by avoiding road transportation, eliminating dust and noise impacts on residential areas, and limiting truck traffic.
- Simplified operations with a single contractor managing the dredging, reducing logistical complexity.

Disadvantages

- High emissions footprint from the diesel-powered booster pump, impacting air quality.
- Potential negative effects on sensitive marine habitats, including seagrass meadows and a sea lion habitat near the proposed pipeline route.
- Noise impacts from the booster pump, especially near residential areas and sensitive coastal habitats.
- Navigational risks associated with submerged pipeline sections across the Port's shipping channel, potentially affecting under-keel clearance.
- Turbid plumes associated with uncontrolled disposal could smother or shade benthic habitats, impacting local marine biodiversity.

Cost

Total Estimated Cost: $1,970,000 (Confidence Level: Class 4 estimate, with a range of +50% to -30%)

Unit rate: $43.78/m^3

Key Cost Assumptions:

- Pumping distance ~1.8km, requirement for minimum of 2 booster pumps (+operator to manage during dredging)
- Expected Hire of Front- End Loader at Town Beach to assist with material distribution if required and complete profiling works post campaign

- Additional costs for mobilisation/demobilisation associated with construction and positioning of pipeline
- Production and Availability averages have been used from the previous 2022 FBH Maintenance Dredging Campaign which was completed using the ‘Mudlark I’ CSD
- Target Volume: 45,000 m^3
- All costs have been escalated to 2025 (QTR SEP 2025) using an assumed factor of 5% (based off previous annual index increases)

5 Multi Criteria Analysis

The MCA was completed as a two-step process in a workshop environment utilising the criteria from the 2022 MCA:

1. Agreement of the relative weighting of each criterion
2. Application of criteria to the shortlisted options

This process was completed in a workshop held on the 22 August 2024. The workshop was attended by a working group of representatives from MWPA, The City of Greater Geraldton, NACC, O2 Marine and BMT.

5.1 Criteria

The criteria utilised was developed as part of the 2022 MCA process and aligns with the MWPA strategic goals and objectives. It includes a total of six evaluation criteria across sustainable resource opportunity, approvals and planning, operations, constructability, social and environmental aspects and financial categories.

Category	Criteria	Description (areas of differentiation)	Interpretation for dredging
Opportunity	Enabling use of resources through sustainable development / waste minimisation	- Alignment with port strategy and PMP / strategic land use intent - Avoids significant loss of future trade opportunities - Contributes to regional economy (e.g. local employment, trade growth, tourism, regional development/ research opportunities) - Protects critical (port + community) assets from future degradation (i.e. reduces coastal erosion/ inundation risks) - Scalable or provides long -term solution for beneficial use of dredge material - Waste minimisation	**Timeframe: Long-term** - Dredged sediments are beneficially re-used - Supports the 2020 Masterplan
Approvals/ Land Use	Planning & Delivery	- Timelines - Complexity of required approvals - Interactions with other existing operations and infrastructure - Development dependencies (linkages to other projects critical for success)	**Timeframe: Pre-works planning** - Time and difficulty of getting all approvals
Operation	Operability	- Short term / intermittent impacts to navigation - dredge & commercial vessels - Accessibility from land and/ or water - Extent of disruption to port operations - Safety - vessel interactions, dewatering operations, traffic impacts	**Timeframe: During & immediately post works** - **Impact to customers** during dredging - Achieve the desired outcome for customers
Constructability	Construction fronts/schedule	- Constructability issues - Complexity (including interactions with existing materials handling infrastructure) - Number of construction fronts - Period to construct - Stageability - Impact on existing operations	**Timeframe: During works** - Ease for a **Contractor** to deliver the works - Ability to deliver the Works within the project schedule
Social & Environmental Aspects	Social impacts and Impacts on the Environment & Public Health	- Amenity and public health (noise, dust, noise, odours) impacts - distance to sensitive receptors - Scale of disturbance to marine habitat, water quality vulnerable/ protected species (e.g. Sea Lions) - Scale of disruption to commercial fisheries - Scale and duration of disturbance to community areas/ activities - Recreational fishing impacts e.g. rock lobster	**Timeframe: During & immediately post works** - Social impacts - Environmental impacts
Financial	Financial aspects	- Capex & Opex costs - Scale of investment and return on investment - Costs provide economic value to user - Potential for external investment e,g, investment from CGG, link to capital dredge program, share mobilisation cost	**Timeframe: During works** - Overall cost - Value for money

Figure 5.1 MCA Evaluation Criteria (Wavelength, 2022a)

5.2 Rating

The criteria were evaluated in relation to one another to establish the relative weighting of each, using the initial values from the 2022 MCA as a baseline. This comparative approach encouraged discussion within the working group on the current significance of each criterion in today's metrics.

Criteria		Criteria B					
		Sustainable Resource Use / Waste Minimisation	Planning and Delivery	Operability	Construction fronts/ schedule	Social, Environmental or Public Health Impact	Financial Aspects
Criteria A	Sustainable Resource Use / Waste Minimisation						
	Planning and Delivery	B					
	Operability	A	B				
	Construction fronts/ schedule	A	B	B			
	Social, Environmental or Public Health Impact	B	A	B	A		
	Financial Aspects	B	B	A	A	A	

Figure 5.2 Criteria Weighting Comparison Summary

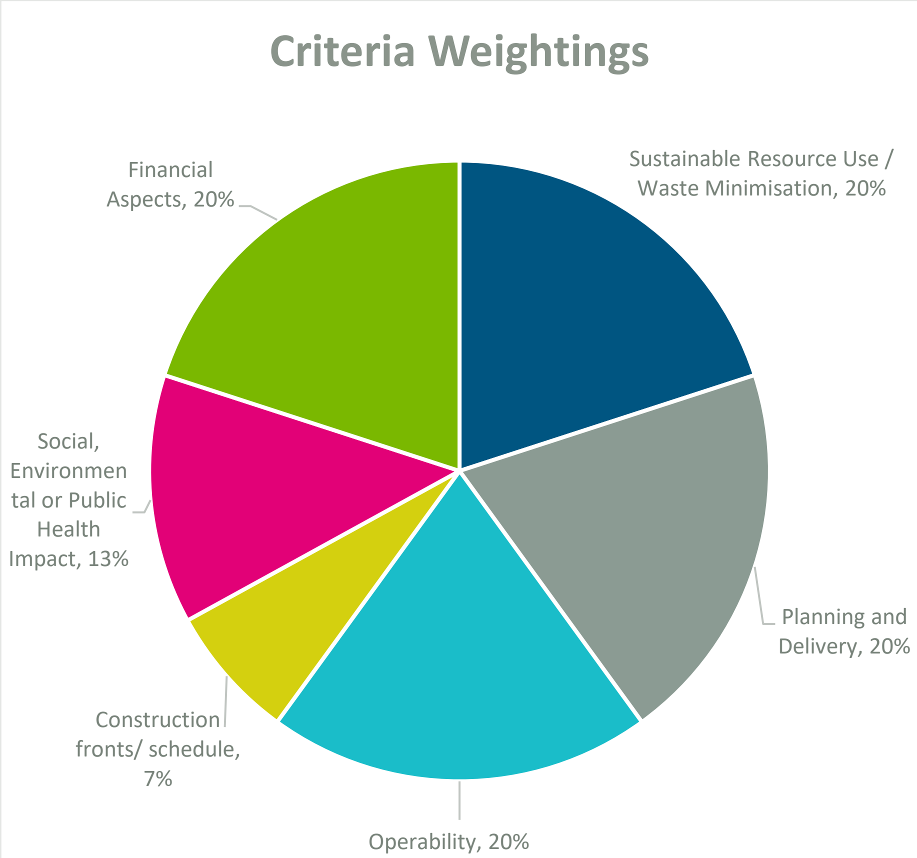

Figure 5.3 Criteria Weighting

5.3 Evaluation Summary

The workshop reviewed and evaluated the options detailed in Section 4 against the criteria in Figure 5.1 on a score of 1-5 with 1 being Very Poor performance and 5 being excellent performance. The chart of unweighted results has been attached as Annex A and the weighted results from the MCA shown in Figure 5.4.

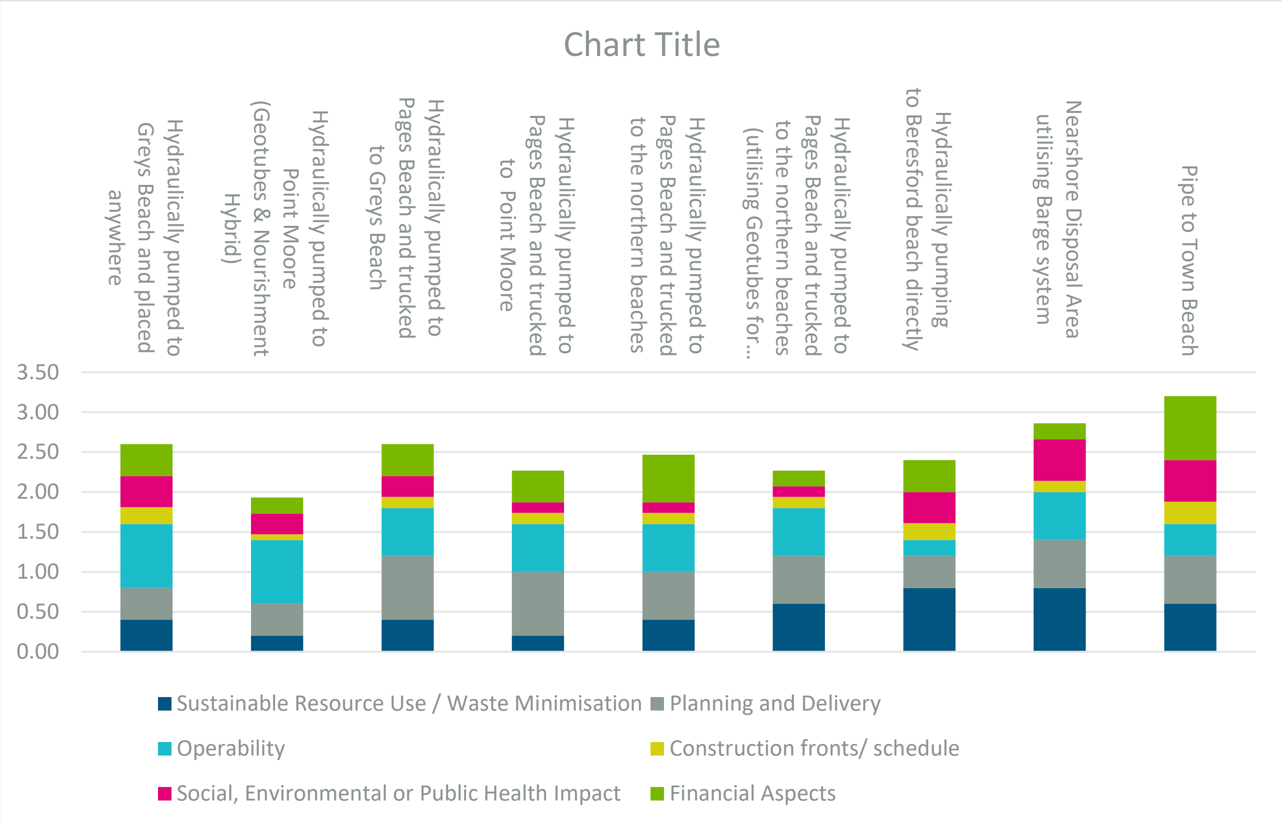

Figure 5.4 Weighted Assessment Results

5.4 Discussion Points

During the workshop several key points were raised, these have been summarised below:

- The sustainable resource use criteria were highlighted as of greater priority to MWPA comparative to the 2022 BUA workshop.
- The use of Geobags and their potential impact necessitates further coastal shoreline modelling to understand their effectiveness at the proposed placement location to trap sand and how it would impact the surrounding coastlines.
- The Port utilising a dynamic under keel clearance system, MWPA emphasised the risks associated with any pipeline (submerged or floating) being placed across the Shipping channel.
- It was noted that the placement of sand at Point Moore is not preferred. This was because it could mislead the community into believing that by placing sand in this area, MWPA is taking responsibility for its protection. However, it's important to clarify that Point Moore is actually designated for retreat under the CHRMAP framework.
- The significant number of trucks required for transporting the required volume does not align with the MWPA Net zero commitment.
- By choosing a Backpassing option the sand will travel back into the FBH entrance over the next few years anyway, MWPA preference is for an option which allows for the sand to move out of the system, north of the Port.

6 Additional Hybrid Options

After internal discussion MWPA provided 3 additional hybrid options for consideration.

6.1 Hybrid Option 1: 4 weeks of dredging to Town Beach and the remainder trucked

The initial hybrid dredging option proposed a two-stage approach:

- an initial four-week trial (Stage 1) where material is pumped from the FBH entrance through a floating pipeline across the shipping channel to Town Beach

- followed by moving the pipeline to Pages Beach for extended dewatering and trucking to the Northern Beaches (Stage 2).

In Stage 1, a CSD would pump material via a pipeline along the back of Berth 7 and then floated across the shipping channel and submerged across Champion Bay. The decision for utilising a floating pipeline across the shipping channel minimised the risks associated with the under keel clearance of vessels and allowed for decoupling (up to four times daily) for ship movements. During this period, earthmoving equipment would be used on Town Beach to manage sediment, with allowances for rehabilitating access tracks to minimise disruption to pathways and gardens. After four weeks, the pipeline would be relocated to Pages Beach, where material would be dewatered and trucked to the northern beaches. By trailing the floating pipeline on Town Beach, this plan allows for testing production rates for a future permanent pipeline solution. This option limits Town Beach activity to a shorter duration, and moves extended operations to Pages Beach, where there is more experience managing dredged materials and activities.

Advantages
- Floating pipeline flexibility with detachments for shipping movements.
- Reduced duration of pumping and earthmoving equipment on Town Beach (4 weeks vs. 12–17 weeks).
- Transporting material north mitigates potential re-entry of sediment into the FBH.

Disadvantages
- Significant downtime and costs associated with uncoupling and coupling of the pipeline for vessel movements, with up to 4 per day, ~2 hrs each time. Permanent anchor handling vessel required.
- Multiple work types incurring additional costs associated with planning and restructuring the pipeline between stages.
- Increased emissions and costs associated with the lengthy trucking route to the northern beaches.
- Dust risks from stockpiling material at Pages Beach, requiring environmental and community management measures.
- Significant impact on the community due to trucking through residential areas, necessitating a comprehensive traffic management plan.
- Double handling of material, which increases project costs and campaign duration, particularly with the longer trucking distance.

6.2 Hybrid Option 2: 4 weeks of dredging to Town Beach, some to the back of Berth 7 and remainder to Pages Beach

The second hybrid option proposed a four-week trial period where sediment is pumped from the FBH entrance to Town Beach via a floating pipeline similar to hybrid option 1. Then a portion of material to be deposited in the corner behind the Berth 7 reclamation area and the northern harbour entrance rock wall and the remainder directed to Pages Beach for dewatering and trucking to the Northern Beaches. The dredging process in FBH would be similar to hybrid option 1 with . Following the four-week trial on Town

Beach, sediment placement would move to the corner and Pages Beach, where dewatering equipment and trucking routes are already established. This option reduces direct impact on Town Beach, allows material to be managed in more familiar areas on Pages Beach, and offers a trial of the pipeline system in multiple sites.

Advantages

- Floating pipeline allows detachment for ship movements.
- Limited Town Beach activity to four weeks (vs. 12–17 weeks) reduces direct impact.
- Northward transport of material reduces re-entry of sediment into FBH.

Disadvantages

- Increased costs associated with pipeline decoupling and relocation.
- All the same disadvantages are hybrid option 1

6.3 Hybrid Option 3: 4 weeks of dredging to Town Beach and the remainder to the Back of Berth 7

The third hybrid option proposed a four-week period where dredged sediment is placed on Town Beach, with the remaining material pumped directly to the corner behind Berth 7 Reclamation area, rather than Pages Beach, which removes the need for extended trucking and relocation to the Northern Beaches. Similar to Hybrid Option 1, sediment would be pumped along the established pipeline route from Berth 7, with an outfall back over the rock wall, utilising natural transport pathways. This approach offers ease of access as it avoids trucking and uses established pipeline paths, reducing overall relocation complexity while still allowing for four weeks of targeted sediment deposition at Town Beach.

Advantages

- Floating pipeline allows detachment for ship movements.
- Limited Town Beach activity to four weeks (vs. 12–17 weeks) reduces direct impact.
- Northward transport of material reduces re-entry of sediment into FBH.
- Pumping directly to the corner from the dredge simplifies operations and removes the need for booster pumps.
- Follows the same pipeline path as prior operations, with an outfall over the Berth 7 rock wall.
- Placement in the corner aligns with natural sediment transport pathways.

Disadvantages

- Increased costs associated with pipeline decoupling and relocation.
- Risk of smothering benthic communities, although approvals are being sought for future reclamation through Port Maximisation Project (PmaxP). However, the area falls within the Development Envelope (DE), currently under Part IV assessment for PMaxP, so cannot be pursued as a parallel clearing permit for this area.
- Potential for an unknown amount of sediment to move around the corner into the main channel, which would require additional management during future maintenance dredging.
- Less immediate benefit to the northern beaches, as material is not directly transported there.

7 Further Analysis of additional criteria

After the inclusion of the three hybrid options MWPA provided additional criteria for all options to be compared, this included:

3. Cost: OPEX not larger than $3M
4. Pipeline Layout: No submerged pipeline within the shipping channel
5. Working footprint: No overlap with Pmax Project proposal boundary
6. Sand Placement in the larger regional cell system: Sand is moved past the Port to ensure no additional management is required at a later stage.

Each option was scored against these criteria as either meeting the criteria (Y) or not meeting the criteria (X), the findings are shown in Table X.

Table 7.1 Additional Criteria Assessment

ID	Option Title	Cost	Pipeline Layout	Working Footprint	Sand Placement	Reason why option was not selected
1a	Hybrid option 1 (4 weeks to town beach, remainder trucked)	X	X	Y	Y	The submerged pipeline over the shipping channel is not feasible with the current depths shown in the March 2024 Bathymetry. The costs associated with this option was significantly larger than other options which moved material past the port.
1b	Hybrid option 2 (4 weeks to town beach, some at the back of Berth 7 rock wall, rest on Pages)	X	X	X	X	Benthic habitat mapping show seagrass in the area behind Berth 7, therefore approvals would be required, and the area is within the development envelope which is now under Part IV assessment for PmaxP therefore not able to run a clearing permit in this area.
1c	Hybrid option 3 (4 weeks to town beach and the remainder at the back of Berth 7 rock wall)	X	X	X	X	Benthic habitat mapping show seagrass in the area behind Berth 7, therefore approvals would be required, and the area is within the development envelope which is now under Part IV assessment for PmaxP therefore not able to run a clearing permit in this area.
1d	Pipe to Town Beach	Y	X	Y	Y	The timeline associated with pumping all the material to town beach is not feasible as it would require the beaches to be closed for

						~18 weeks. The risks associated with having the pipe crossing the channel for this length of time was significant as well. CGG do not want the beach closed for that length of time.
2	Nearshore Disposal Area utilising BHD or CSD	X	Y	Y	Y	The costs associated with mobilising and completing the work with the required fleet (barges, backhoe dredge, tugs etc.)
3	Hydraulically pumped to Greys beach	Y	Y	Y	X	The sand is not moved out of the system and therefore will continue to affect the port.
4	Hydraulically pumped to Pages Beach and trucked to Greys	X	Y	Y	X	The sand is not moved out of the system and therefore will continue to affect the port.
5	Hydraulically pumped to Pages Beach and trucked to Northern Beaches	Y	Y	Y	Y	Option Selected - All criteria are met
6	Hydraulically pumped to Beresford beach directly	X	X	Y	Y	The submerged pipeline over the shipping channel is not feasible with the current depths shown in the March 2024 Bathymetry.
7	Hydraulically pumped to Pages Beach and trucked to Northern beaches (geotubes)	X	Y	Y	Y	Costs, timings and available land for placement of the geotubes, no added value when compared to option 5.
8	Hydraulically pumped to Pages Beach and trucked to Point Moore	X	Y	Y	X	The sand is not moved out of the system and therefore will continue to affect the port.
9	Hydraulically pumped to Point Moore	X	Y	Y	X	The sand is not moved out of the system and therefore will continue to affect the port.

8 Preferred Option

The preferred option that met the additional criteria and also meets the original objective of providing a solution that utilised beneficial use of material was found to be:

Option 5: Hydraulically pumped to Pages Beach and trucked to Northern Beaches

The preferred dredging option for the FBH entrance channel includes 16 weeks to remove 45,000m³ of material. The timeline could be shortened to 12 weeks with weekend work. A short pipeline (700-900m) will feed into a bunded dewatering area which will be built to retain 80% of the sediment before trucking to the northern beaches for nourishment of erosion prone areas.

Pros:

- Proven, low-impact method with minimal disturbance to the port and FBH.
- Permanently removes material from the system, reducing future buildup.
- Most cost-effective option that permanently removes sediment.
- The beneficial use promotes economic activity and also enhances northern beaches, providing public benefit for summer.

Cons:

- Double handling and stockpile management needed, with risks of Pages Beach being inundation.
- Longer campaign impacting local roads, with high truck traffic (2,160 loads).
- Wind and dust issues on Pages Beach; extended trucking impacts to the community.

Challenges:

- Coordination needed for multiple work fronts (dredging, trucking, sand bypassing).
- Close collaboration with CGG on sand volumes and beach profiles.
- Public notifications for Pages Beach closures and extended trucking.
- This option offers efficiency, cost-effectiveness, and summer beach improvement, while ensuring engagement with CGG and community stakeholders.

9 Recommendations

After facilitating this BUA BMT have provided several recommendations regarding future dredging campaigns and sediment management as a whole. Option 5 was selected as the preferred strategy, but it did not achieve the highest score. Therefore, BMT propose that another assessment is completed once the Pmax is completed to identify any more suitable options.

Likewise, BMT recommends a strategic approach to managing sediment in the FBH entrance channel to ensure both immediate and long-term coastal resilience. To address ongoing sand accumulation challenges, we propose the following actions:

Increase Annual Sand Bypassing from Pages Beach
Expanding the annual sand bypassing volumes from Pages Beach will create greater capacity at this site, helping to reduce sediment buildup in the channel. This approach will support ongoing navigability while providing more flexibility in managing sediment over time.

Shipping channel pipe placement viability
Incorporating a deeper dredge pipeline design route across the shipping channel, specifically where a submerged pipeline would be located, could facilitate a targeted dredging campaign down the line.

Explore a Permanent Sand Bypassing Solution
BMT suggests researching a more permanent sand bypassing system, potentially through a buried pipeline along key areas. This pipeline would have outflows at known erosional hotspots, such as Town Beach and the Northern Beaches, to stabilise these areas proactively. A land-based pipeline could be a possible option, (which would allow for the placement of containerised booster pumps to ensure suitable flow rates are achieved) is recommended for ease of maintenance and operational flexibility. This system could be configured as an automated pumping system, capable of initiating sand bypassing directly from Pages Beach as required, reducing reliance on periodic dredging and providing a responsive, adaptable solution.

Conduct Erosion and Sediment Transport Studies
Additional research into local erosion and sediment transport patterns will help fine-tune placement areas and optimise the effectiveness of a permanent bypassing solution. Data from these studies could improve pipeline outflow placement and inform coastal management strategies for the area.

Community and Stakeholder Engagement
Ongoing engagement with the City of Greater Geraldton, local stakeholders, and the community will be critical to achieving long-term coastal resilience. Collaborative efforts will ensure that any new infrastructure aligns with community needs and minimises impacts on recreational beaches.

Explore Funding Opportunities for Infrastructure Development
Investigate potential funding sources for the permanent sand bypassing solution, such as grants or partnerships, which could help offset initial installation costs while securing long-term savings through reduced dredging frequency.

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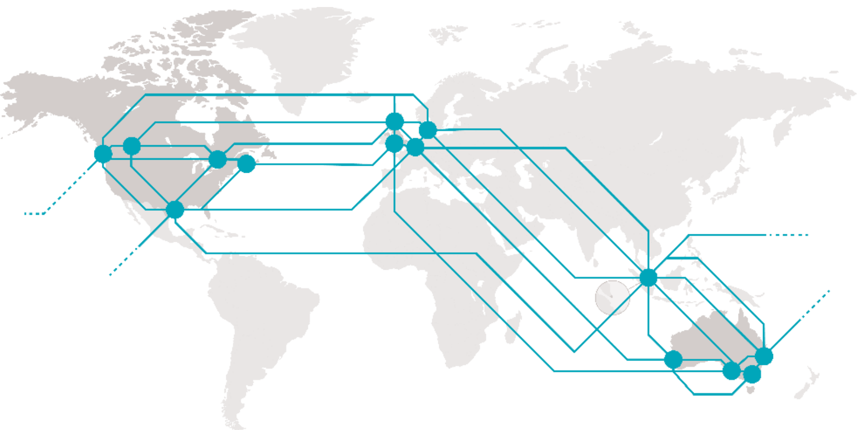
Annex A Option Analysis (BUA) Unweighted Results

Beneficial Use Option Assessment Worksheet

Score from 1 to 5 - how well does the option deliver the criteria outcomes?

1. Very poor performance/outcome expected against criteria
2. Poor performance/outcome expected against criteria
3. Sound performance/outcome expected against criteria
4. Good performance/outcome expected against criteria
5. Excellent performance/outcome expected against criteria

		Criteria						
ID	Option Title	Sustainable Resource Use / Waste Minimisation	Planning and Delivery	Operability	Construction fronts/ schedule	Social, Environmental or Public Health Impact	Financial Aspects	Unweighted Total
1	Hydraulically pumped to Greys Beach and placed anywhere	2	2	4	3	3	2	16
2	Hydraulically pumped to Point Moore (Geotubes & Nourishment Hybrid)	1	2	4	1	2	1	11
3	Hydraulically pumped to Pages Beach and trucked to Greys Beach	2	4	3	2	2	2	15
4	Hydraulically pumped to Pages Beach and trucked to Point Moore	1	4	3	2	1	2	13
5	Hydraulically pumped to Pages Beach and trucked to the northern beaches	2	3	3	2	1	3	14
6	Hydraulically pumped to Pages Beach and trucked to the northern beaches (utilising Geotubes for dewatering)	3	3	3	2	1	1	13
7a	Hydraulically pumping to Beresford beach directly	4	2	1	3	3	2	15
11	Nearshore Disposal Area utilising Barge system (CSD potential for use of backhoe dredge option)	4	3	3	2	4	1	17
7b	Pipe to Town Beach	3	3	2	4	4	4	20



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