Job No.10292

MEMORANDUM

To: Jamie Cox

From: Hamish Lowe

Date: 14 August 2017

Subject: A7I4 – Wairoa River Mouth Data & Pioneering History

Introduction

The Wairoa wastewater treatment and discharge system requires evaluation as to its suitability for a replacement discharge consent on expiry of the existing consent in May 2019. Identification and consideration of a range of discharge options will be required. One option to be considered will be continuation of the present discharge into the Wairoa River. The configuration of the river mouth has not been static but has changed from time to time, and this has a bearing on any future discharge into the lower reaches of the river.

Purpose

This summary describes the known physical history of the Wairoa River mouth, and in particular, aspects of its known behaviour that may be expected to have a bearing on any future discharge into the estuary.

This memo does not provide a recommendation for improvements or modifications to the river to avoid river mouth closures, it is merely a collection of data and information to assist with understanding the nature of the river mouth.

Scope

This Memorandum reports the results of Task A7I4 of the Wairoa Wastewater Consenting Task Scopes. The matters to be addressed for this task are as follows:

- Source information on river mouth bar openings and closures; when, how and why they happen;
- Present information in a format to enable lower river estuary discharge to be assessed as a future option; and
- The history of the Wairoa River mouth and bar crossings during pioneering times.

It is not intended that this memorandum cover matters relating to cultural perspectives on the Wairoa River estuary, which are addressed elsewhere.

Sources of Information

The sources of information from which this memorandum has been prepared are as follows:

- Information from Hawke's Bay Regional Council ("HBRC") in its capacity as River Engineers for the area that includes the Wairoa River mouth, on its responses to river mouth closures;
- Published papers and books on river history, marine information and sediment yields, including published information regarding the history and use of the Wairoa River during the late 1800s and early 1900s.

Morphology

The Wairoa River, located in northern Hawke's Bay begins at Te Reinga, where the Hangaroa and Ruakituri Rivers join some 65 km north of the Wairoa township. Before reaching its mouth into northern Hawke's Bay, the river widens into the Whakamahi and Ngamotu lagoons (Haggitt & Wade, 2016), noted for their recreational qualities.

The Wairoa River, known for its high sediment load, is fed by the various tributaries within the Wairoa catchment, some 356,300 km² of which 264,547 km² is within the Hawke's Bay regional boundary (Haggitt & Wade, 2016). These areas produce the highest sediment yield within the Hawke's Bay area (Hicks, et al., 2011).

This sediment travels down the Wairoa River and into Hawke's Bay where the resuspension through persistent wave activity, tidal currents and wind driven mixing (Haggitt & Wade, 2016) causes this sediment to contribute to the highly dynamic bar at the mouth of the river. This very active bar controls the location of the Wairoa River mouth, causing partial to full closures generally during low river flows and high sea conditions. When the estuary/lagoon is closed off, this results in a back log of water and sediment affecting low lying land adjacent to the river and the threat to building infrastructure and water quality within the lagoons.

Pioneering History of the Wairoa River Bar

The Wairoa River entry into Hawke's Bay was prone to wander during settler times and the river mouth inlet created a hazard for small boats and ships from Napier needing to enter the harbour (Wright, 2010). In 1866, the Hawke's Bay provincial council voted to contribute £10 to dig out a channel to open the mouth (Wright, 2010). A constant battle emerged to continue to keep the river mouth inlet open. This created a drain on the provincial and local government finances through the settler period (1850 – early 1900s).

The uncertainty of the state of the Wairoa River mouth was known to affect the people of the Wairoa district and travellers of further afield who needed access in and out of the river to Hawke's Bay via the Wairoa River mouth inlet. Concerns were also raised over the expenditure to maintain the opening of the river mouth inlet. Harbour works in 1882 were quoted at £25,000, and concerns were raised over the success of these works at keeping the inlet open for trade (Williams, 1882).

During March 1887, Trading steamers were unable to navigate up the river. The lower reaches of the Wairoa River were reported to be "practically useless for purposes of navigation" at this time (Poverty-Bay-Herald, The Wairoa bar, 1887). The mouth of the river was opened about 200 yards north of the signal bluff to create a straight navigable entrance. However, the 'natives' warned of the winter floods causing the river to revert to the original channel, alongside the signal bluff (Poverty-Bay-Herald, The Wairoa bar, 1887).

During the early 1900s, the Wairoa Harbour Board accepted a tender to clear the bar for £79,000 with work commencing in March 1912 (Poverty-Bay-Herald, 1911). The importance of creating an accessible entrance up the Wairoa River could not be overlooked during this period. Goods were often delivered into Wairoa and valuable cargo was often transported out of Wairoa via the river mouth inlet. In May 1913, the closure of the Wairoa River mouth resulted in the Wairoa township's necessities (e.g. coal, kerosene and baking goods) to run low (Poverty-Bay-Herald, 1913). Fortunately, a rise in river level allowed the river mouth inlet to be cut and a steamer to deliver these necessities. The closure of the river mouth inlet over the previous year had resulted in goods only being delivered on three occasions. In addition to goods delivery, trade ships also had their own battle with the bar during the early 1900s. In June 1919, the trade ship 'Scow Echo' attempted to leave the Wairoa River but ran aground on the bar with a cargo of tallow valued at £9,000 (Poverty-Bay-Herald, 1919).

These pioneering times highlighted the troubles seen when navigating across the Wairoa River bar. Successive river works took place to create a more permanent structure for ships to pass through. Failure of these river works were continually caused by the breakdown of the papa rock used during construction. Likewise, high seas would redistribute shingle across the bar, closing off access, and additionally, large volumes of silt were transported down the Wairoa River during heavy floods and were deposited into the lagoon at Signal Bluff causing it to dry at half tide (Poverty-Bay-Herald, 1919).

Present Day Conditions Triggering River Mouth Openings

The potential for damage to property due to flooding caused by a closure of the river mouth is significant. Numerous pastoral and residential properties along Kihitu and Kopu Roads are affected. Access roads into Whakamahi and Kihitu can become blocked.

A maximum water level within the Wairoa River (measured at top of the timber piles of the old pier out by the coast of 1.65 m AMSL in conjunction with minimum fluctuations between tides triggers the requirement for action to re-open the river mouth. Generally, the river mouth will be fully blocked before mechanical opening will be undertaken.

Re-opening of the river mouth will occur at low tide with minimal sea swell and suitable weather. Excavated material is then stock piled clear of the mouth to minimise the risk of further closures soon after re-opening.

Re-opening of the river mouth is funded and managed by HBRC in its capacity as manager of river control structures, with the actual work undertaken by a contractor. Mechanical openings involve an extensive operation, sometimes taking days to complete. Excavation will take place at the same position every time when the river mouth becomes blocked. When the mouth is partially closed or restricted or is in an unfavourable position, this can increase the risk to safely re-open the river mouth therefore resulting in the river mouth taking its own course of action to either unblock itself or fully close until excavation can take place during more favourable conditions.

Record of Re-openings of the Wairoa River Mouth

Data has been collated by HBRC over the last 18 years (1998 to 2016) to identify when the Wairoa River mouth was mechanically opened. Figure 1 identifies that between the years 1998 to 2004 openings occurred on average 1.5 times/year. A higher frequency of openings occurred between 2006 to 2010, with on average the river mouth needing to be opened 2.25

times/year over this period. Over the total of the 18-year period the river mouth has needed to be mechanically opened on average 1.1 times/year.

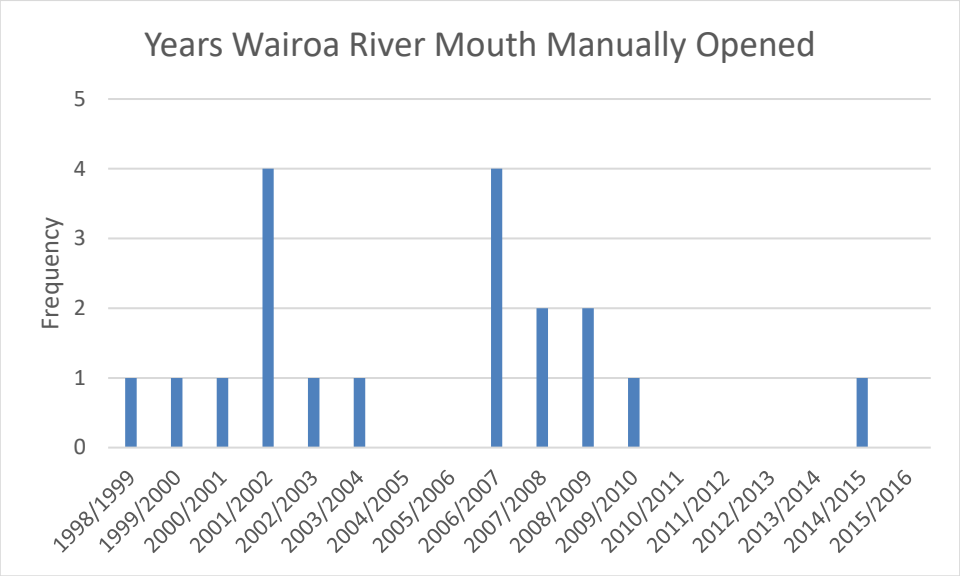

Figure 1: Frequency of manually opening of the Wairoa River mouth from 1998 to 2016 (Source: HBRC – Engineering)

Over the past 18 years, the most common months when the Wairoa River mouth was mechanically opened were December and June (Figure 2). Within these months, the river mouth was opened a total of four times each during this period. Additionally, the most active time for the river mouth to be opened were from the months of November through to July, with the exception of January. River mouth openings were not necessary during January and August through to October. On average river mouth openings occurred 2.4 times/month over this 18-year period.

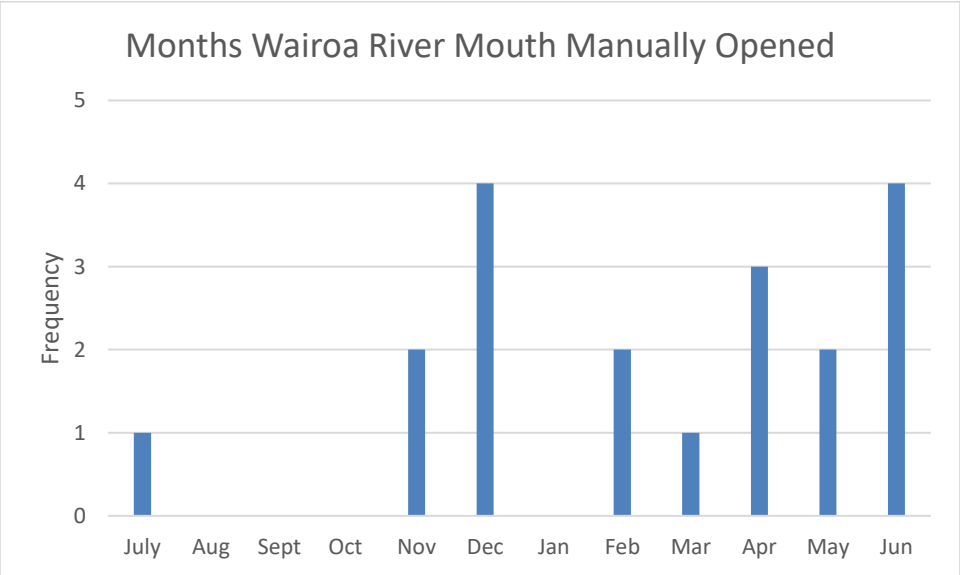

Figure 2: Months where the Wairoa River mouth was manually opened from 1998 to 2016 (Source: HBRC – Engineering)

The previous data highlights the known years and most active months where the Wairoa River mouth needed to be mechanically re-opened. However, if there is only a partial blockage or sea conditions are unfavourable, re-opening may not occur, leading to the risk of flooding and damage to infrastructure as the head of water increases behind this blockage.

Wairoa River Mouth Issues Affected by Mouth Closure

The Wairoa River mouth is fed by the Wairoa catchment, the largest catchment within the Hawke's Bay. Within this catchment, the dominant land use includes exotic forestry (36%) and sheep and beef farming (35%) (Haggitt & Wade, 2016), with smaller horticultural practices located along the river flats.

Active erosion from steep, unstable hill country and forestry production has contributed to an increase in sediment entering the estuaries/lagoons at the river mouth. Samples taken within the lagoons have shown a median mud content of >60%, and ranging between 33-88% (Haggitt & Wade, 2016). Additionally, debris from forestry operations can contribute to channel blockages. The high sediment load can accumulate in the estuary when the mouth is closed, potentially increasing the likelihood of further closures.

In particular, the closures trap the effects of industrial and municipal discharges to the river (meat processing plants at Frasertown and Wairoa; Wairoa municipal wastewater discharge) within the estuary. This can cause the discharged water to persist in the lower river reaches until such time as the river mouth inlet is opened. However, given the substrate at the mouth of the river there may be some soakage through the foreshore.

Conclusion

The Wairoa River mouth is a highly dynamic environment. An active bar crossing the river mouth results in partial to full closures of the river mouth inlet and a continual change in location of this opening. Closures cause a back log of water and sediment and create a flooding threat to low lying areas adjacent to the Wairoa River.

Pioneering history of the late 1880s and early 1900s state the issues associated with trade and passenger ships crossing the Wairoa River bar. Continual efforts and expenditure were spent to maintain an accessible entry to and from the Wairoa River. These efforts were made in vain as high seas and flooding events would erode any harbour construction and close the river mouth to any ships, causing delays with trade leaving and essential supplies entering Wairoa.

Within the last 18 years (1998 – 2016), on average, action needed to be taken at least once per year to re-open the river mouth, with December and June being the most likely months for mechanical opening to occur. However, mechanical re-opening of the river mouth was reliant on a large head of water backing up and a relatively calm sea for operations to go ahead.

Although re-opening only occurs when the river mouth inlet is fully blocked, there are other times throughout the year where mechanical re-opening cannot occur due to an increase in safety risk during excavation. As a result, unfavourable conditions are still likely to happen, such as flooding of low-lying areas adjacent to the river and threat to building infrastructure when the river mouth is partially blocked.

The physical and biological condition of the Wairoa River mouth and estuary is determined by the processes and activities within the Wairoa catchment. Such processes include sediment

entering the river via erosion of steep, unstable hill country. River mouth closures potentially increase the risk of adverse effects of industrial and municipal discharges into the lower reaches of the river.

References

Haggitt, T., & Wade, O. (2016). *Hawkes Bay marine information: review and strategy.* Raglan, New Zealand: eCoast Marine Consulting and Reserach. Retrieved from http://www.hbrc.govt.nz/assets/Document-Library/Technical-Publications/HB-Marine-Information-Review-and-Research-Strategy-eCoastLtd.pdf

Hicks, D. M., Shankar, U., McKerchar, A. I., Basher, L., Lynn, I., Page, M., & Jessen, M. (2011). Suspended sediment yields from New Zealand rivers. *Journal of Hydrology, 50*, 81-142.

Poverty-Bay-Herald. (1887, March 15). The Wairoa bar. *14(4814)*. Poverty Bay Herald.

Poverty-Bay-Herald. (1911, December 6). Wairoa harbour contract. *38(12630)*.

Poverty-Bay-Herald. (1913, May 20). Wairoa's worries. *40(13079)*.

Poverty-Bay-Herald. (1919, May 24). Isolated Wairoa. *46(14919)*.

Poverty-Bay-Herald. (1919, June 20). Scow on Wairoa bar. *46(14941)*.

Wanganui-Herald. (1903, May 18). The Wairoa bar. *(10951)*.

Williams, H. J. (1882, December 11). Wairoa River Improvement. *(3564)*. Daily-Telegraph.

Wright, M. (2010). *Historic Hawke's Bay and East Coast.* Auckland: David Bateman Ltd.