

Nelson City Council  
PO Box 645  
Nelson 7040

Attention: Sue Robb

Dear Sue

## **Nelson City coastal inundation maps**

### **1 Introduction**

Nelson City Council (NCC) engaged Tonkin & Taylor Ltd (T+T) to map the mean high water springs (MHWS-6) and 1% annual exceedance probability (AEP) static coastal inundation extents for the present-day and future scenarios with selected sea level rise increments for the Nelson City district. We understand that NCC intends to place these map layers on their public GIS viewer for use in community engagement on coastal inundation susceptibility of the Nelson City district. This letter sets out the approach and adopted levels that have been used to map the inundation layers.

This work has been undertaken and outputs provided in accordance with our conditions of contract set out in the Professional Services Brief dated 12 October 2020.

### **2 Purpose and scope**

NCC has requested T+T to update the bathtub modelling coastal inundation layers previously provided to NCC in the T+T (2020) report titled "Coastal Inundation Hazard Report, Nelson City". The updates include:

- a Inclusion of a new estimate by NIWA for MHWS-6; and
- b new design sea level rise (SLR) values adopted by NCC for planning purposes.

Information on these updated estimates are provided below.

This letter is to be read in conjunction with T+T (2020), and presents information associated with these updates only. For background information and detail on the modelling methodology used, refer to T+T (2020).

### **3 Scenarios**

NCC has requested mapping of coastal inundation extents based on the following present-day water levels:

- MHWS-6;
- 1% AEP static inundation.

The MHWS-6 is defined as the Mean High Water Springs level, which is exceeded by 6% of astronomical tides. The 1% AEP static inundation level is the combined storm tide plus wave setup water level with a 1% Annual Exceedance Probability. The storm tide is a combination of astronomical tide and storm surge, with the latter comprised of barometric setup and wind setup (refer to Figure 3.1). Wave set-up is the increase of the mean water level induced by breaking waves and should be included when considering land susceptible to coastal inundation (see Figure 3.1).

In addition to the present-day water levels (+ 0m SLR), the following sea level increments have been mapped as requested by NCC for both scenarios (i.e. both MHWS-6 and 1% AEP static inundation):

- 0.5 m
- 1 m
- 1.5 m
- 2 m

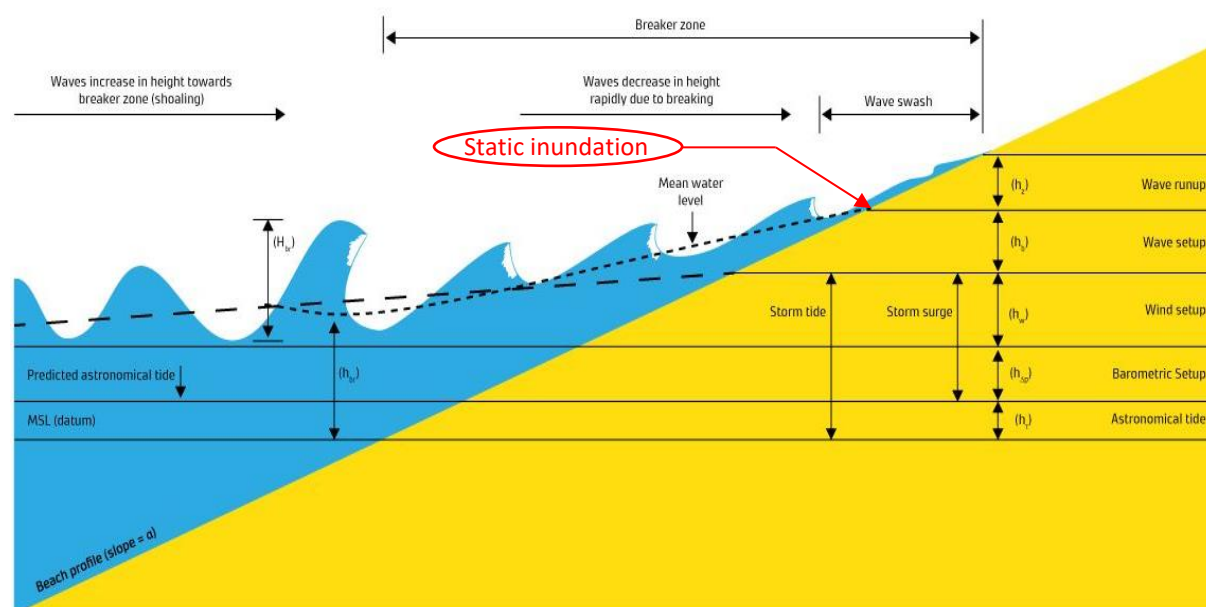


Figure 3.1: Schematisation of water level components

#### 4 Adopted values

Two MHWS-6 levels have been adopted and mapped based on two sources. The Coastal Calculator by Stephens et al. (2018) used a MHWS-6 level of 1.72 m NZVD2016 based on Goodhue (2013). NIWA revised this level in 2020 based on more recent analysis using the 2008-2017 mean sea level and found a level of 1.77 m NZVD2016 (refer to NIWA, 2020). As both sources are used by NCC both levels have been mapped. The MHWS-6 is generally constant across the Nelson City district and this level has been adopted for all sites across the district. The MHWS-6 level and future levels for the adopted sea level rise (SLR) increments for the Nelson City district are shown in Table 4.1.

The 1% AEP static inundation levels for the eight coastal cells have been based on T+T (2020) and are shown in Table 4.2. The 1% AEP static inundation levels have been rounded up to the nearest 0.1 m.

**Table 4.1: MHWS-6 water levels (m NZVD2016) for all sites used for mapping**

| Source                 | Present-day | +0.5 m SLR | +1.0 m SLR | +1.5 m SLR | +2.0 m SLR |
|------------------------|-------------|------------|------------|------------|------------|
| Stephens et al. (2018) | 1.72        | 2.22       | 2.72       | 3.22       | 3.72       |
| NIWA (2020)            | 1.77        | 2.27       | 2.77       | 3.27       | 3.77       |

**Table 4.2: 1% AEP static inundation levels (m NZVD2016) used for mapping**

| Coastal cell            | Present-day | +0.5 m SLR | +1.0 m SLR | +1.5 m SLR | +2.0 m SLR |
|-------------------------|-------------|------------|------------|------------|------------|
| Waimea Inlet            | 2.6         | 3.1        | 3.6        | 4.2        | 4.6        |
| Tahunanui Beach         | 2.7         | 3.2        | 3.7        | 4.2        | 4.7        |
| Rocks Road              | 2.6         | 3.1        | 3.6        | 4.1        | 4.6        |
| Nelson Haven            | 2.6         | 3.1        | 3.6        | 4.1        | 4.6        |
| Boulder Bank/Glenduan   | 3.1         | 3.6        | 4.1        | 4.6        | 5.1        |
| Delaware Estuary        | 2.6         | 3.1        | 3.6        | 4.1        | 4.6        |
| Delaware Bay open coast | 2.9         | 3.4        | 3.9        | 4.4        | 4.9        |
| Oananga Bay open coast  | 2.7         | 3.2        | 3.7        | 4.2        | 4.7        |

## 5 Mapping

The coastal inundation extents have been mapped using the bathtub modelling approach, with inundated areas classified in terms of whether they are connected or not connected to the coast (in line with T+T (2020) mapping method – refer to that report for more details):

- 1 **Connected areas** are areas that are flooded due to being directly connected to the coastal water body via overland flowpaths. Stormwater (piped) network connections are not considered and so results may not necessarily show all areas expected to be flooded during high tidal events;
- 2 **Non-connected areas** are areas of low-lying land that are not hydraulically connected to the coast via overland flowpaths. This indicates areas that may be flooded through the piped stormwater network or raised groundwater levels.

Coastal inundation extents have been mapped using existing digital elevation models (DEMs), as constructed for Nelson City in T+T's 2020 assessment using NCC's LiDAR data from 2014/2015. DEMs were constructed at a 0.5 m horizontal grid resolution and represent the bare earth (i.e. with buildings and vegetation removed). Note that stopbanks or sharp elevation transitions may not be accurately represented by the processed DEM.

The inundation extents have been mapped up to the values stated in the tables above, with output polygons based on a 1 m horizontal grid resolution. Layers for each scenario are combined and provided to NCC in a single geodatabase. A sample of the mapped attribute table is shown below in Table 5.1 and a further explanation of each attribute column is described below in Table 5.2. The attributes provided allow NCC to geospatially present the layers as may be required for a particular application.

**Table 5.1: Sample of the mapped attribute table**

| Cell                    | coast_conc | mRL (NZVD) | Scenario   |
|-------------------------|------------|------------|------------|
| Boulder Bank / Glenduan | 1          | 1.72       | MHWS6+0.0m |
| Boulder Bank / Glenduan | 0          | 2.22       | MHWS6+0.5m |

**Table 5.2: Attribute table explanation**

| Attribute  | Description  |
|------------|--|
| Cell       | [text / categorical] the coastal cell that the polygon is within   |
| coast_conc | [binary] is whether or not the polygon is connected to the coast:<br>0 = no, polygon has been generated as a non-connected bathtub<br>1 = yes, polygon is connected to the coast |
| mRL (NZVD) | [number] the surface elevation of the polygon in NZVD2016  |
| Scenario   | [text / categorical] the scenario that has been mapped to produce this extent polygon  |

## 6 Applicability

This report has been prepared for the exclusive use of our client Nelson City 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

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:

.....

Patrick Knook  
Senior Coastal Engineer

Quinn Hornblow  
Water Resource Engineer

.....

Mark Foley  
Project Director

Report reviewed by:

.....

Dr Tom Shand  
Technical Director Coastal Engineering

Damian Velluppillai  
Project Manager

Internal Review has comprised:

- Review of scenarios adopted
- Review of levels adopted
- Review of mapped levels and extents

PPK

p:\870888\870888.0021\issueddocuments\20201116.nccinundationmappingletter-final.docx