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TO	Earl Hope-Pearson	**COMPANY**	Shelly Bay Taikuru Limited Wellington City Council
CC	Damon Winter Wayne Juno	**COMPANY**	Brian Perry Civil Holmes Consulting
DATE	7th December 2022		
FROM	Lee Griffiths		
SUBJECT	**Shelly Bay Wharf Demolition and Seawall Renewal, Methodology & Associated Risks**		

1 INTRODUCTION

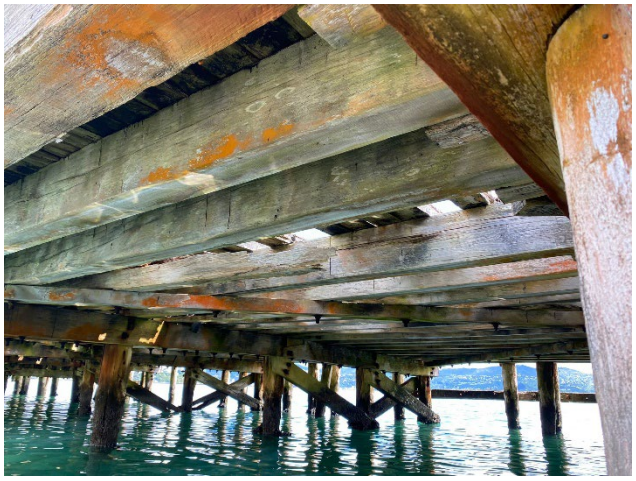
Brian Perry Civil Construction Limited (Brian Perry) have been engaged to provide Early Contractor Involvement (ECI) for the removal of the existing wharf structures and seawall renewal by Shelly Bay Taikuru Limited (SBTL). The engagement for the seawalls is part of ISPA works being undertaken by SBTL and Wellington City Council.

Brian Perry have been engaging with SBTL project team and consultant Holmes Group Limited (Holmes) specialist engineering consultant.

Brian Perry have reviewed proposed concept designs, background reports provided and undertaken site assessments on land and from water in developing the proposed renewal methodology.

The Shelly Bay wharf, seawall and structures were constructed in the mid-1940s, since this time little maintenance or repair has been undertaken to maintain the structures all of which are in significant state of disrepair with several areas of the wharf and seawall deteriorated to the point of collapse and significant failure.

The wharf pile foundation has been attached by marine borer which has led to pile failures and where not failed, has weakened the piles to the point of near failure. The headstocks and joists are in variable condition, some of which appear to be good homogeneous sections of 200 x 300 mm hardwood timber and others have weakened and collapsed. The deck has weathered to such an extent that most of which is susceptible to collapse. The fendering structures have mostly failed or collapsed because of the marine borer causing pile failure.



The condition of the existing wharf will be formative in the deconstruction methodology. It is assumed generally that no plant, equipment, or materials will be able to access the wharf deck though fear of collapse. It may be possible to complete individual assessments of the structure for access suitability however upon risk assessment we believe that at this stage it is prudent to assume no access is feasible.

In behind the wharf structure exists a significantly degraded seawall structure and structures currently being temporarily secured via Acro props and in some instances no physical restraints, where there has been significant

failure beneath the existing structures and scouring of the landholdings in others, putting the existing structures at risk of failure.

The Shed 8 structure has been identified and classified by Wellington City Council's consultants as a significant hazard area with no access permitted as there exists a risk of failure and a health and safety risk.

Once the wharf has been de-constructed, the new retention/wharf structure will be constructed from modular units. Piles will be driven for the seawall and deck structure, with precast elements forming the seawall retention frame and deck and minor cast insitu elements to tie them together.

As identified within this report the proposed solution which we view as the optimum solution based on current assessments, is however significantly constrained by the existing structures which are a health safety risk due to their current condition and the fact that they have been undermined.

As noted within this report, the elements comprising of the wharf, seawall, and existing structures, namely the Shed 8 and Shipwrights Buildings are all intrinsically interlinked and cannot be viewed in isolation. Any remedy or fix must consider the short- and medium-term risks of any intervention.

The following report provides Brian Perry Civil Construction Limited (BPC) advice on the proposed demolition and construction methodology works for the Shelly Bay Seawall and Wharf demolition and replacement.

This report has been informed through on site investigations, the review of reports prepared by Shelly Bay Taikuru Limited (SBTL) consultants and provided by Wellington City Council (WCC) and other publicly available records.

Limitations

This report has been prepared by BPC for the sole benefit of SBTL/WCC and is not to be relied upon by any third party. It was prepared with partial access to historic records and limited site investigation so is therefore subject to change or revision upon any new, relevant information becoming available. The methodologies contained herein are presented as an option for the works, actual works may vary.

Contents

2 METHODOLOGY

The methodology for the deconstruction of Shelly Bay wharf and seawall stabilisation has been assessed as individual sections of work. These sections are, mobilisation, wharf demolition, material recovery, seawall improvement, wharf framing and wharf deck. The programme attached in the appendix combines each aspect holistically.

It is worth noting this report does not consider the risk present within the existing structures and it is noted these present a significant risk to all works proposed, through the failure of the existing structures through demolition and construction of these works.

2.1 Mobilisation

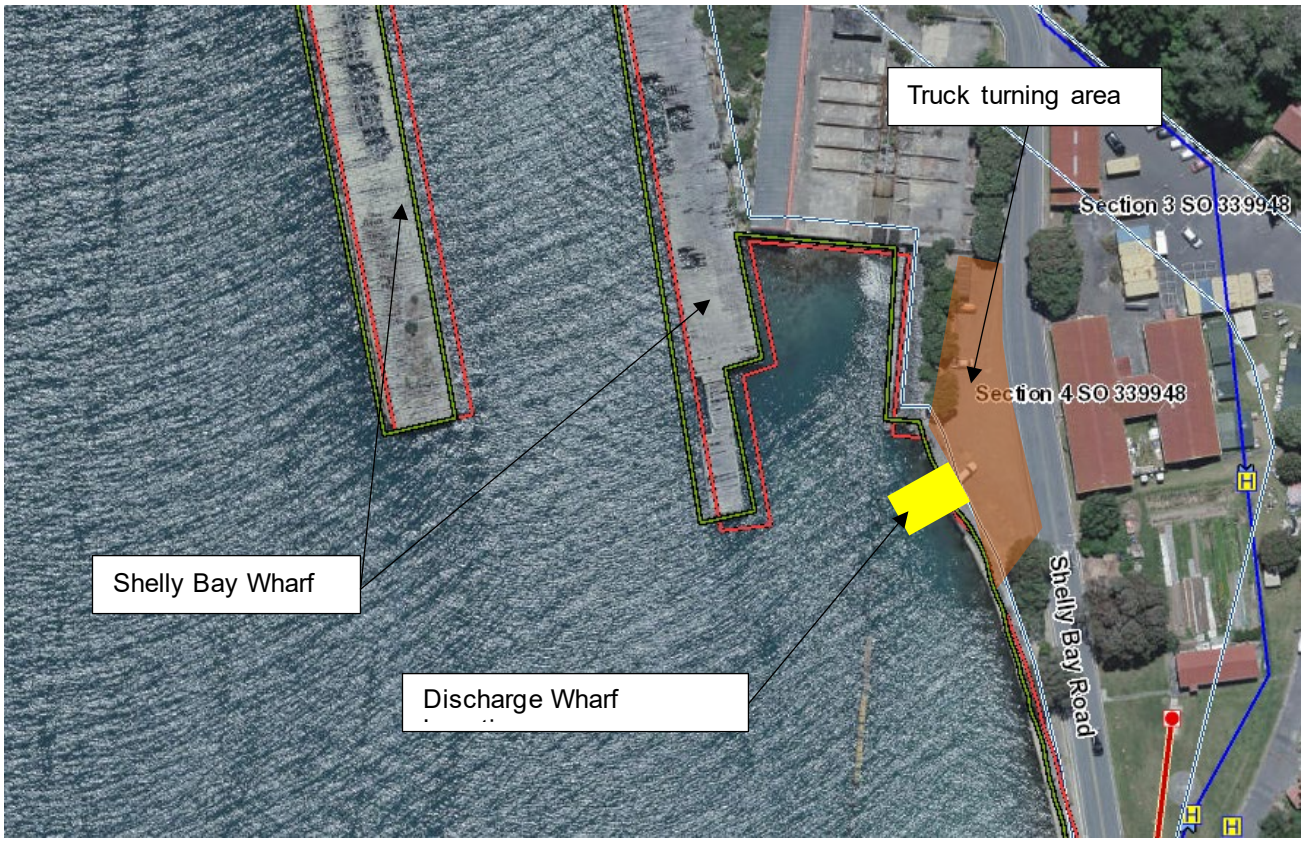
Prior to the mobilisation of the wharf demolition works BPC requires confirmation from a suitably qualified party that the existing structures will not fail through the demolition of the wharf demolition works, BPC considers the existing structures due to the significant failures (namely seawall and structural piles) to present a significant health and safety risk.

The weak nature of the existing wharf dictates that the deconstruction of the wharf needs to be completed from barges on the water and from land, if as recommended the existing structures are removed. The barges will be used to site demolition plant and to transport the demolished material back to land as to stockpiled on land.

There are several other locations around the wellington harbour which provide access to the water for material recovery which have been assessed and detailed in the table below. The criteria for a suitable recovery terminal are that there should be sufficient water depth for a barge and tug combination to move in, there should be suitable means to moor the vessels during the transfer of materials, wharf side should be strong enough to carry a c. 50-ton crane or 30-ton excavator to recover the material, and there should be sufficient access for large delivery trucks to collect the material.

#	Location	Distance to Site	Comments on Suitability
1	Shelly bay Wharf	0 mins	Existing structure is too weak to site an excavator or small crane to lift material off barges. Water depth not sufficient for barge and tug combo
2	Burnham Wharf	5 mins	Wharf is in poor condition and is unlikely to be capable of siting the unload plant. Water depth and mooring is adequate. Not sufficient turning area for trucks.
3	Evans Bay Boat Ramp	10 mins	Not sufficient water depth at point of unload for barges
4	Aotea Quay	40 mins	Water depth, mooring, quayside, and vehicle access is suitable however the wharf is mostly occupied by CentrePort operations and will be more congested at the commencement of the IRex Wellington project
5	Point Howard Staging	70 mins	Sufficient depth, mooring, vehicle access and quayside.

Points 4. & 5. Above have potential to facilitate the project however the time to site creates many in-efficiencies plus increased environmental, Health and safety impact/risk. It is preferable to construct minor temporary works onsite to facilitate the unload. The sketch below details the proposed location of material transfer. This position provides all the required attributes for unload and benefits from keeping the discharge point contained in the site.



The wharf and berthage would be constructed from approximately 12 no. piles driven into the seabed with vibratory and impact driving piling equipment. The temporary wharf structure would be made from proprietary wharf equipment, steel fabricated headstocks and beams with a precast concrete panel deck. Several of these 10 piles would form a berth face with floating fendering to support barge berthing.

Much of the floating equipment is already mobilised into the wellington harbour and would be transferred to site by tug.

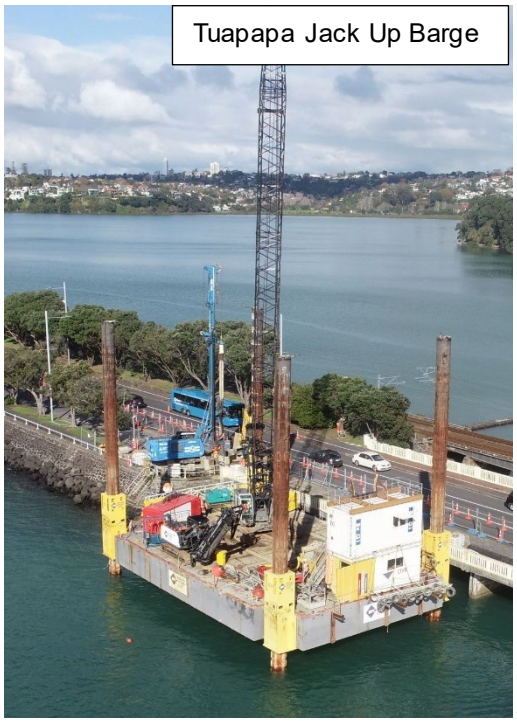
The compound would be erected in an area north of the main wharf where 3x welfare containers will be sited plus 1 x tool shed, these will be double stacked to save space. These facilities will be powered by a diesel generator and the ablution block will have a septic tank; it is possible that these services may be provided by mains connection. The compound will be fenced with 2m high site fencing and hoarded with scrim cloth. The foundations for this may be excavated into the ground.

This compound may be used as an additional storage area for the materials generated from the wharf demolition, temporary works materials and new materials purchased for the seawall stabilisation.

2.2 Wharf Demolition

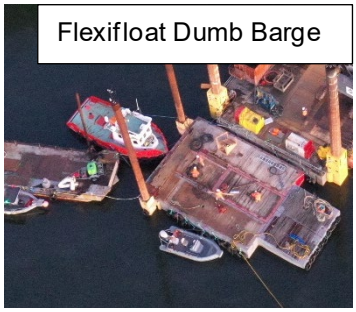
The wharf will be demolished by an excavator mounted on a construction barge. The construction barge will have spud legs to anchor itself to the seabed which are operated by a hydraulic system. This will be supplemented by an additional barge which will be used to transport the demolished material back to land. Images of these barges are shown below. The demolition equipment will be sited on either the Tuapapa jack up barge or the Kaupapa Dumb Barge and the materials transferred back to land by either the kaupapa or the Flexifloat barges. The Kaupapa and the Tuapapa are 24 m long and have 2 m draft and the Flexifloat barge is 15 m long and has a draft of 1.5 m

Tuapapa Jack Up Barge



Kaupapa Dumb Barge

Flexifloat Dumb Barge



The demolition will be completed by a long reach excavator which will be equipped with a hydraulic grab and a demolition shear. The grab will be used to pull deteriorated sections of the wharf apart starting with the deck and joists. The demolition shear will be used to cut through the stronger members of the wharf. The demolished material will be lifted onto the transport barge by the excavator. Any materials which fall off the wharf into the water during the works will be recovered by small boat if floating or by divers if the material has sunk to the seabed. A floating debris boom will be erected around the works area to prevent the straying of materials into the channel.

When the wharf deck and ancillaries have been removed from site, the piles will be cut off at the seabed by divers using pneumatic or hydraulic chainsaws.

2.3 Material Recovery

When the materials have been loaded onto the transport barge, they will be returned to the discharge point by a tugboat. An excavator or crane will lift the materials off the barge and onto the land or a waiting truck. Dependent on the condition of the material it may be treated in different ways as per the below:

Timber description	Disposal
Long timber sections in good condition	Reused in the development or sold to a salvage yard
Long timber sections in good condition with marine growth (piles)	Taken to a yard and cleaned, marine growth deposited back into the sea.
Short lengths or poor condition timber	Disposed of at licenced landfill

**Note a combination of these measures may be employed, dependent on availability of resource and demand for surplus timber.*

2.4 Seawall Improvement

Prior to the seawall demolition the structure will be assessed for the potential of any further damage caused by the repair works. This damage may be caused by (but not limited to); the existing seawall removal, vibratory, impact and bored piling works or backfilling of retention material.

The existing undermined seawall will be removed as part of the wharf demolition.

The pile line will be cleared of debris from the collapsed wharf/seawall by divers. Seabed probing will be conducted by the divers to ensure no timber has sunk below the seabed, through the sediment which may impede piling works.

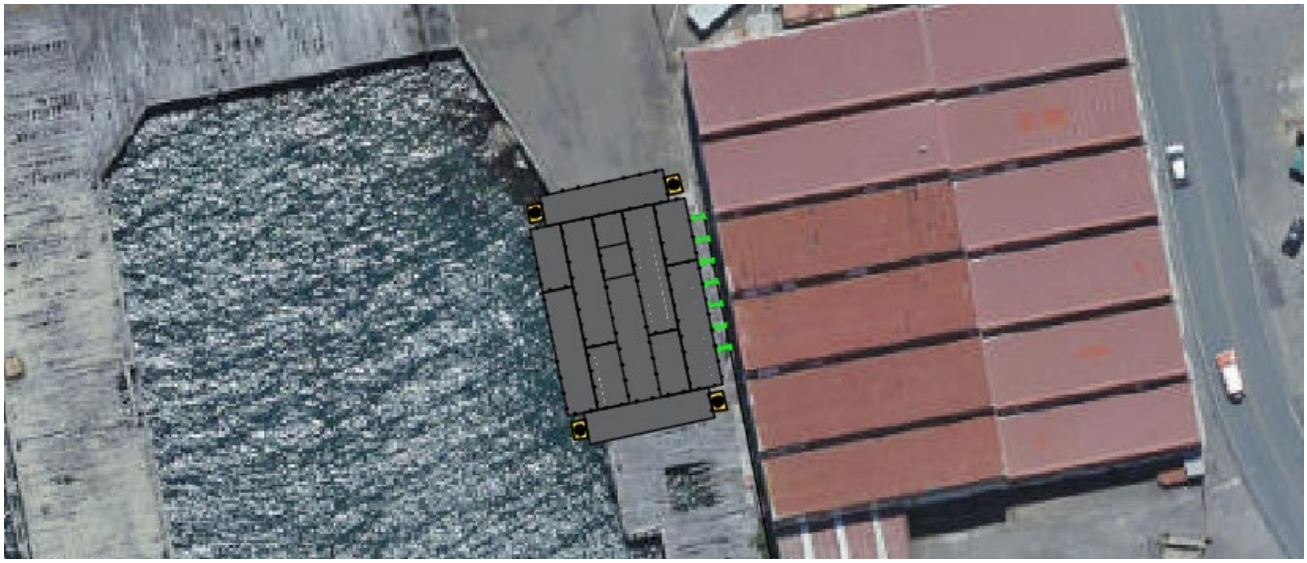
The piling works may be constructed in two ways using differing equipment. The table below summarises the methods with their plant service requirements and dependent conditions.

Method of Construction	Key Plant	Methodology Dependencies
Marine Based	Floating Barge and Jack up barge with Crane and piling hammers	Sufficient water depth throughout work area to access with vessels
Land Based	Crane and piling hammers	Design aligns with standard staging Existing shed provides sufficient space for mobile plant to slew Existing structures can carry large construction equipment Piles are driven only

Draft methodology is shown below for each of the approaches.

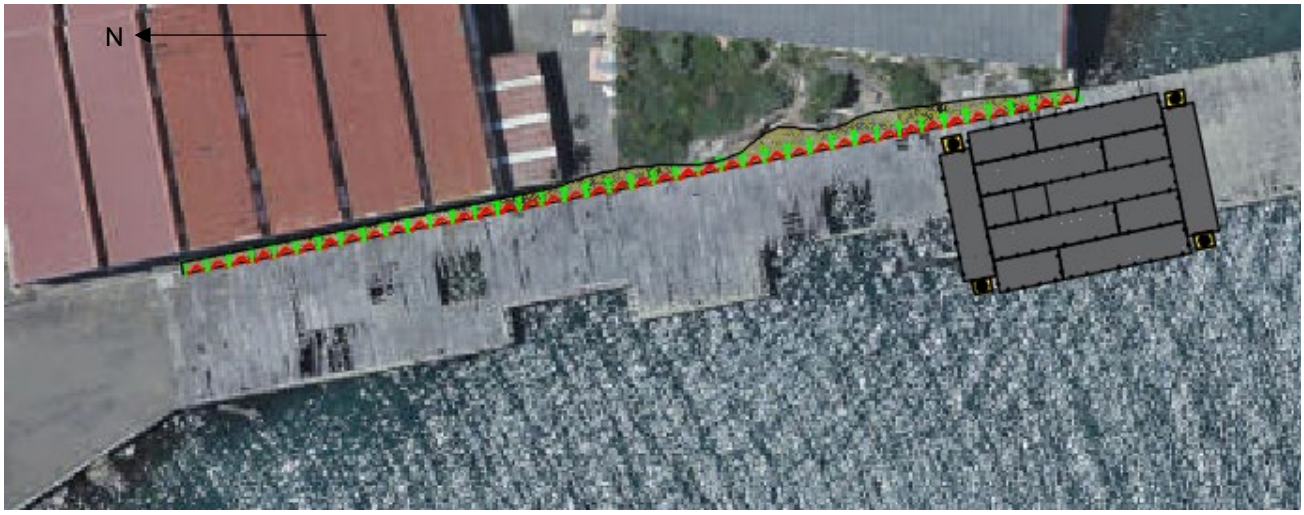
2.4.1 Marine Based Construction

The jack up barge will be positioned offset from the seawall and a piling gate erected to guide the piles vertically. The tubular piles/I beams will be driven first as shown below.



The sheet piles will be driven to infill the tubular piles as shown below.

The wall will be completed and backfilled behind with a porous cementitious fill.



The materials for the works will be provided by a dumb barge which will be pushed into place by a tugboat after being loaded at the transfer platform as depicted in the mobilisation section above.

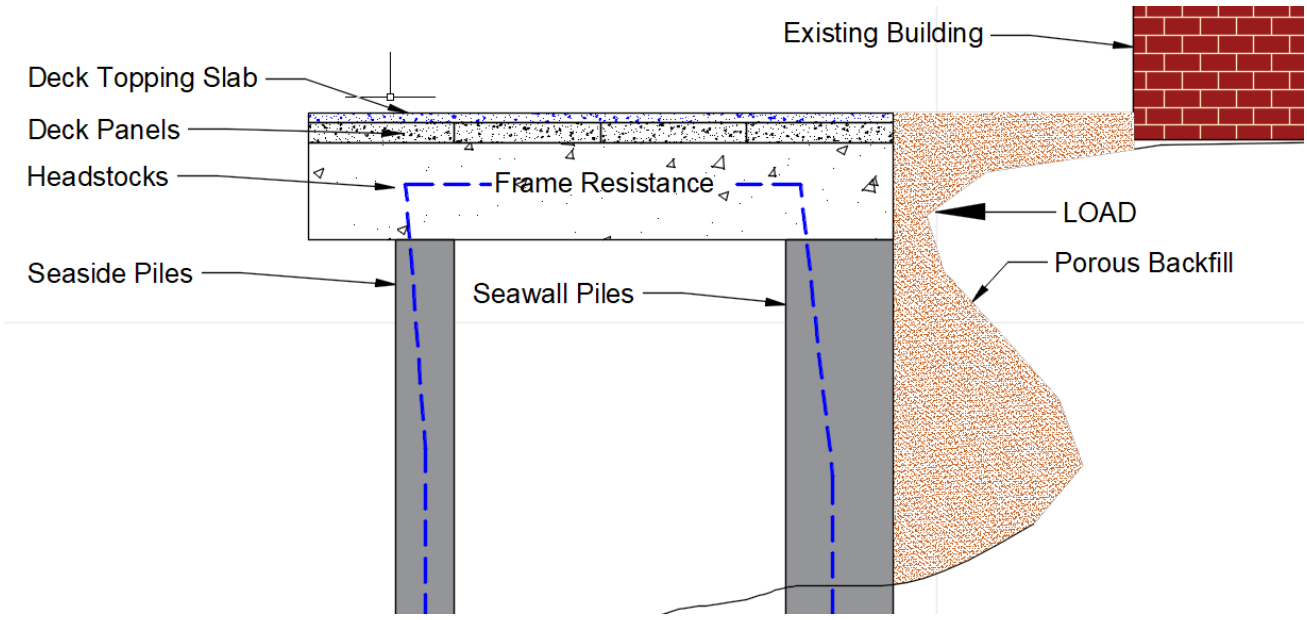
2.4.2 Landside Construction

The landside construction method involves progressively constructing the seawall and the wharf structure with a crane from the concrete structure to the north end of the main wharf.

In this method, a crane reaches out and erects self-standing piling gates with temporary beams The seawall would be constructed inside these piling gates. A second set of piling gates would then be erected on the seaside which would provide guides for the seaside piles. These gates would be removed, and precast concrete headstocks installed from the seaside piles to the seawall. The headstocks would be grouted into place on top of the piles and seawall. Precast concrete panels would then be installed between two headstocks, the deck panels would then have additional reinforcement installed above and between them. A concrete topping slab would be poured and after curing would allow the crane to progress further forward to begin the next cycle.

2.5 Wharf Framing

To provide adequate restraint to the new seawall, the piles to the seaside and interconnected deck structure is required to act as a frame. The diagram below gives details of the wharf structure in cross section and an explanation of the structural design philosophy.



2.5.1 Headstocks

The pile tops will be prepared to receive the headstocks which will be precast offsite. The precast headstocks will be transported to site with either a barge or a truck and lifted into place on top of the piles. The pile to headstock connection will be grouted to secure the connection.

2.5.2 Decking

The deck panels will be delivered to site as precast panels either by truck or by barge and lifted into place with the crane. The joints between the panels and edges of the deck will be formed and a topping slab cast to bind the whole structure together.

2.6 Wharf Ancillaries

After the main structure has been constructed, the wharf furniture will be constructed. Elements such as lighting, handrails, benches, and kerbs will be cast or fixed into the deck as per the landscape architect design.

3 RISKS & OPPOURTUNITIES

Most of the risk in this project is presented by the existing structures which are in various states of disrepair. Collapse of the existing wharf or any of the surrounding buildings is potentially fatal and in respect of the wharf imminent.

Secondarily the removal or loss of the wharf presents another significant issue to the structures which exist which in part are being restrained and protected by the highly degraded wharf structure; removal will increase the potential surge effect on the already degraded seawall and piles underpinning the structure.

Further the weather and environmental conditions could cause delays which are amplified from any normal project by the nature of marine works.

A summary of the risks, potential mitigations are given below.

3.1 High Level Risks

#	Risk	Risk Description	Mitigation
1	Existing structure collapse: Buildings	The seawall collapse in front of the existing building may undermine the foundations further potentially resulting in complete collapse.	Leave as much of the existing seawall in as possible, only removing parts of the seawall which obstruct the permeant works.
		Vibration caused by piling works could cause further foundation decay and result in partial or complete collapse.	High frequency vibratory equipment will be used, but the risk from the drop hammer work is more likely to cause damage and there are no mitigations for this.
		The existing wharf is acting as a wave break to the exposed areas of material, when the wharf is removed, this material will be exposed to further erosion which could undermine the foundations further resulting in partial or complete collapse.	It is possible to demolish and install in phases to prevent the full length being exposed. The barges would act as a wave break. Note: this method is significantly slower.

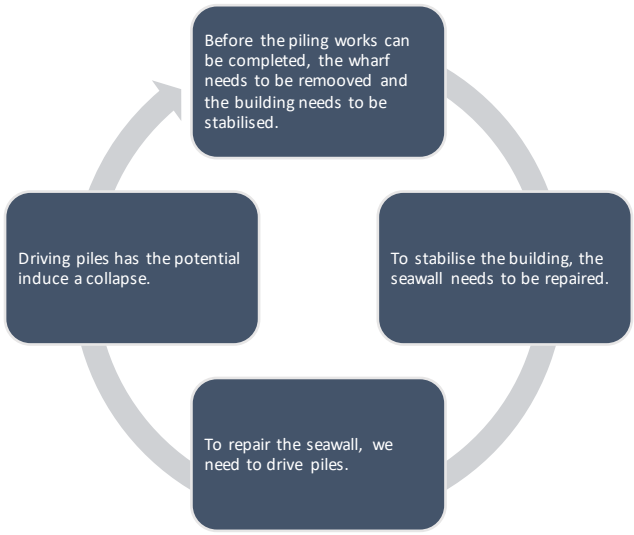
#	Risk	Risk Description	Mitigation
2	Existing structure collapse: Wharf	There is no confidence that the existing wharf can support demolition activities – even pedestrian access.	The demolition of the wharf would be completed solely from a barge with no access to any part of the structure.
		The remaining structure may collapse under its own weight during demolition, if parts of it are buoyant it could become a navigational safety hazard.	Debris booms will be set up to capture any debris which fall off the wharf during demolition. A workboat will remain on standby throughout to retrieve this debris.
3	Existing structure collapse: Seawall	The seawall may collapse through the wharf being taken away.	The only mitigation is to demolish carefully however a significant risk remains.
		The vibration created by installing the new seawall may cause the existing seawall to collapse further.	High frequency vibratory equipment will be used, but the risk from the drop hammer work is more likely to cause damage and there are no mitigations for this.
4	Weather: Sea State	High swell/waves prevent works from barges through the increased safety risk.	Haven areas are planned as part of the project work plans. Historical weather data is used to estimate the downtime expected.
5	Weather: High Wind	High wind prevents crane works.	Historical weather data is used to estimate the downtime expected.
6	Environmental pollution: noise	Noise generated from vibratory and impact piling works has the potential to travel long distances underwater and above.	Bubble curtains will be used to limit the underwater noise transfer for aquatic life as opposed to MMO attendance. Vibrator and impact piling works would be completed from 7:30-19:00 only.
7	Environmental pollution: unexpected release of material into the environment.	Hose bursts or chemical release into the environment	Spill booms to be present on every work barge. Liaison with Harbour master to manage larger emergency events Biodegradable hydraulic oil used in plant wherever possible.

3.2 Opportunities and Next Steps

The main opportunity for this project is to remove what we view is the primary risk – the existing structures namely the Shed 8 and Shipwrights building. Both these structures will require significant temporary, and remediation works to enable the removal of the wharf and the seawall which are interconnected with the structures.

The health and safety risk the structures currently present is significant and based on our analysis the only feasible way in which to complete the wharf removal and seawall works is to remove the structures to remove and mitigate the risk.

The problem presented here is described below:



If this building were to be removed, there would be no risk of collapse and there would be a range of opportunities available to the project, i.e.:

- The significant health and safety risks associated with the structures are mitigated,
- The existing landside wharf could be demolished from land,
- The new seawall and wharf structure could be constructed from land,
- The increased area available opens opportunities for a more efficient seawall and wharf design,
- More land area allows more work to be completed within the site boundary, reducing programme risk, cost and cost risk.

Next Steps

As per our report, the current wharf, sea wall and structures present a significant health and safety risk, our recommendation to mitigate this risk is as follows:

1. Management of wharf debris – ASAP and ongoing,
2. Removal of the outer wharf – Q1 2023,
3. Removal of the existing structures including Shed 8 and Shipwrights – Q1 2023 to isolate the structure from the seawall and create a safe working environment,
4. Removal of inner wharf – Completion of removal of structures,
5. Reinstatement of the seawall – Completion of removal of inner wharf/ or in parallel subject to further assessment and,
6. Reinstatement of the wharf structure based on an optimised wharf strategy reviewed in parallel with action items four and three five.

We believe based on the current condition of the structures urgent action is required to remove the current and existing health and safety risks on site.