Attachment 4

SUMMARY BY BECA

Paihia Waterfront Project
Summary of Review of Breakwater Crest Level

FNHL (Far North Holdings Ltd) are progressing the Paihia Waterfront project, which was granted consent in 2011. The consented scheme includes offshore breakwaters and abutments/groynes, as well as a renourished beach.

FNHL's primary objectives for the project are:
- Improved public beach and promenade amenity;
- Less energetic wave environment along the Paihia waterfront to help protect existing coastal assets and the proposed beach and abutments against storm waves.

Taking onboard comments and concerns from the community and stakeholders, FNHL has asked Beca Ltd to review the consented breakwater crest levels.

The review was based on a high-level comparison of the influence of the breakwaters and crest height on estimated wave heights and wave runup at Paihia (Horotutu Beach). The review also considered the change in rock volume with different crest heights.

The findings of the review are:
- Observations on site and recent wave modelling (MetOcean, 2020) show that wave conditions at the beach and wharf are a combination of waves travelling into the Paihia basin through the western entrance (between Nihinui Point and Motumaire Island), the northern entrance (between Motumaire and Taylor Islands) and the eastern entrance (between the Lookout and Taylor Island).
- As documented in previous reports (MetOcean, 2020; Beca, 2021), the wave modelling has showed up to-30% reduction (0.1-0.2m) in wave heights at the wharf and beach with the Northern and Western Breakwaters. This is a modest reduction in the existing 0.5m-0.7m wave heights[1] estimated at the wharf and beach.
- The modelling results show that, even with the Western and Northern Breakwaters, waves would continue to travel into the beach and wharf from the west and east, around Motumarie and Taylor Islands.
- Based on the comparative review, discussions with FNHL regarding the review, and a simplified wave and rock volume analysis, protection of Horotutu Beach and waterfront against up to a 1 in 100 year storm could be provided by:
  - Northern and Western breakwaters with crests reduced to approximately 800mm above low water level (approximately m to m PSD[2]) to minimise visual impacts. The low breakwaters incrementally reduce wave heights at the wharf and beach. Waves continue to enter the basin around the eastern side of Taylor Island.
  - Some widening of the renourished beach, which is contained by abutments, consistent with the parameters of the existing consent. The beach reduces wave runup, helping to protect State Highway 11 and the proposed waterfront park. The review indicates that runup levels could be accommodated by the beach and lowering the breakwaters does not materially increase the expected wave climate, based on modelling.

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[1] These are the significant wave heights, the average of the highest 1/3 of the modelled waves, typically used in coastal science and engineering applications. Wave heights larger than this average will occur at the site.

[2] Paihia Sounding Datum, equivalent to Lowest Astronomical Tide, the lowest tide predicted under average weather conditions

- The combination of renourished beach, abutments and low breakwaters, with monitoring and management to adapt to future conditions, provides a marginally more conservative approach than an option without breakwaters.
- Detailed analysis and design of the structures in accordance with technical guidance will be required to determine the final crest and beach levels, as for any proposed scheme.
- Future climate change could be addressed through monitoring of the breakwaters and beach over time, as well as regular review of actual sea level rise, sea conditions and future updates to climate change predictions (national studies and guidance are published regularly). The breakwater crests can be raised by additional placement of rock in the future, as identified through the monitoring and reviews.

REFERENCES

Beca Ltd, 2021. Detailed Scheme Layout Report.

MetOcean Solutions Ltd, 2021. Paihia Wave Modelling Report.