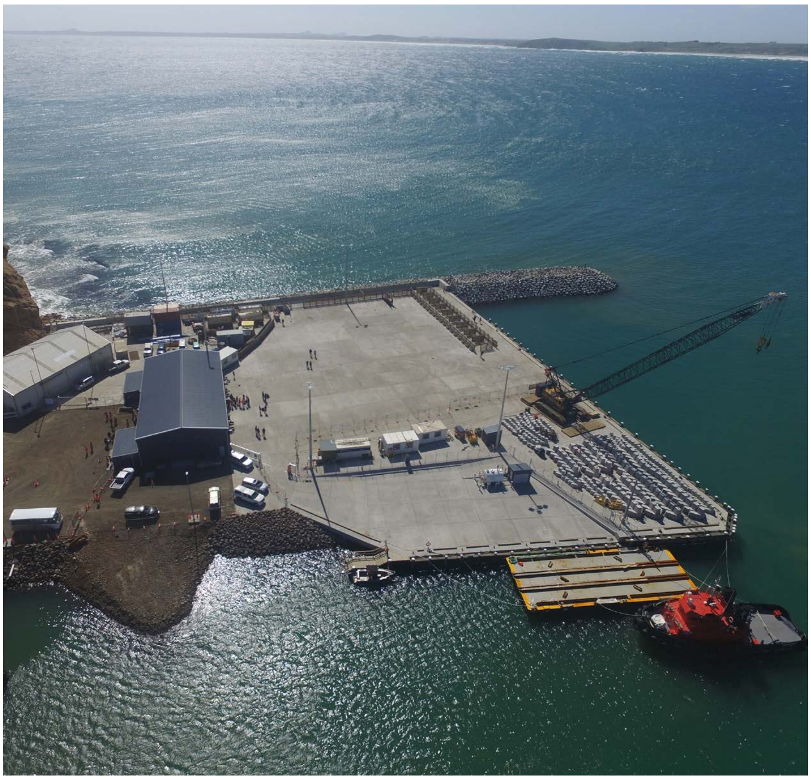
January 2021

Waitangi Wharf Upgrade

Resource Efficiency in Action



The Waitangi Wharf project was completed in 2018 and demonstrates how innovative design and resource efficient practices can deliver a legacy of environmental and community benefits to our most remote locations.

The 600 residents there are reliant on the Waitangi Wharf for the import and export of essential supplies, including goods, diesel, fuel, fishing and livestock. Nearing the end of its structural life, a complex upgrade project was completed making ship docking more reliable in poor weather to encourage economic growth.

The Waitangi Wharf upgrade project involved:

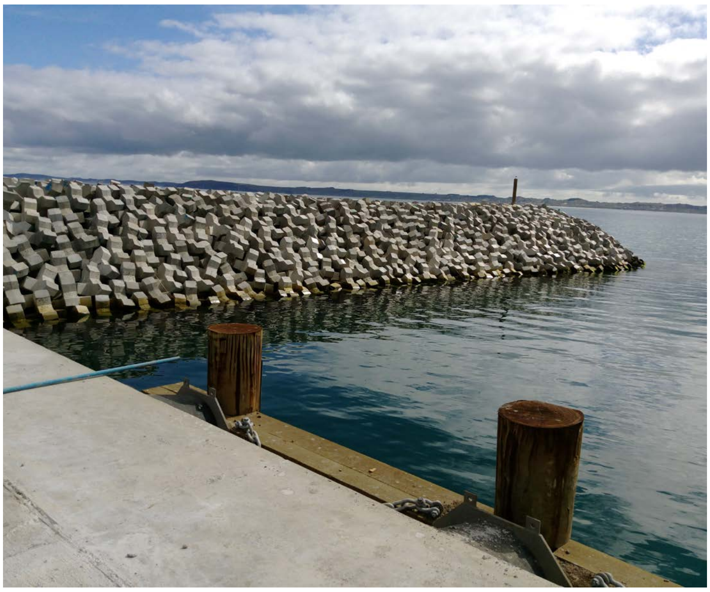
- Demolition of the existing wharf structures;
- Reclamation of 9,500 m^2 of land for development of new commercial and fishing wharves;
- Construction of a new 163 metre breakwater for wave absorption;
- Dredging of the harbour to allow for improved berthing and construction; and
- Improvements to surrounding services such as the fuel dispensing and transfer system, wharf power supply and livestock holding areas.

The site is prone to extreme weather conditions. Strong weather systems meant that the existing wharf was only able to provide safe harbour 50% of the time, resulting in narrow weather windows for successful berthing. Failed attempts to berth or load cargo caused delays as ships remained offshore until conditions improved. Providing a breakwater as part of the wharf upgrade helps to protect the wharf and decrease the number of days berthing was not possible.

Owing to the remote project location and the associated scale of the project, several challenges were recognised.

The project success relied heavily on access to the island's limited resources and services including; food, accommodation, fuel supplies, electricity, water resources, solid waste disposal options, shipping, flights and the labour force.

The isolated project site and minimal construction infrastructure also meant resources would need to be shipped or flown to the island unless innovative solutions were found.



The construction of the wharf structure and breakwater armour required approximately 100,000m³ of rock aggregate and sand materials.

Early inspection and testing of local rock found sources of good quality basalt, however, the size of the rock was limited by shear planes. The limited raw materials available on the island and high cost to transport resources meant conventional breakwater armour stone designs were not a viable option. Concrete armour units were therefore chosen as the preferred option.

Establishing the Ohinemama Quarry on the island allowed the project to source the required aggregate and sand locally rather than shipping the material from the mainland. This significantly reduced the project's carbon footprint and the number of barge loads required by up to 80%, also saving project time transporting the aggregate materials to the island.

Local aggregates were used in the construction of the 10,700 m² wharf, including all wharf pavement slabs, the capping beam on the top of the concrete pile and panel reclamation facing.

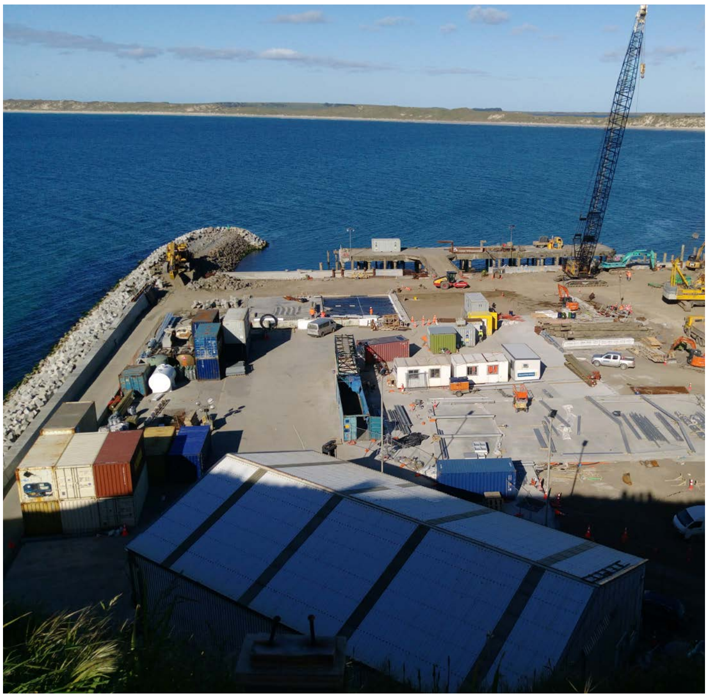
An innovative breakwater design was required to protect the wharf. The project team altered a double-layered Xbloc design creating a single layer interlocking Xbloc concrete armour unit. The concept, the first of its kind in Aotearoa New Zealand, resulted in Xblocs that were small enough that the available rock on island was suitable to be used as underlaying material.

A portable concrete batching plant was shipped to the island and set up in a standalone construction yard which was designed to become the island's emergency response centre at the conclusion of the project. About 3,300 Xblocs were made using specially designed moulds and local aggregate and water resources.

As the local water supply was already under pressure, a new water supply bore was installed at the construction yard. At the conclusion of the project the bore was handed over to the Chatham Island Council to augment the Waitangi township water supply.

AWARD

The innovative design and resource efficient practices were recognised by the winning of the Civil Contractors New Zealand National Award in 2018 and the Gold Award of Excellence from the Association of Consulting and Engineering NZ in 2019. It was noted that "The Gold award acknowledges a superior project for innovative achievement or setting a new industry precedent".



Waste Minimisation

The isolated site also created challenges for removal of the old wharf structure and residual resources, with the project finding solutions that reduced environmental and commercial impacts.

To allow for the surrounding seabed construction and improved berthing for vessels into the wharf, 13,300 m^3 of sand was dredged over an area of 10,700 m^2. Residual sand from this part of the project was repurposed to replenish the main Waitangi Beach, with the remaining materials transferred to a consented location offshore.

The project team employed waste minimisation practices with almost 100% of the existing wharf structures being repurposed; the wooden wharf structure was reused for building materials and firewood on the island, as vehicle impact barriers on the main wharf and concrete decking from the wharf was used to provide for an improved boat haul-out area for the collection of boat cleaning, antifouling and maintenance water.

Resource Efficiency at a glance

MORE EFFICIENT PORT OPERATIONS

- The new design was modelled to provide for up to 351 days of berthing an improvement of up to 40%. For the two years following the wharf commissioning, the port management reports that not a single ship has been delayed in berthing.

EFFECTIVE USE OF LOCAL AGGREGATE

- 100,000m^3 of aggregate and sand were sourced locally. This helped to avoid approximately 145 additional barge trips saving 7,900 tonnes of carbon equivalent (the approximate emissions of 300-400 average annual households) and $30-60 million in cost for barging alone.

USE OF INNOVATIVE SINGLE LAYER CONCRETE XBLOCS

- Using a non-standard design in order to suit the local rock source, resulted in approximately 17,800 tonnes less aggregate and concrete, less water and approximately $9.5 million less costs than the standard double-layered concrete unit solution.
- The design used by the project required less Portland Cement reducing carbon dioxide equivalent emissions by approximately 800 tonnes due to less transportation of the concrete materials.

REPLENISHMENT OF THE LOCAL ENVIRONMENT

- To improve berthing for vessels into the wharf, 13,300m^2 of sand was dredged over an area spanning 1.5 rugby fields.
- Approximately 3,300 m^3 of residual sands were used to replenish Waitangi Beach rather than disposing of the materials offshore.
- The addition of the sand to Waitangi Beach provides extra protection against erosion from large storm events.

REUSE/ REPURPOSING EXISTING STRUCTURES

- 3,400 tonnes of concrete and rebar waste diverted from landfill. By reusing the material as a boat haul out area, as wheel stops on the wharf and some for a concrete seperation station at the island refuse sorting centre saving $150k in cost.
- The diversion of waste from landfill and reuse of materials helped to avoid 1,000 tonnes of carbon dioxide equivalent emissions had the structures been created from virgin materials.

For further information, please contact: **sustainability@nzta.govt.nz**