

BUILDING ON NEW ZEALAND'S MOST CONTAMINATED SITE – THE MAPUA WHARF WASTEWATER PUMP STATION

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Abstract

This paper describes the award winning Mapua Wharf Wastewater Pump Station project.

Due to predicted growth and development of the Mapua region in the Tasman district, Tasman District Council required the existing Mapua Wharf wastewater pump station to be replaced. The new pump station was to be constructed within part of the former location of the Fruitgrowers' Chemicals Company, once acknowledged as the most contaminated site in New Zealand.¹

Challenges included designing a pump station which could be constructed without compromising environmental or health and safety standards. In addition, the available construction area was restricted as the site was part of a proposed waterfront park development for the local community. The site was also close to the popular wharf area.

As the history of the site was well publicised, the project was an emotive issue for the local community.

To overcome these unique issues a design was required that could address the challenging constraints and still provide a cost effective and long term solution. In addition to working around the constraints the design had to incorporate the needs of the community.

The project won the 'Projects \$2 million to \$10 million' at the 2014 IPWEA NZ Excellence Awards.

Key Words

Contaminated land, wastewater, pump station, surge, environmental, community, health and safety

Introduction

The Tasman district has been one of the fastest growing regions in New Zealand over recent years. This has led to increased development in rural residential areas such as the township of Mapua.

The Tasman District Council commissioned MWH NZ Ltd to evaluate and report on the Mapua wastewater reticulation system. The system was reported to be operating close to capacity and growth projections predicted that the present population could double over the next 30 years.

The report advised that none of the existing pump stations would have sufficient capacity to handle the future peak wet weather flows mainly due to the size of wet wells, configuration of pumps and inadequate rising

main diameters. The downstream pump station in the catchment was located at Mapua Wharf and identified as the first to be replaced.

Former Fruit-growers' Chemicals Company site

The new pump station was to be constructed within part of what was the former location of the Fruit-growers' Chemicals Company (FCC) manufacturing plant, once acknowledged as the most contaminated site in New Zealand.

The Ministry for the Environment (MfE) completed the remediation of the site in 2009. Whilst the remediation was to a standard fit to occupy and build on, it was still considered contaminated in terms of the adjacent marine environment and the groundwater beneath the site regularly monitored since. In addition, any surplus excavated material was required

to be disposed off-site as it was considered contaminated. Due to these contaminated land issues, all construction activities were required to be carefully controlled and managed.

One of the conditions of the Government's funding for the site remediation was that at least 40% of the FCC site would remain as public land. Tasman District Council, in consultation with the local community, proposed to develop a waterfront park on part of the site. This would be around the new pump station.

Pump station design requirements

The pump station site underwent a number of location iterations due to landscaping, access and constructability issues, and MWH had to design the final pump station layout to fit within a designated 20m x 10m area.

The pump station design included the following elements:

- 70l/s capacity pump station including wet well, 85m³ of emergency storage, valve chambers, odour control and surge vessel and emergency power generation.
- rising main from new pump station to existing rising main
- gravity main from existing pump station to new pump station
- management and removal of contaminated soil and groundwater during the construction works

Technical complexity

There were a number of complex issues to overcome on this project. These included the unprecedented site contamination history which meant an unknown amount of contaminated surplus material and water to be disposed of off-site without contact with any other surface. Related to this there was a requirement for meticulous excavation processes due to potential health and safety risks for contractors and residents.

As the location was in close proximity to tourist facilities the designers needed to closely liaise with landscaping professionals so the final structures would not detract from

the local ambiance. Related to this there was a requirement for no foul odour.

The most important issue given the history of the site and the location of the previous pump station was to get buy in from the local community. This required a large amount of ongoing local community liaison to ensure the final solution addressed the majority of their concerns.

Available land footprint

As mentioned, due to the waterfront park requirements, the final pump station layout had to be designed to fit within a tight designated area.

Elements such as the standby generator, backflow prevention and electrical equipment which did not need to be within the direct pump station location were located outside of the designated area to meet the landscaping requirements.

Due to the space constraint the obvious solution would be to design elements at a greater depth to allow a smaller footprint however this would have increased the excavation into the deeper remediated soil layers and also increased the amount of de-watering. To overcome this, elements such as GRP storage tanks were used that could be constructed under water at relatively shallow depths.

Considerable thought was given to the pump station site layout, such as the alignment of the rising main from the valve chambers to the connection point. This was unusual as it needed two 90 degree bends. Appendix B shows the site layout.

Specific structures within the pump station layout were designed with an emphasis on enabling easy site access for maintenance direct from the road, cost effective construction such as reduced storage tanks size (flushing volume requirements were supplemented with water supply).

To achieve this, manufacturers and suppliers were brought into the design process to enable the optimum configuration of the various components such as storage tanks and valve chambers. The final design

balanced hydraulic requirements, constructability and future operation with as small a vertical and horizontal footprint as possible. This can also be seen in Appendix B which shows structures placed close together with pipework over the top of them.

Groundwater management

The volume of potentially contaminated groundwater to be removed during construction, and where to dispose it was one of the biggest unknowns with this project. Groundwater investigations were carried out alongside the geotechnical investigations to further define the groundwater flow levels, as well as to confirm the groundwater disposal options.

Groundwater was likely to be present beneath the site at depths of between 0.9m and 2.5m below ground level, varying due to location of works and time of year. Groundwater encountered during construction was deemed contaminated and could not be discharged to the stormwater system. This also included the groundwater encountered during the installation of the gravity main and rising main, located between the proposed site and the existing pump station at Mapua Wharf.

A number of groundwater disposal options were considered from re-injection back into the site through to disposal to the Mapua estuary. The final solution was to discharge back into the sewer system and pump to the wastewater treatment plant, if required.

Surge pressure

The rising main that discharges from the pump station to the wastewater treatment plant is 8.5km long. Immediately downstream of the pump station it crosses the 300m wide Mapua estuary. This line, a combination of PE and PVC, is vulnerable and would pose a high level of environmental risk in the event of a pipe burst. In order to protect this line from collapse due to large negative pressures in the line caused by sudden pump stoppage due to power failure, design of surge mitigation was required.

A surge vessel was proposed as the solution to deal with this issue. This was selected as other surge protection measures could not

deal with the large negative pressures that would be encountered. The surge vessel was located adjacent to the wet well.

Consultation

Due to the unique nature of this project there were a large number of stakeholders involved in the consultation process. This ranged from the local residents and businesses, the iwi, Historic Places Trust to the Department of Conservation as well as the project architect a number of different departments within the Council.

Successful community engagement was vital for the project to proceed. The community was emotionally involved in the project due to the outcomes of the original de-contamination scheme and the location of the original pump station. During the feasibility stage, MWH worked collaboratively with the Council and local community to assess the options and select the best site whilst also ensuring the local community concerns were heard and addressed. The location required two site changes before the community was comfortable with the project proceeding.

The consultation required a well-planned strategy throughout the project life which included regular communication through Tasman District Council's website and 'News line' publication. In addition, during construction, a web-cam was installed on the site to allow the public real time viewing of the works through Council's website.

Environmental

Managing contaminated land

As mentioned, the disposal of surplus excavated material was deemed contaminated. This created a major challenge to construct the pump station without compromising environmental standards or health and safety risks to contractors and residents. MWH had to determine how the surplus excavated material would be handled and disposed.

A site management plan was developed in accordance with the guidelines produced

from the MfE remediation project. Surplus excavated material was transferred to a lined truck. At no time was the material to come into contact with any other land area, vehicle or person prior to being transported to the Council's approved Landfill. A sprinkler system was also installed for dust suppression.

MWH's design minimised the volume of earthworks where possible and the amount of dewatering by cutting off groundwater via sheet-piling and using GRP tanks that could be constructed under water if necessary.

Minimising odour

As the site was in an area of major development and high public amenity, minimising odour from the pump station was imperative. To address this, an odour control design and philosophy was developed. A carbon filter with a fan was installed within the valve chamber to extract odours from the wet well and air valve chamber to the carbon filter. The carbon filter unit was designed to treat low levels of H₂S.

Social and Cultural

There were many social and cultural issues that the project needed to address during design and construction. These included:

Aesthetic challenge

As part of the site was to be developed as a waterfront park the aesthetic values of the project were very important. With the fixed site footprint there was significant constraint on the size of all structures, and even the emergency generator could not be visible at the immediate site. This was hence located elsewhere. All new structures except the standby generator and surge vessel were constructed underground. Extensive work with the landscaper was required to achieve the best outcome.

Health and safety

Working on this project provided a number of health and safety management challenges. There was risk to both the contractors operating machinery and working on site and local residents because of potential

groundwater and material contamination risks. Before work started, MWH liaised closely with the Department of Labour and as a result comprehensive safety management plans were prepared which were audited by external industry specialists.

Contract specifications included site staff having to wear additional protective clothing, receiving the appropriate inoculations before commencing work and the stipulation of specific health and safety site management protocols.



Figure 1: Staff wearing protective equipment during excavations in contaminated land

The combined benefit of consistent site inductions, together with management by experienced senior staff with careful contractor operators, led to the work being completed without incident or injury to personnel or residents.

Archaeological discovery

In spite of the extensive remediation previously undertaken at the site of the wet well and storage tanks, archaeological sites were found comprising middens. This required an application to New Zealand Historic Places Trust (NZHPT) for approval to destroy the middens. The approval was granted, however the process took about six weeks. As a consequence excavation in this area was closely monitored by the NZHPT Archaeologist and iwi for the remainder of the construction.

Economic

Design

Overcoming the many technical challenges required the design team to develop fit for purpose bespoke solutions. The final outcome was a solution that addressed both the current and future needs of the area. In addition, addressing the requirements of high aesthetic value and odour mitigating has meant the facility does not impact economically on Mapua's vital tourist industry. An example of this future-proofing was a wet well design that can manage a range of flows over time, 40-70l/s, as development increases.

Constructability

MWH delivered a solution that the contractor was able to build and so gain industry respect and recognition for its work. The use of precast elements such as storage tanks, valve chambers and sprinkler systems all assisted in minimising construction time. The contractor, Ching Contracting Ltd won the Contractors' Federation award for Project > \$1.5M in 2013.

Innovation and creativity

The many complex and conflicting project requirements resulted in MWH developing a design that brought together several novel engineering concepts.

Contaminated land and groundwater management

During preliminary design, alternative construction techniques from open trenching to caissons were considered and various soil and groundwater disposal options investigated and evaluated. The final excavation for the 7m deep wet-well and 5m deep storage tanks involved sheet steel piling into dense, weathered Moutere gravels. This was selected as it provided excellent groundwater cut-off, significantly reducing the volumes to be dealt with. Groundwater disposal was pumped via the sewer system to the treatment plant.



Figure 2: sheet-piling into dense, weathered Moutere gravels provided excellent groundwater cut off

Aesthetic challenge

As the pump station was to be integrated into a waterfront development in a highly public area the finished pump station site had to be cleverly landscaped. This required the individual components to be profiled to fit the landscaped finished levels and provide public access over the whole site. The design had all the new structures except the standby generator and surge vessel underground with other elements designed out of the direct site to not bring attention to the facility.

Project Outcomes

MWH, the Council, the Contractor and the landscaper all worked collaboratively to deliver the best solution. The approach that all parties took fostered strong relationships which allowed solutions to be adjusted and monitored together with mitigation of risks as they were identified.

The project team also helped ensure the community was engaged and satisfied with the project every step of the way. This was a critical success factor.

Additionally:

- No complaints were received from the public during construction, or since commissioning on 31 July 2013.

- There have been no significant operational or maintenance problems with the pump station.
- The project was completed on time and within budget.

Tasman District Council and the community have expressed their great satisfaction with the way the project was delivered and the excellent outcome achieved.

Lessons Learned

While the project was successful there were a number of lessons learned for future projects that involve a wide range of competing needs. One of the main lessons learned was the importance of having consistency and follow through between personnel at the design and construction phases from both the Client and Consultant(s). This allowed good knowledge transfer and the ability to minimise changes between phases of the project.

Further lessons included:

- Working more closely with landscape designers with respect to programming i.e. landscape designers would have benefited from understanding more of the operational/maintenance requirements at the preliminary design phase to inform them of maintenance requirements
- Spending more time at the detailed design phase working more closely with the geotechnical engineers to firm up construction risk
- An open pro-active communication process was vital in problem resolution and keeping the project on track.
- Continued consultation throughout the entire project life cycle, and not just during the initial phases was key to the final stakeholder satisfaction

- Investigating the surge impacts at an earlier stage in the design
- Investing more time on the provision of more detailed mechanical checks, which may have minimised some construction changes. For example, PE stub flanges versus Aqua grip flange adapters, and more detail with respect to grouting under pump bases
- The tender procurement method using the Price Quality method was an important factor in getting the most qualified Contractor for the work

Conclusions

Overall the project was very successful at integrating the primary needs of all the different stakeholders. The final outcome has created an asset that will meet future development needs whilst blending in with the surrounding landscaped area.

Some of the main conclusions from this project include:

- This was a highly complex project due to the multi-faceted nature of the site
- Having continuity between the design and construction monitoring teams from both Council staff and the Consultant was a large contributor to the success of the project
- A collaborative approach amongst all parties was essential

References

¹The Ministry for the Environment (2011) Cleaning up Mapua: The story of the Fruitgrowers' Chemical Company site

MWH NZ Ltd. (2011) Mapua Wharf Wastewater Pump Station - Preliminary Design Report

Appendix A – Project Photos



The original pump station next to a popular restaurant in the Mapua wharf area



The finished product: a pump station that blends with its surroundings including the restaurant and a public recreation area

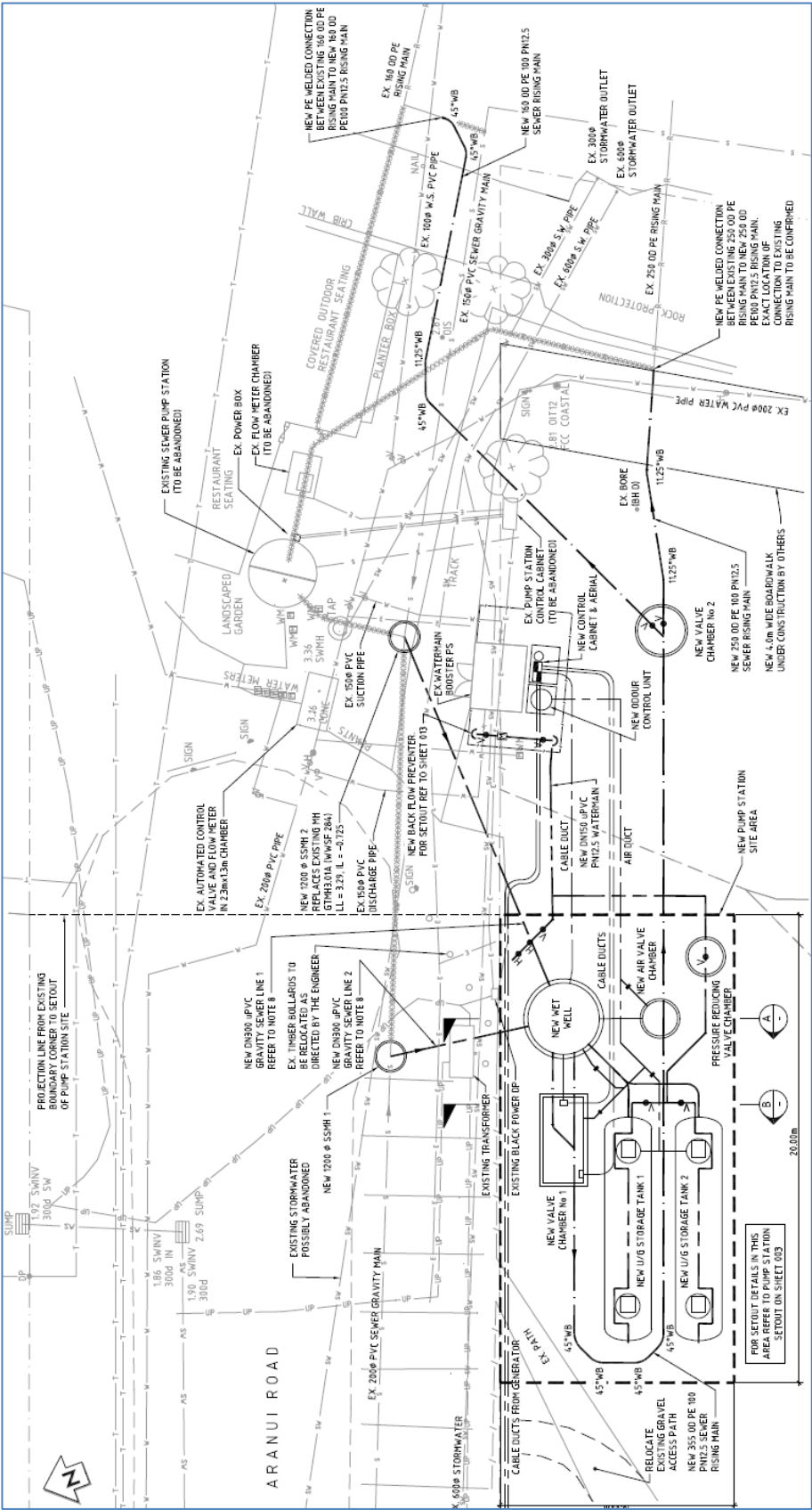


Taking soil samples



Installation of the two 30m³ propriety fibre-glass storage chambers

Appendix B - Pump Station Site Layout



Pump Station Site Layout

Author Biographies



Avik Halder is the Technical Development Leader (Water and Waste) for MWH New Zealand Ltd. Avik has been active in various projects for Tasman District Council as well as several other NZ Local Government clients since moving to New Zealand in 2006. Previously, he has worked in the United Kingdom and Ireland on a variety of utilities infrastructure projects.

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