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MEMORANDUM

TO: SUE ROB, NELSON CITY COUNCIL
FROM: JIM DAHM, ECO NOMOS LTD
SUBJECT: PEER REVIEW – TONKIN AND TAYLOR COASTAL INUNDATION ASSESSMENT
DATE: 16 NOVEMBER 2020

As requested, I provide a peer review of the report “Coastal Inundation in Nelson City” prepared by Tonkin and Taylor Ltd.

1 Background

Nelson City Council (NCC) engaged Tonkin + Taylor (hereinafter referred to as T+T) to undertake a high level or *first-pass* coastal inundation assessment for Nelson City, including:

- Review of available extreme coastal water level information
- Derivation of current and future extreme coastal water levels for the various areas within the NCC region.
- Mapping areas susceptible to inundation

The initial high level inundation assessment by T+T identified The Wood and Nelson City CBD as being particularly prone to coastal inundation. Given the considerable existing development and infrastructure in these areas, Council also commissioned T+T to undertake a detailed hydrodynamic coastal inundation assessment for these areas.

The final T+T report was prepared in September 2020. Eco Nomos was engaged to peer review the report and comments were provided verbally. This report provides a more detailed written review.

2 Estimation of Existing and Future Extreme Sea Flood Levels

T+T adopted a planning timeline of 100 years, in line with the minimum requirements of Policy 24 of the NZCPS (2010). The extreme sea flood level assessed was the 1%AEP (Annual

Exceedance Probability) event, being the extreme sea level which has a 1% probability of being equalled or exceeded in any given year. These standards are consistent with existing best practice and I concur with T+T that they are appropriate standards for the purposes of managing existing areas of development. It is important however to bear in mind, that the sea flood levels estimated are not the highest which can potentially occur.

Flood levels in their report are expressed in terms of New Zealand Vertical Datum 2016 (NZVD2016). The relationship of NZVD to other local datums and to current mean sea-level is also provided in their Table 1.1.

T+T assessed existing and potential future extreme sea levels by estimating and summing the following coastal inundation components:

- **Storm tide**, the static sea level arising from the combination of astronomical tides and storm surge
- **Potential future changes in relative sea level**, and
- **Nearshore wave effects**, including both wave set up (super-elevation of static sea level by wave effects) and wave run up

This is a standard approach consistent with current best practice.

The NCC coastline was subdivided into representative coastal cells within which the assessed extreme water levels are expected to be similar, with estimates of extreme sea levels developed for each of these cells. In my opinion, this is a sound approach and the various cells identified are reasonable.

T+T assessed both extreme static water levels (flood areas relevant over a wide area) and extreme wave run-up levels (typically only relevant within nearshore areas, within approximately 30m of the shoreline).

A 1%AEP storm tide of 2.34m (NZVD) was adopted based on an earlier analysis of 10 years of sea level data from Port Nelson by NIWA (2018). This figure is virtually identical to the extreme sea level of 2.35m measured at Port Nelson during Cyclone Fehi (1 February 2018).

I concur with T+T that this is the best estimate presently available. However, there is some uncertainty around the accuracy of the figure, as the NIWA estimate was based on analysis of only 10 years of sea level data. This record is not likely to be long enough to reliably estimate the 1% AEP storm tide.

Nonetheless, the following considerations suggest the estimate is probably reasonable:

- Close correspondence with the Cyclone Fehi peak sea level, which appears to be the worst sea flooding experienced in this area for at least 50-60 years and probably longer (based on various community feedback during initial public consultation conducted in 2019)
- A brief search of the Papers Past data base (which covers available historical newspapers for the period 1839-1950) using various inundation related search

words found no mention of a similar sea flood event for Nelson City, Monaco or other low-lying suburbs vulnerable to inundation in the NCC region.

- The addition of wave effects components to the estimated storm tide adds some safety to the estimate.

Future sea level rise projections (Table 3.3 in T+T) were based on existing national guidance (MfE, 2017). I agree that these are the most appropriate projections to use.

Estimating wave effects (both wave set up and wave run up) is complex and subject to uncertainties. T+T provide a useful and transparent discussion of these uncertainties and in my opinion adopt both a reasonable and precautionary approach, consistent with a first pass analysis. Nonetheless, further checking and refinement of these estimates should be undertaken during the next public consultation phase, when more data on historic flooding events is likely to be provided by the community.

Wave set-up is a particularly important parameter as it contributes to the estimate of extreme static water level, which can apply over a wide area. Given the uncertainties with estimating this parameter, I concur with the more conservative approach T+T adopted, relative to the NIWA calculator. However, wave set-up is a significant component of the total extreme static sea level estimated at some developed sites (e.g. Tahunanui – see Table 4.2 in T+T). Accordingly, these estimates will need to be checked using site-specific data. Once the next stage of community consultation commences, it is likely that landowners and others in these areas will be able to provide useful information on past flooding. This can be used with existing data and further analysis to improve the estimates. This work should ideally be conducted in close consultation with affected stakeholders.

The lower value of wave set-up adopted in sheltered harbour environments appears reasonable. However, there are sites (e.g. Monaco) in the identified sheltered areas where there may be more significant wave influence, possibly including highly refracted storm swell. I believe the values adopted by T+T for Monaco are reasonable for this first pass assessment and suitable for the next stage of community consultation. However, a number of properties and houses were inundated in this area during Cyclone Fehi. Accordingly, both the total estimated extreme sea levels and the wave components will need to be checked and (if required) improved using information on flooding experienced during that event. This work is best conducted with stakeholders in the next round of community consultation, when considerable useful information on the Cyclone Fehi event is likely to be provided by the community.

3 Mapping of Flood Hazard and Hydrodynamic Modelling

In the mapping of the existing and potential future sea flood areas, T+T adopted two simple “bath tub” approaches as outlined in their Section 5.1.

In my opinion, these approaches are appropriate for a first pass analysis. However, as discussed by T+T, a bath tub approach assumes that the peak of any sea flood event persists long enough to completely inundate any land below that level. In reality, this may not always be the case. Accordingly, bath tub approaches can sometimes over-estimate both the area and the depth of flooding for any given sea flood scenario.

The mapping indicated The Wood and Nelson City CBD as being particularly prone to coastal inundation. Given the extensive development in these areas, Council commissioned T+T to undertake a detailed hydrodynamic coastal inundation assessment for these areas to check the bath tub assumptions. This work was undertaken using an existing hydraulic flood model of the Matai River. The hydrodynamic modelling assessed flooding for existing and potential future sea level, for both a large spring tide (MHWS-6) conditions and for the assessed 1%AEP static extreme sea level.

A limitation of the model is that it does not currently incorporate the stormwater reticulation network which does provide a conduit for seawater inundation in places. As such, it will under-estimate hydraulic connections and therefore flooding. However, if (as assumed by T+T) the stormwater outlets will ultimately be retrofitted with flap-gates, then I agree that the modelling provides a more realistic indication of flooding potential than the simple bath tub assumptions.

T+T also recommend various additional work (their Section 8.2) to improve the assessment of coastal inundation in the Nelson region. I agree that many of these areas of work would be useful, but recommend that any further work is left until after more detailed community consultation, which will help clarify priorities.

4 Summary

Overall, it is my view that:

- The first pass assessment and the hydrodynamic modelling of The Wood and CBD by T+T has been conducted according to existing best practice and has used existing best information.
- The work is suitable for initial mapping, District Plan development and community consultation.

There are various uncertainties, which have been clearly highlighted by T+T. It is likely that the estimates can be improved by further work, including some of the areas of further work suggested by T+T. However, any further work is best left until the community have been consulted on the findings, and on the initial management recommendations in the draft District Plan. It is very likely that there is valuable knowledge within the community that will considerably assist any further refinement of the estimates. Any further refinement of the estimates should also, ideally, be undertaken collaboratively with relevant community stakeholders.