Tonkin+Taylor

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Wanganui District Council
PO Box 637
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Attention: Rowan McGregor

Dear Rowan

# Implications of proposed Whanganui Port and lower Whanganui River dredging

## 1 Summary

We understand that it has been proposed to bring large vessels into the Port at Whanganui requiring the excavation of a channel up to -7m CD within the Port, lower Whanganui River and offshore. Furthermore, the turning basin may require expansion to accommodate a larger turning circle for such vessels.

This memo sets out a high level assessment of the physical requirements and effects of accommodating such a vessel in the manner and location proposed. We note that this high level review is based on existing information only and we have not undertaken any investigations of the effects of the proposed works, nor undertaken any specific feasibility design work for the proposal at this stage.

The assessment finds that substantial capital dredging in the order of 1M $m^3$ may be required with ongoing maintenance dredging of up to 650,000 $m^3$ annually. Upgrades of the North mole structure, the Port Wharves and the Turning Basin wall would be required to accommodate the deeper river bed depths. Any re-alignment of the turning basin wall to accommodate a larger vessel turning circle would create a constriction within the river, potentially resulting in higher flood levels upstream. This could only be mitigated by providing another outlet (i.e. along the South Spit which presents risks of breech from the ocean) or by raising upstream stop bank levels. Both options are likely to be technically difficult and very high cost. Increased riverbed depths would likely occur and require armouring of the South Spit Bank and South Mole. Prop wash and channel deepening may cause damage to the existing boat ramp and associated infrastructure requiring substantial upgrade or relocation. Finally, The Tanae Bank, which acts as a spending beach reducing wave energy penetrating into the lower Whanganui River and Port and protecting the south spit and mole should be reinstated to resume this function.

This report also does not review the navigation issues considered by Capt. Dilley. We do however support Capt. Dilley's recommendation that if the Port is to cater for vessels up to 182m in length, then the 'Port area needs to be viewed as a clean sheet', and 'a focused port design process' is required to optimise the port layout, lower harbour hydrodynamics, river flood implication, and vessel navigational and operational safety considerations.

Rough order quantities for capital and maintenance works required to dredge channel within Port and Lower Whanganui River to -7m CD are presented in Table 1.

Table 1 Rough order quantities for capital and maintenance works required to dredge channel within Port and Lower Whanganui River to -7m CD

| Capital works | Quantity |
|---|---|
| Dredge offshore of North Mole tip | 150000 $m^3$ |
| Dredge turning basin to North Mole tip | 170000 $m^3$ |
| Dredge within turning basin | 750000 $m^3$ |
| Reinforce North Mole | 930 li m |
| Upgrade Wharf Walls (Sheet Pile) | 465 li m |
| Re-align basin wall to accommodate larger turning circle | 750 li m |
| Reinforce South Spit to allow for deeper channel | 900 li m |
| Reinforce South Mole | 500 li m |
| Boat ramp upgrade or replacement | - |
| Re-instate Tanea Bank and groynes | - |
| Maintenance works | Quantity/year |
| Dredge offshore of North Mole tip | 400000 $m^3$ |
| Dredge turning basin to North Mole tip | 120000 $m^3$ |
| Dredge within turning basin | 133000 $m^3$ |

## 2 Background and objective

We understand that it has been proposed to bring large vessels into the Port at Whanganui. A Vessel Navigation Report considering the possible implications of the size of vessels navigating at the Port of Whanganui has been prepared by Capt. J. Dilley. One of the proposed vessels has a 181.7m length, 23.4m beam and 5.3m draft requiring a channel depth of 7.1 m below Chart Datum (and with no allowance for siltation), channel width of 70m (B x 3) and manoeuvring area of 325 m (L x 1.8).

We understand the preferred solution proposed by Midwest Ferries involves dredging a navigation channel into the inner Harbour, and constructing a turning basin for the vessel south of Wharf Number 3. This proposal is likely to require a range of ancillary works which are discussed in the following sections.

This memo sets out a high level assessment of the physical requirements and effects of accommodating such a vessel in the manner and location proposed. We note that this high level review is based on existing information only and we have not undertaken any investigations of the effects of the proposed works, nor undertaken any specific feasibility design work for the proposal at this stage.

This report also does not review the navigation issues considered by Capt. Dilley. We do however support Capt. Dilley's recommendation that if the Port is to cater for vessels up to 182m in length, then the 'Port area needs to be viewed as a clean sheet', and 'a focused port design process' is required to optimise the port layout, lower harbour hydrodynamics, river flood implication, and vessel navigational and operational safety considerations.

## 3 Capital works

A range of works would be required to facilitate the increased channel depths required by a 5.3m draft vessel. These include dredging of the seabed, and upgrades to structures adjacent the dredged area to prevent undermining or damage by increased wave penetration and/or prop wash. The location and typical extent of these works are shown in Figure 1 and discussed below.

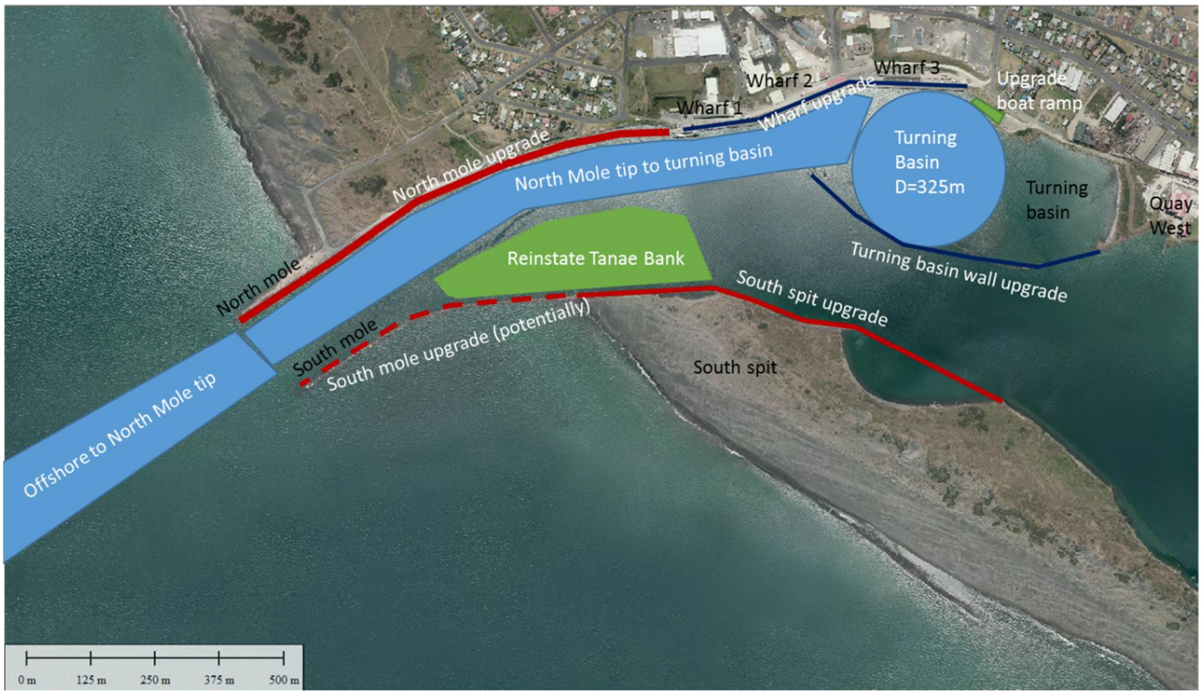


*Figure 1  Location of likely required capital works*

## 3.1 Dredging

*Offshore of North Mole Tip*

Offshore of the River entrance, a transverse bar joints offshore bar systems of Castlecliff to South Beach. The crest of this bar fluctuates between -2 and -5m CD and in location between 100 and 150 m offshore of the North Mole tip. Offshore the seabed slopes at around 1(V):150(H). Waves currently break on this bar in moderate seas (Hs < ~1.5m) at low tide and during all tide conditions in high sea conditions (Hs < ~3m). The superposition of incoming waves with outgoing tidal current and alongshore wave-induced currents can result in very confused sea states at the entrance.

*Figure 2   Confused seas offshore of Whanganui River entrance (R Shand, 2008)*

To achieve a channel -7m CD, dredging would be required some ~800m offshore of the current entrance. Assuming a 70m wide channel and side slopes of 1:10 for fine sand in an active water (BS 6349; 1991), a total dredge volume of approximately 150,000 $m^3$ may be required.

Dredging a channel to -7m CD will reduce the incidence of depth-limited breaking at the river entrance, although it is likely that larger waves may still break at low tide during high sea conditions (Hs < ~3m) and waves may still break either side of the dredged channel. Furthermore, wave focussing may occur adjacent to the dredged channel as waves move more quickly through the deeper water. The effect of this on structures such as the moles and amenity values such as surfing at Morgan St should be considered. Outgoing river current and along-shore currents may be reduced slightly due to the deeper water at the entrance.

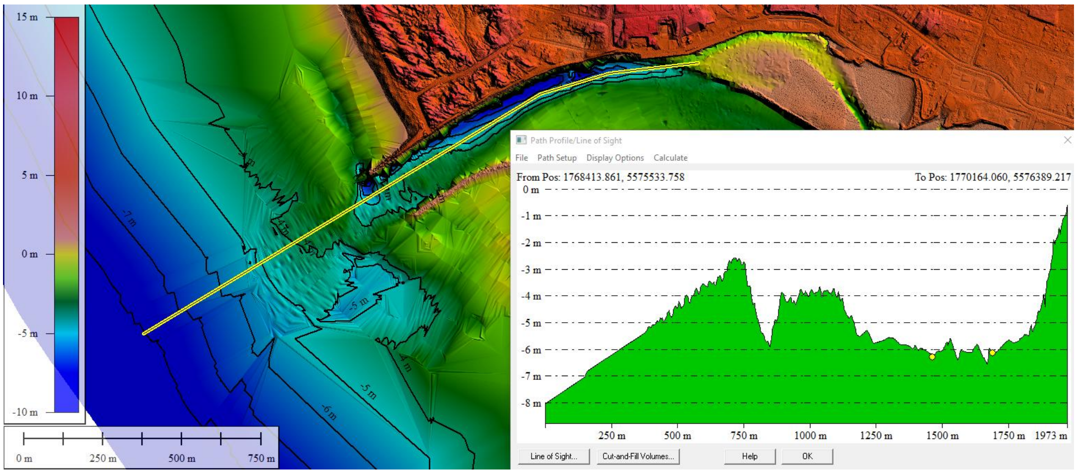


*Figure 3 Long-section offshore from the turning basin*

*Turning Basin to North Mole Tip*

Between the Turning Basin and North Mole tip, depths adjacent the North Mole range from -4 to -5m near the wharves to -6m near the entrance. Depths decrease across the river to the south with typical depths of -2m CD in mid river, 500m upstream of the entrance. A scour hole up to -7m deep occurs immediately off the North Mole head.

Dredging would be required over a 1.1 km length. Assuming a 70m wide channel with no batter on the northern side (i.e. intersects the North Mole) and side slopes of 1:10 in fine sand in active water on the southern side, a total dredge volume may be approximately 170,000 $m^3$.

*Within the Turning Basin*

The seabed within the turning basin is currently at ~+0.5 to +1.5m CD except for a narrow channel adjacent to the wharves. To dredge 325m diameter turning circle (83,000 $m^2$) to -7m would require approximately 660,000 $m^3$ of dredging. This assumes all sides are vertical (i.e. constrained by structures. Otherwise side batter slopes need to be allowed, likely <1:6 in fine silts (still water). A partial batter slope on the eastern side would increase dredging to ~750,000 $m^3$.

## 3.2 Wall upgrades

*North Mole*

The depth and condition of the North Mole toe is presently unknown but is unlikely to be deeper than the required -8m (allowing 1m below channel depth). Assume that 2 layers of armour rock is required from -8m CD to North Mole crest (~6m CD) along 950 m length (~60m3/li m). Any effects of wave focussing or larger waves impacting the moles due to the dredged channel should be allowed for in rock sizing.

*Wharves 1-3*

100m length of Wharf 1 has recently been upgraded. We believe it can accommodate riverbed design level of approximately -4m to -6m Chart Datum, but this needs to be confirmed. It is likely that some additional depth will be required at the berth, and some wharf widening and under-wharf bank protection may be needed. As the proposed vessel is significantly larger than the existing vessel, new fenders, bollards and mooring points may also be required. The existing Number 1 wharf has a small section approximately 25m long which can support highway deck load, but away from this area, only light loads are permitted. The capacity of the existing wharf will need to be considered in relation to the cargo operational requirements for the new vessel, and some areas of the existing wharf may need to be strengthened to allow for the cargo handling for the new vessel. If the navigation channel and turning basin is dredged close to the existing wharves 2 and 3, some strengthening or scour protection of these structures will be required. Alternatively the dredging works could be off-set from the existing structures to minimise costs for these structures.

*Turning Basin wall*

The turning basin wall would need to be upgraded and/or reconstructed further into the river to enclose the new larger turning basin, along a 750 m length to allow dredging to -7m within the basin. If rock is used, the structure would be approximately 50m wide. If a vertical structure is used it would likely be ~10m wide. The wall would also need to be realigned a minimum of 75m (and probably 90 to 100m) to the south to accommodate a 325m diameter turning basin. This would reduce the minimum river width between the turning basin wall and the south spit from 230m to 155m or less. While the width at the entrance is 180 m, the depths are significantly greater giving a larger total cross-section. This realignment would therefore reduce the minimum river outflow cross-section, particularly if the turning basin breech is also closed. This throttling of the river is likely to increase flood levels upstream. This could only be mitigated by providing another outlet (i.e. along the South Spit which presents risks of breech from the ocean) or by raising upstream stop bank levels. Both options are likely to be technically difficult and very high cost.

*South Mole/Spit*

Any encroachment of the basin wall into the river is likely to cause channel deepening and place additional pressure on the South Spit Bank and to a lesser extent the South Mole. Upgrade of these structures should be considered along 900m south spit bank and potentially along a further 500 m of the South Mole depending on channel width and location. Assume 30 $m^3$/li m along south spit and 60 $m^3$/li m along the South Mole.

## 3.3 Other

*Replace/reinforce Boat Ramp areas*

Prop wash and channel deepening may cause damage to the boat ramp and associated infrastructure. Substantial upgrade or relocation of this infrastructure should be allowed.

*Reinstate Tanae Bank*

The Tanae Bank is a remnant of the original south spit located on the south bank of the river just inside of the entrance. The sand bank plays an important role in directing currents towards the northern side of the river to maintain navigation depth and also as a spending beach to reduce wave energy penetrating into the lower Whanganui River and Port (Figure 4). Recent loss of groyne structures up river have resulted in the partial loss of the bank which has resulted in damage to the South Mole and Spit and increased wave energy within the port. As part of port development, this bank and upstream groynes should be reinstated as a spending beach. The bank may be reinstated using sandy dredged material.

*Figure 4 Comparison of the lower river at low tide in 1994 (left) with 2010 (right). The lack of a spending beach as provided by the Tanae Bank is apparent in 2010 with waves propagating into the inner harbour and up the river rather than dissipating energy by breaking (sources: Shand; left, Digitalglobe; right).*

# 4 Maintenance works

## 4.1 Dredging

*Offshore of North Mole Tip*

Sediment transport along the Whanganui coast is bi-directional as a result of the bi-modal wave climate with a net drift to the south. A range of estimates of sediment transport rates have been undertaken with McLean and Burgess (1969) estimating net transport at 200,000 $m^3yr^{-1}$, although the gross drift is likely to be at least twice this. The proposed channel depth is deeper than the adjacent seabed and therefore material moved alongshore through littoral drift (in either direction) will infill the channel to the adjacent seabed depth before continuing alongshore. Maintenance dredging equivalent to the gross transport estimate of 400,000 $m^3$ per annum has therefore been assumed, but could be higher particularly stormy years. It should be noted that a major dredging campaign on the bar in the late 1980s spent a reported $1M on dredging with the bar reportedly infilled within 6 weeks.

*Turning Basin to North Mole Tip*

Sediment yield from the Whanganui catchment has been estimated at 1.17 x $10^6m^3yr^{-1}$ (Tonkin and Taylor, 1978), though only an estimated 10% (120,000 $m^3$) is sand and gravels. Finer materials are likely to be carried offshore under tidal and river flows but coarser materials are likely to infill the artificially deepened channel. A maintenance dredging value of 120,000 $m^3$ has been assumed per annum.

*Within the Turning Basin*

Pre-breech dredge sedimentation rates within the turning basin have been estimated at ~1.6m per annum (T+T, 2017, Review of lower river management options) giving a total volume of 133,000 $m^3$ pa.

# 5 Applicability

This report has been prepared for the exclusive use of our client Wanganui District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

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