Memorandum

To	Stefan Roets
Copy	Isabelle Farley, Liam Foster
From	Sarah Yeo
Office	Wellington
Date	13 November 2024
File/Ref	1-14657.00
Subject	Whatuwhiwhi WWTP Flood Hazard Risk Assessment

1 Introduction

The Whatuwhiwhi Wastewater Treatment Plant (WWTP) is located on the Karikari Peninsula in Northland (Figure 1-1). As part of the consent renewal process for the Whatuwhiwhi WWTP a desktop assessment of the flood hazard to the site from coastal inundation is required to identify any risk to assets and infrastructure on the site. This assessment does not consider tsunami risk to the site. This memorandum outlines the available information and high-level flood hazard risk assessment that has been carried out for the Whatuwhiwhi WWTP site.

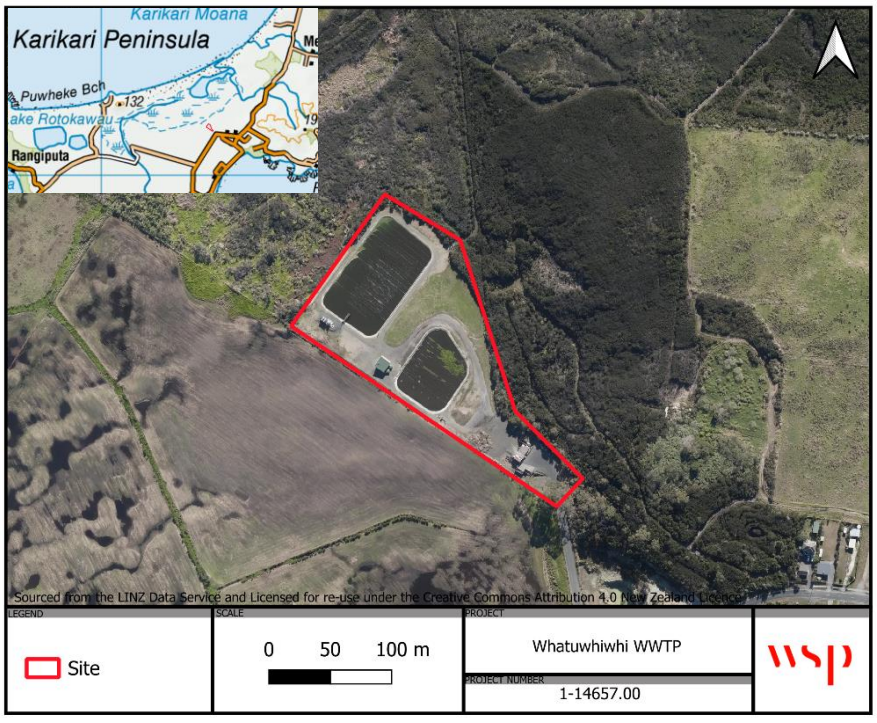

Figure 1-1: Whatuwhiwhi WWTP site in Northland.

WSP
Wellington
L9 Majestic Centre
100 Willis Street
Wellington 6011, New Zealand
+64 4 471 7000
wsp.com/nz

2 Available Data

The flood hazard risk assessment for the Whatuwhiwhi WWTP site has been undertaken based on publicly available information on the site characteristics and previous regional scale flood hazard assessments. A summary of the information used in the desktop assessment is outlined below.

2.1 Whatuwhiwhi WWTP As Builts

Information on the Whatuwhiwhi WWTP site design from the As Built drawings is available and has been used to assess the location and design of key structures and assets within the site. This information was used to compare against projected flood hazard elevations to inform areas at risk under different flooding scenarios.

2.2 LINZ 1m DEM LiDAR

The Northland 1m resolution Digital Elevation Model (DEM) LiDAR data from 2018-2020 is the most recent publicly available topographic data that covers the Whatuwhiwhi WWTP site. This information was accessed from the LINZ online data service and used to gain an understanding of the topography of the site.

2.3 Existing Regional Flood Hazard Assessment

A Coastal Flood Hazard Assessment for the Northland Region was undertaken by Tonkin and Taylor Ltd for Northland Regional Council based on data up to 2019-2020 (T&T, 2021). This analysis synthesised the risk of coastal inundation around the whole Northland Region based on a range of coastal processes under different return period events and projected sea level rise (SLR) scenarios.

The key output of the T&T coastal hazard assessment that is relevant to the current assessment was the identification of elevations at which inundation is estimated under different scenarios. The four key scenarios are detailed below.

- CFHZ0 – Present day extreme static water level (1 in 100-year ARI). SLR value adopted was 0m.
- CFHZ1 – Extreme static water level (1 in 50-year ARI) at 2080. SLR value adopted was 0.6m.
- CFHZ2 – Extreme static water level (1 in 100-year ARI) at 2130. SLR value adopted was 1.2m.
- CFHZ3 – Extreme static water level (1 in 100-year ARI) at 2130 under highest SLR scenario. SLR value adopted was 1.5m.

The extreme static water level takes the baseline elevation of the mean high water spring (MHWS) that is exceeded 10% of the time (MHWS-10) and adjusts this value to consider storm tide, wave set-up, and SLR. The values for each of the coastal flood hazard zone categories from the T&T (2021) analysis relevant to the Whatuwhiwhi WWTP site are from Site 99 and are summarised below in Table 2-1.

Table 2-1: Coastal flood hazard water level elevations (NZVD2016) sourced from the T&T (2021) analysis for Northland Regional Council. Site number 99 corresponds with the area which the Whatuwhiwhi WWTP site is located. Water level values extracted from Appendix C Table 2 of T&T report.

Site Number	MHWS10	CFHZ0	CFHZ1	CFHZ2	CFHZ3
99	0.9m	2.8m	3.3m	4.0m	4.3m

2.4 2024 Water Level Data and Sea Level Rise Projections

The coastal flood hazard assessment undertaken by T&T (2021) outlined in Section 2.3 was carried out using available data up to 2020. There are national datasets that have provided more recent data on water level and sea level rise projections since 2020, LINZ (2024) and NZ SeaRise (2024). Therefore, a review of the publicly available datasets from these sources was undertaken to compare the findings to the T&T report.

Information on water level under a range of different tidal conditions is available for tide gauges throughout New Zealand from LINZ (LINZ, 2024). This data from LINZ can be used to estimate the tidal conditions at a range of different coastal locations across the country. The Marsden Point location is the closest dataset available to the Whatuwhiwhi WWTP and can be used as a high level proxy of the potential tidal conditions at the site. The MHWS water level estimate for this site is 0.98m (NZVD2016).

The combination of the water level at a desired event (e.g. MHWS) can be considered in conjunction with SLR projections to provide a high-level estimate of potential inundation risk into the future. NZ SeaRise (2024) has estimated the potential SLR for locations around New Zealand into the future under different Shared Socioeconomic Pathways (SSPs) and has also considered vertical land movement (VLM). The projected SLR elevations with VLM for two SSP scenarios at 2130 are shown below in Table 2-2.

Table 2-2: Sea level projections for 2130 from NZ SeaRise (2024) at the Whatuwhiwhi WWTP accounting for vertical land movement.

Scenario	Water Level Increase
SSP3-7.0 +VLM	1.28m
SSP5-8.5 +VLM	1.44m

3 Flood Hazard Risk Assessment

The topography of the Whatuwhiwhi WWTP site is important to understand when undertaking this flood risk hazard assessment. Figure 3-1 show the elevations in the area surrounding the site up to 10m. The Whatuwhiwhi WWTP ranges in elevation from approximately 4m in the south western corner, to approximately 9m in the south eastern corner. Within the lowest lying area, in the south west of the site, the main asset is the UV building with a base elevation of approximately 5.1m. All other assets within the site area are at elevations greater than 5.1m and are therefore not subject to inundation risk under the currently assessed scenarios. The south eastern entrance to the site has much higher elevations, which range from 6.2m to 10.0m. Therefore, the inundation risk to the site is much higher from the northern coastline (Rangaunu Bay) than from the southern coastline (Doubtless Bay). This information will be used to identify any areas of the site at risk to coastal inundation based on the publicly available water level and SLR projections (Section 2.4) as well as the previous analysis undertaken by T&T (2021) described in Section 2.3.

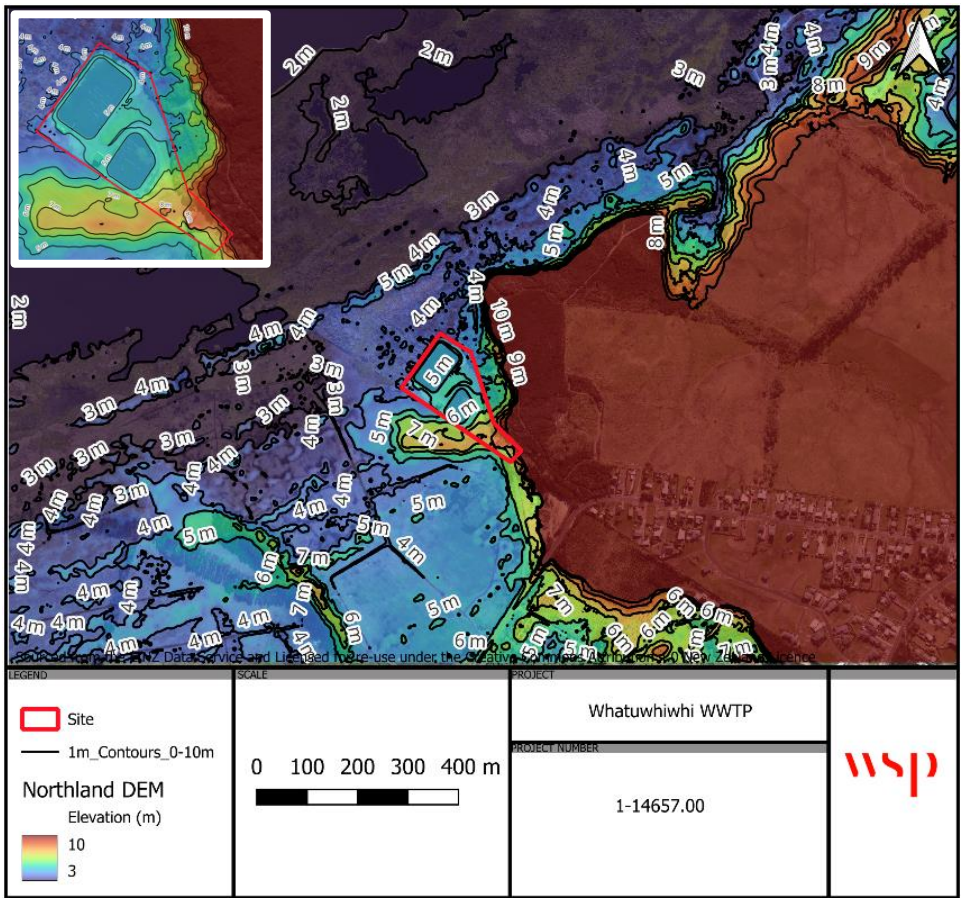

Figure 3-1: Topography of the Whatuwhiwhi WWTP site based on Northland 1m DEM Lidar and generated 1m contours. Note elevations >10m are represented in dark red. Inset map shows details of elevation at the site at finer resolution.

When undertaking the high-level assessment of the potential hazard of coastal inundation at the Whatuwhiwhi WWTP site two different approaches were adopted based on available information. Firstly, the water level when combining the MHWS from LINZ (2024) at Marsden Point with the NZ Sea Rise (2024) SLR+VLM projections for SSP3-7.0 and SSP5-8.5 at 2130 was calculated. The water level elevations from this method are outlined below in Table 3-1. When comparing these simple calculations to the regional assessment undertaken by T&T (2021) it was found that the MHWS level was lower in the T&T report when compared to the available LINZ data. Analysis of the flood hazard elevation estimates (CFHZ0-3) show that these flood hazard elevations (Table 2-1) were greater than those using the MHWS in combination with the SSP scenarios (Table 3-1). Therefore, the more conservative estimates based on the regional T&T study were used to assess the potential for coastal inundation at the Whatuwhiwhi WWTP site as these account for wave set-up and tidal surge.

Table 3-1: Estimates of inundation levels (NZVD2016) using LINZ MHWS at Marsden Point and NZ SeaRise SLR+VLM scenarios for SSP3-7.0 and SSP5-8.5 at 2130.

MHWS	MHWS +SSP3-7.0	MHWS +SSP5-8.5
0.98m	2.26m	2.42m

Based on the Northland 1m DEM (2018-2020) contours were derived at 0.1m intervals and the contours associated with the T&T CFHZ scenarios were overlayed on the Whatuwhiwhi WWTP site (Figure 3-3). As is evident on the figure, inundation from the coast to the north of the site poses the highest risk. Due to the higher elevations in the south eastern edge of the site, no inundation risk from the southern coastline was identified for the Whatuwhiwhi WWTP site. Additionally, the figure indicates there is no risk of inundation of the main access road to the site (Inland Road).

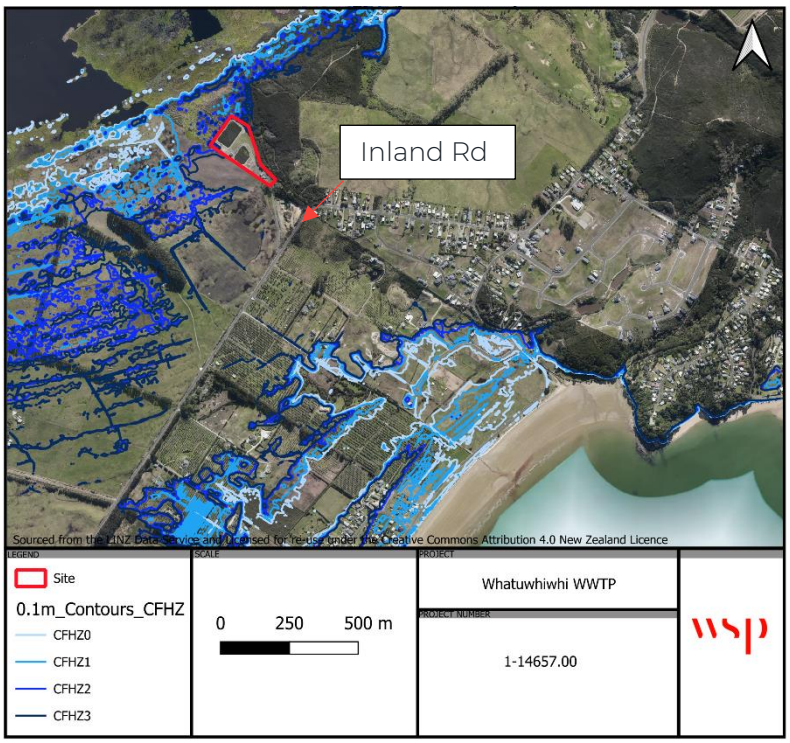

Figure 3-2: Mapped inundation risk for T&T (2012) coastal flood hazard zones elevations based on 2018-2020 1m DEM LiDAR for the Northland Region.

Closer analysis of these risk zones on the Whatuwhiwhi site indicates there are two locations on the site that are potentially at risk for coastal inundation, the south western corner and the northern extent of the site which would result from inundation from the northern coastline through the wetland immediately adjacent to the site (Figure 3-3). Analysis of the south western area of the site indicates that there is risk of inundation from the most extreme scenario, CFHZ3. Due to the disconnection of the areas of ponding (localised depressions) indicated in the CFHZ2, it is unlikely that inundation from the coast will occur under this scenario. Within this area of the site the CFHZ3 water level does not reach any of the assets on site, with the UV building approximately 0.8m higher than the water level from this scenario.

In the northern edge of the site there is risk of inundation to the Whatuwhiwhi WWTP site under both the CFHZ2 and CFHZ3 scenarios. There are no assets from the site located within these hazard zones, but there is a currently un-used access road that would be impacted by inundation in both of these hazard levels.

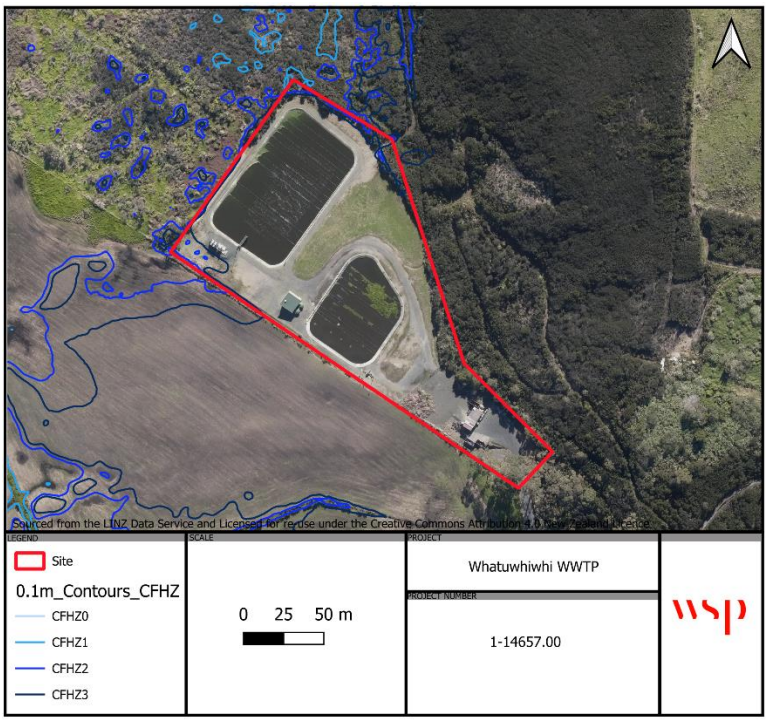

Figure 3-3: Mapped inundation risk for T&T (2012) coastal flood hazard zones elevations based on 2018-2020 1m DEM LiDAR for the Northland Region.

Analysis of the pluvial flood risk (runoff and ponding during rainfall events) has also been undertaken using the DEM topography data for the site. The runoff flowpaths have been derived using the 1m resolution DEM data for the area surrounding the site. The results indicate that there is one area that may be subject to water flowing along the edge of the site during a rainfall event. This flowpath is the result of natural depressions in the topography and natural drainage channels. The natural drainage channel along the north of the site drains an area of approximately 4 hectares (0.04km^2) and drains away from the site to the north (through the adjacent wetland). The average elevation of the drainage path on the margin of the site is approximately 4.5m and does not appear to intersect with any assets within the site.

4 Conclusions

A high-level flood hazard risk assessment was undertaken for the Whatuwhiwhi WWTP site located on the Karikari Peninsula in Northland. This assessment was undertaken using publicly available data, and takes into coastal inundation to the site, but does not consider tsunami risk.

An assessment of the topography of the site was undertaken using 1m DEM LiDAR to identify low lying areas of the site, and which assets/ infrastructure were present in these areas. The lowest lying area of the site is in the south western corner of the site, with the UV building located at an elevation of approximately 5.1m. Due to the low lying nature of the south western and northern areas of the site, any inundation is likely to be from water flowing from the northern shoreline (Rangaunu Bay) through the wetland and into the site. The higher elevations in the south east of the site indicate that water from the southern coastline (Doubtless Bay) will not pose a risk to the site based on information from the current assessment.

Two different approaches were used to identify water levels for potential inundation within the Whatuwhiwhi WWTP site. The first method was to use the available LINZ tidal information in conjunction with the NZ SeaRise sea level rise scenarios to identify potential inundation levels at 2130 based on SSP3-7.0 and SSP5-8.5. The second approach was to adopt the water level estimates derived by T&T (2021) for the Northland Region coastal flood hazard assessment. When comparing the water levels of the two approaches, the T&T CFHZ estimates for future events were more conservative and took into account a number of additional parameters such

as storm tide and wave set up, therefore were used for this high-level assessment. Based on the CFHZ water levels, there are two areas of the site that are at risk of inundation under CFHZ3 (south western and northern corners), and the northern corner of the site is also vulnerable to CFHZ2 in some localised areas. There are no WWTP assets within these hazard zones on the site, but the unused access road in the north of the site may be impacted under CFHZ2 and CFHZ3.

Analysis of the pluvial flood risk within the site showed one drainage path along the northern margin of the site that drains a catchment of approximately 4 hectares. This drainage path is set back from any assets on the site and has an average elevation of approximately 4.5m.

5 References

LINZ (2024). Standard Port Tidal Levels. Accessed from: https://www.linz.govt.nz/guidance/marine-information/tide-prediction-guidance/standard-port-tidal-levels. Accessed on: 31/10/24.

NZ SeaRise. (2024). Predicting Sea Level Rise for Aotearoa New Zealand. Accessed from: https://www.searise.nz/. Accessed on: 31/10/24.

T&T. (2021). Coastal Flood Hazard Assessment for Northland Region 2019-2020. Prepared for Northland Regional Council. Reference Number 1012360.1000v4.