38 Whatuwhiwhi

38.1 Description and geomorphology

The site is located at the northern end of Doubtless Bay and extends for 2 km of south facing coast and includes sections of headland cliff and three pocket beaches. Figure 38.1 shows the site sand its division into eight coastal cells for the purpose of assessing coastal erosion hazards. Site photos showing key features of the site are presented in Figure 38.2.

The site starts at the north end of Tokerau Beach with a section of cliff before a small pocked beach with no public access. The middle beach is Parakerake Bay, which has public vehicle and pedestrian access and a holiday park across the road. The third pocket beach, referred to here as Waihapurua has a modern dynamic beach and dune system backed by a sequence of dunes deposited in the Holocene. Coastal sediment deposition and dune formation in the Holocene appears to have filled in the embayment at Waihapurua, with the modern backshore characterised by a low elevation fore-dunes. Holocene sediments extend 250–500 m landward of the modern shoreline. The three pocket beaches are separated by headlands with a dominant geology of basalt and basaltic andesite. Each pocket beach is characterised by similar sediment, with moderately sorted coarse sand at the upper beach and well sorted medium sand and the lower intertidal beach. Cliff cells are typically rocky with no beach at the toe.

Stream flow has an influence on the morphology and development of the two larger pocket beaches (Parakerake and Waihapurua), with beach streams situated at the eastern end of each beach that create a low terrace at the corner of each beach. The stream at Parekereke runs alongshore at the bank toe before turning seaward and discharging into the sea. Stream action locally lowers the beach and forms a low point that allows tidal flow and waves to reach the bank toe. Away from the streams, both beaches decrease in width moving west but have steeper profiles and more developed and vegetated fore-dune features.

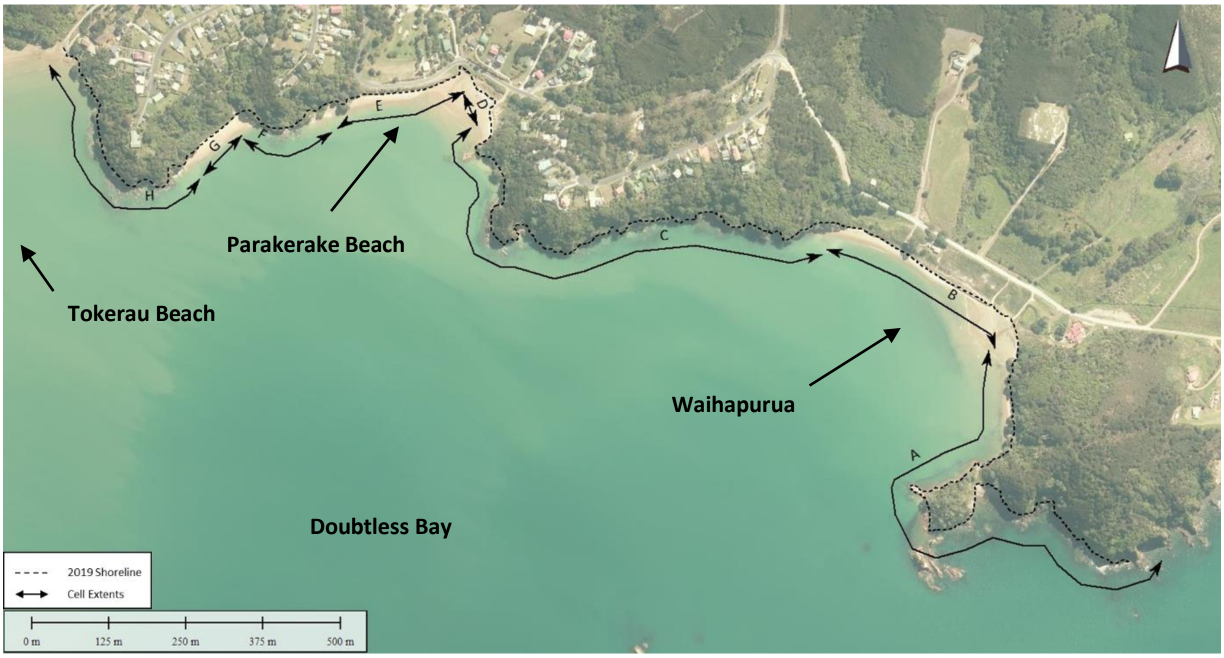


Figure 38.1: Map showing 2019 shoreline position and cell extents with background aerial imagery from 2014.

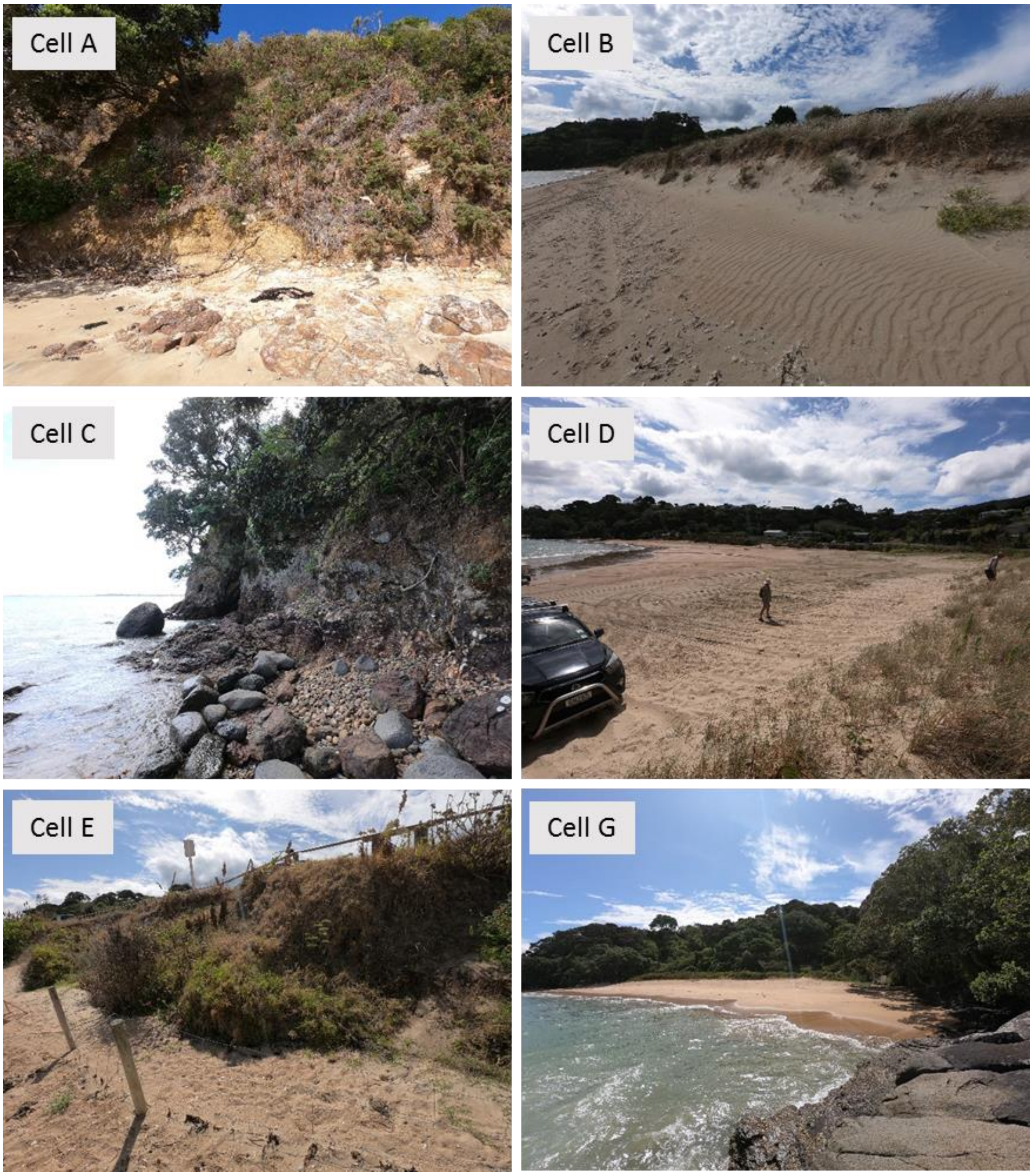


Figure 38.2: Photos from Whatuwhiwhi site visit on 22/01/2020.

38.2 Local considerations

A road follows the coast at Parekereke Beach, with the road edge within 5 m of the bank toe in places. Vehicle access is used on both larger embayment beaches for launching boats. Vehicle access has a localised impact on dune formation and stability.

38.3 Component values

The site is split into eight cells based on coastal type and the interchange between cliff headland and pocket beaches. There are four cliff cells and four beach cells. Two of the beach cells are characterised by a dune system and two are characterised by a vegetated terrace with limited space for a wind-blown dune to form.

All cliff cells (Cells A, C, F, H) have a consistent geology of underlying basalt, resulting in a relative stable hard cliff that can sustain a steep slope and a damped response to sea level rise. Cliff height is similar at these cells with a mean of 30 m based on height between toe and crest extracted from LiDAR data. Adopted long-term rates did not consider positive values because erosion on consolidated shorelines is not balanced by accretion. Positive rates may be influenced by landslides and slips.

Beach cells at Whatuwhiwhi (Cells B, D, E, G) are small pocket beaches that are influenced by neighbouring headlands and Holocene infill of sediment in landward valleys. The eastern beach (Waihapurua) is represented in a single cell (B) and has a modern foredune, narrow backshore and low tide terrace formation. Historic shoreline analysis at Cell B indicates a long-term trend of erosion with a mean rate of -0.1 m/yr. The central beach (Parekereke) is split into two cells. Cell D is a discrete section east of the stream where sand dunes have built up in recent years. Cell E is west of the stream and is backed by a vegetated unconsolidated coastal terrace with little accommodation space between the road and beach. Historic shoreline change at Parekereke indicates a period of beach rotation where Cell D to the east is building up with sand dunes and Cell E to the west is erosion. This may be associated with beach stream channel migration in recent decades (Figure 38.1). Coast Care planting has been undertaken at Cell E to stabilise the bank and encourage sediment retention. Beaches backed by unconsolidated by vegetated terrace are considered to be less dynamic than dune systems and therefore have a lower short-term component. Consistent values were used for closure slope at all beach cells, using the method outlined in Section 4.6.5 of T+T (2020).

Cell G is the small pocket beach west of Parekereke, characterised by a vegetated coastal terrace that extends landward for 20-30 m before reaching the cliff toe. Coastal erosion at Cell G was assessed using the consolidated cliff method due to the small volume of sand on the beach and the vegetated backshore.

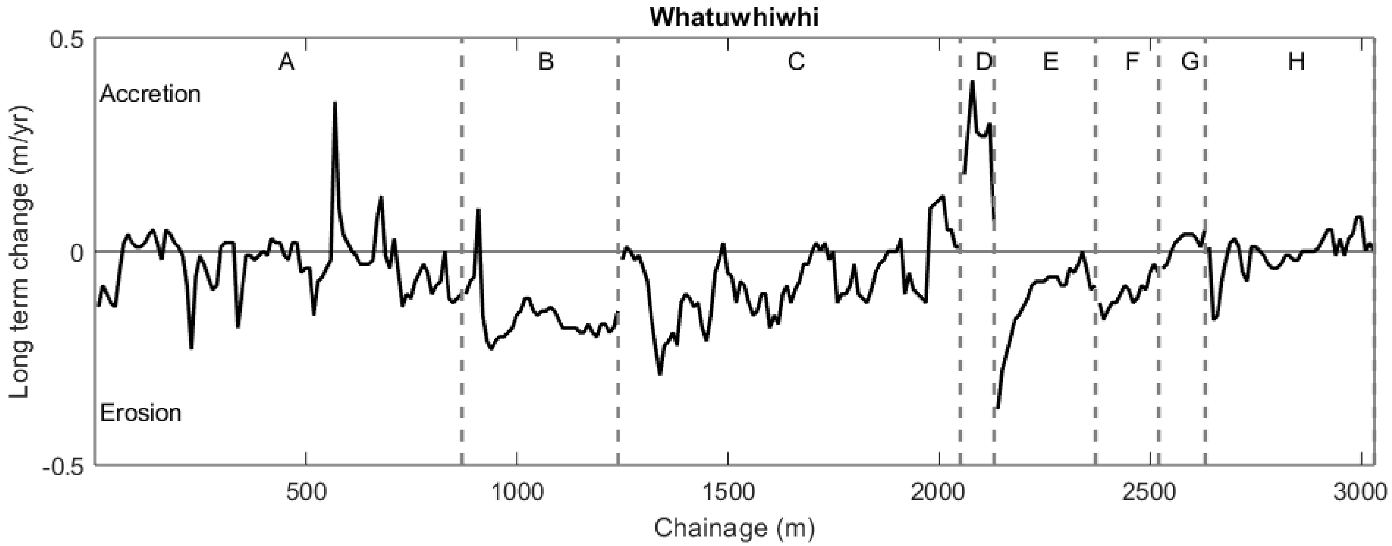


Figure 38.3: Rate of long-term shoreline change along the site showing each cell.

Table 38.1: Component values for Erosion Hazard Assessment

Site		**38. Whatuwhiwhi**							
Cell		**38A**	**38B**	**38C**	**38D**	**38E**	**38F**	**38G**	**38H**
Cell centre (NZTM)	E	1636369	1636401	1635804	1635670	1635571	1635361	1635267	1635025
	N	6139988	6140374	6140396	6140668	6140662	6140596	6140595	6140618
Chainage, m (from E)		1-860	870-1230	1240-2040	2050-2120	2130-2360	2370-2510	2520-2620	2630-3020
Morphology		Basalt lava cliff	Dune	Basalt lava cliff	Dune	Coastal terrace	Basalt lava cliff	Consolidated terrace	Basalt lava cliff
Short-term (m)	Min	-	5	-	5	2	-	-	-
	Mode	-	8	-	8	4	-	-	-
	Max	-	10	-	10	6	-	-	-

Site		38. Whatuwhiwhi							
Cell		**38A**	**38B**	**38C**	**38D**	**38E**	**38F**	**38G**	**38H**
Dune/Cliff elevation (m above toe or scarp)	Min	20	0.4	15	0.5	1.7	27	0.5	30
	Mode	35	2.0	30	1.3	3.3	30	1.6	35
	Max	45	3.3	45	2.1	5.5	35	2.5	37
Stable angle (deg)	Min	45	30	45	30	30	45	30	45
	Mode	57.5	32	57.5	32	32	57.5	32	57.5
	Max	70	34	70	34	34	70	34	70
Long-term (m) -ve erosion +ve accretion	Min	-0.15	-0.20	-0.15	0.00	-0.15	-0.15	0	-0.15
	Mode	-0.05	-0.15	-0.05	0.10	-0.07	-0.05	0.025	-0.05
	Max	0.00	-0.10	0.00	0.25	0.00	0.00	0.05	0.00
Closure slope (beaches) / Cliff response factor	Min	0.00	0.013	0.00	0.013	0.013	0.00	0.3	0.00
	Mode	0.05	0.018	0.05	0.018	0.018	0.05	0.4	0.05
	Max	0.10	0.084	0.10	0.084	0.084	0.10	0.5	0.10

Table 38.2: Adopted sea level rise values (m) based on four scenarios included in MfE (2017) adjusted to 2019 baseline

Coastal type	Year	RCP2.6M	RCP4.5M	RCP8.5M	RCP8.5+
Consolidated cliff	2080	0.29	0.34	0.46	0.64
	2130	0.52	0.66	1.09	1.41
Unconsolidated beach[1]	2080	0.16	0.21	0.33	0.51
	2130	0.28	0.42	0.85	1.17

[1]Adjusted to remove the influence of historic SLR (2.2 mm/year) on long-term rates of shoreline change

38.4 Coastal erosion hazard assessment

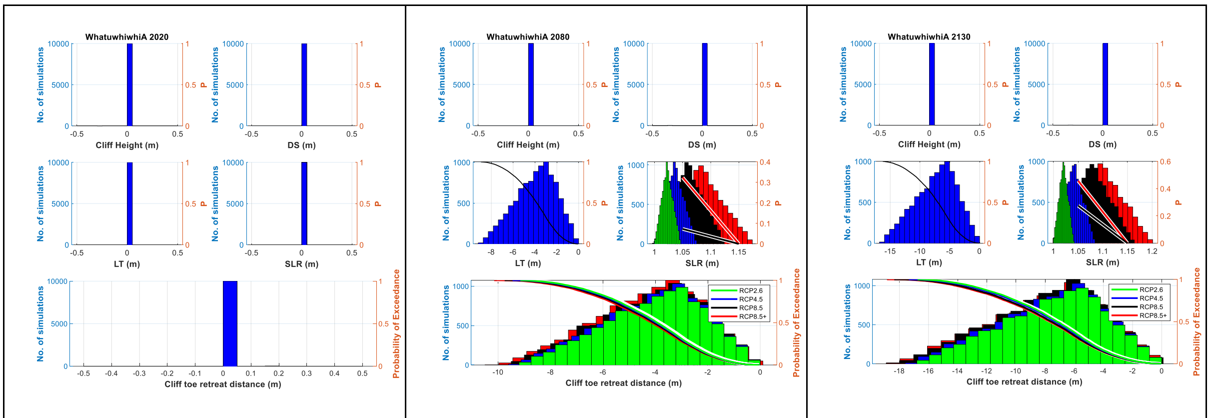
Histograms of individual components and resultant CEHZ distances computed using a Monte Carlo technique are shown in Figure 38.4 to Figure 38.11. Coastal Erosion Hazard Zone widths and future shoreline distances are presented within Table 38.3 to Table 38.5 and mapped in Figure 38.12.

For Cells B, D and E, CEHZ1 values range from 15 to 26 m, with Cell D rounded up from 9 m to the minimum value of 15 m for dunes. CEHZ2 values range from 47 to 76 m and CEHZ3 values range from 65 to 94 m.

For cliff cells, the cliff projection method was used to identify total coastal erosion hazard distances. Therefore, probabilistic outputs presented below are specific to the future toe recession distance. Toe recession distances range from 2 to 3 m to 2080 for RCP8.5, 7 to 15 m to 2130 for RCP8.5 and 8 to 15 m for RCP8.5+.

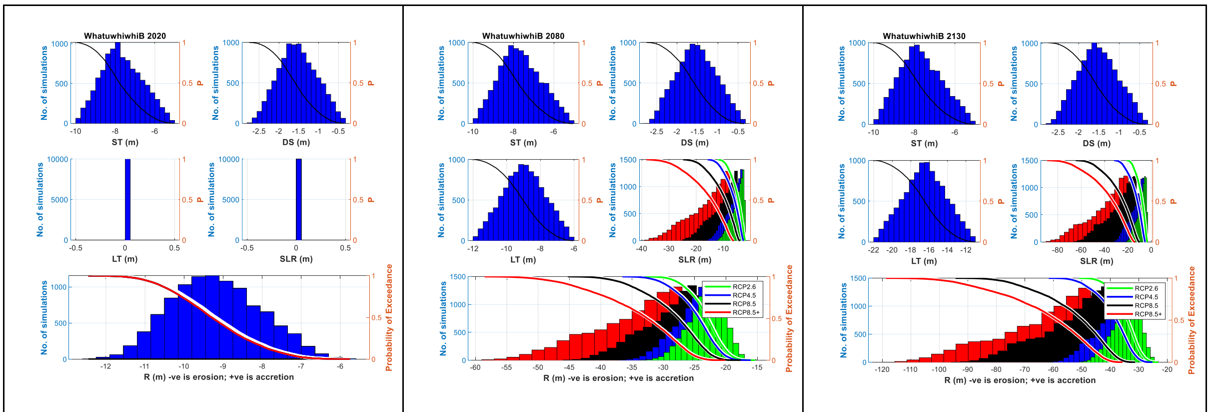
The toe recession distance and stable angle were used to project the total hazard zone but projecting the stability zone on LiDAR extracted profiles spaced in 10 m intervals. A summary of the resulting total coastal erosion hazard distance for cliff cells is presented in Table 38.6.

Figure 32.17 shows the available historic shorelines for Whatuwhiwhi.



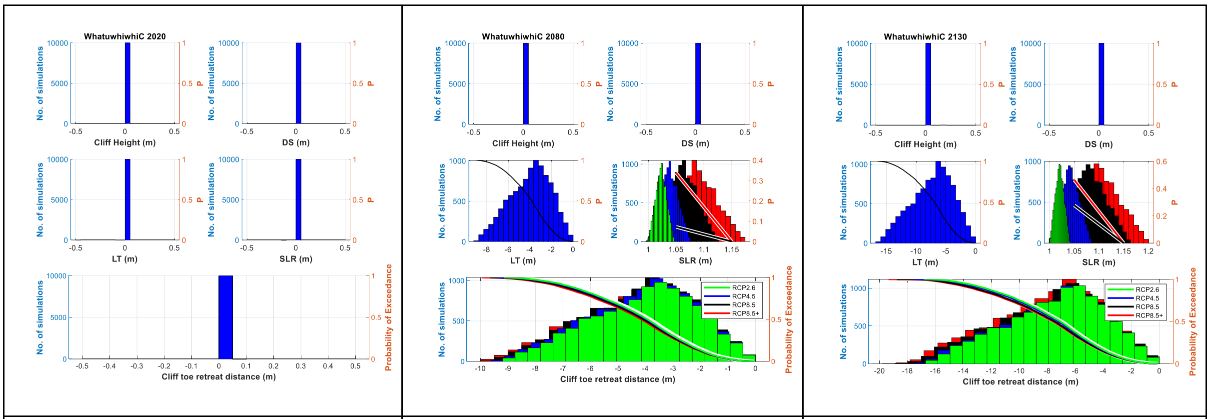
2020	2080	2130

Figure 38.4: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38A



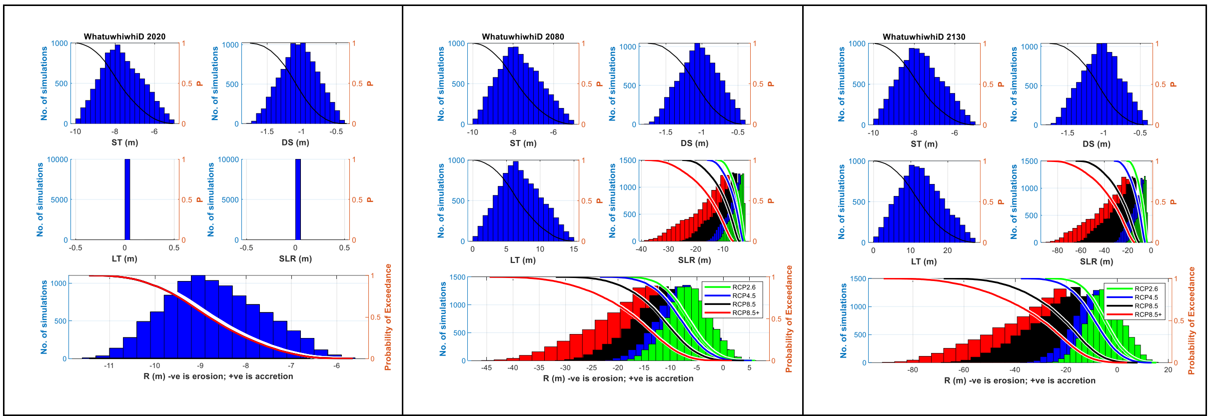
2020	2080	2130

Figure 38.5: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38B



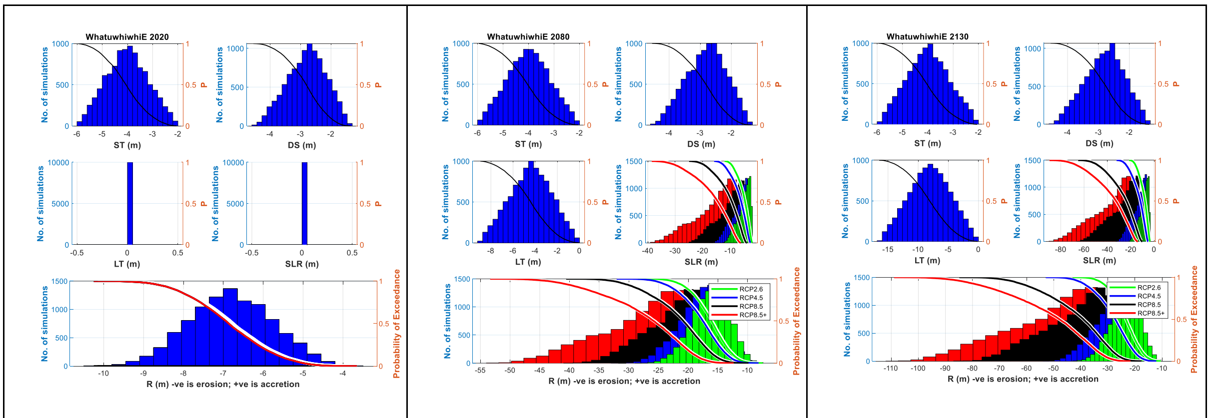
2020	*2080*	*2130*

Figure 38.6: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38C



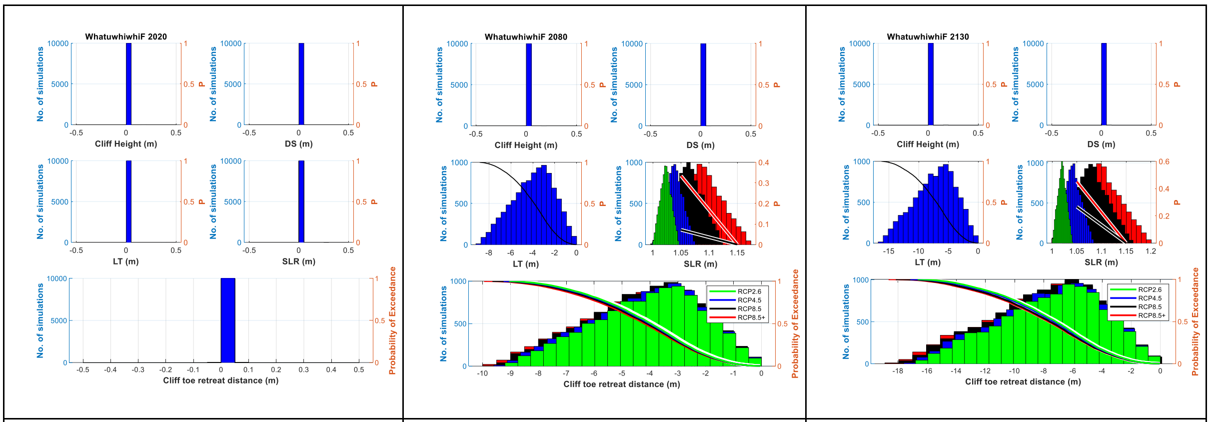
2020	*2080*	*2130*

Figure 38.7: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38D



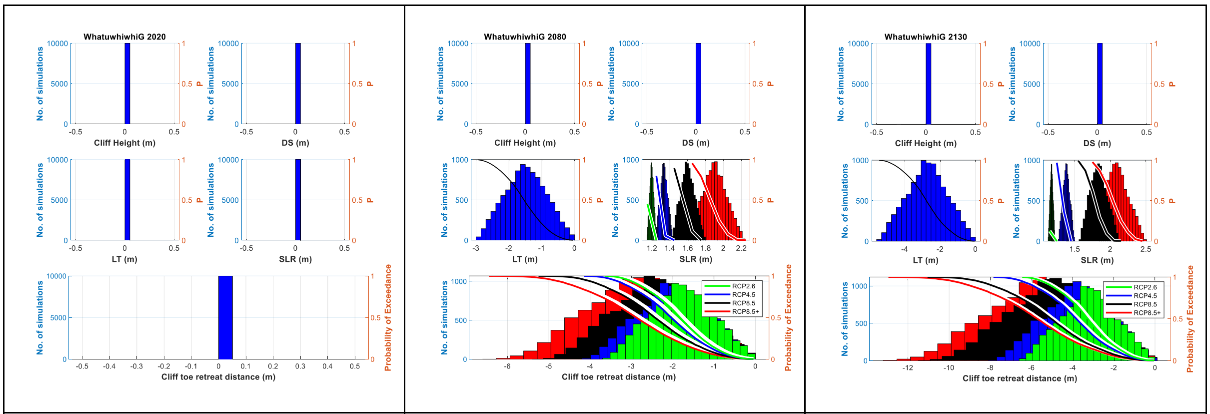
2020	*2080*	*2130*

Figure 38.8: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38E



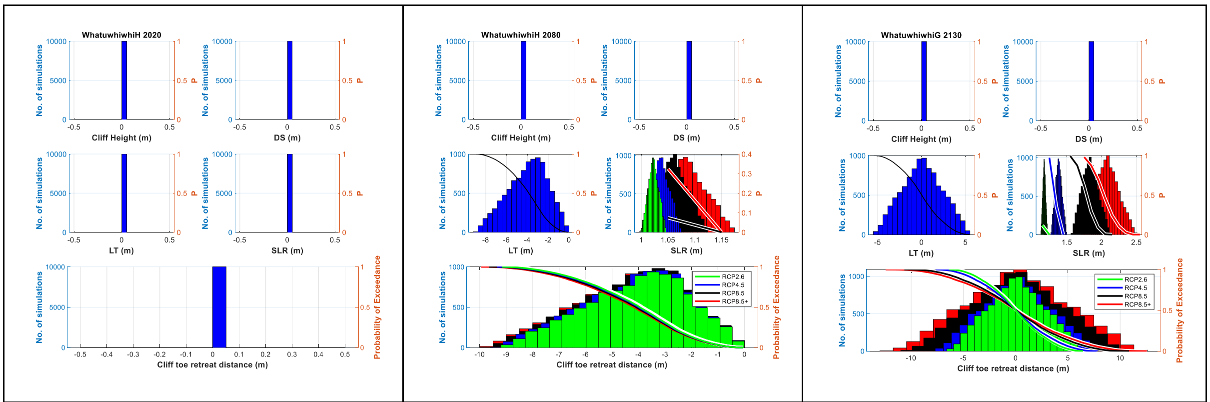
2020	*2080*	*2130*

Figure 38.9: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38F



2020	*2080*	*2130*

Figure 38.10: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38G



2020	*2080*	*2130*

Figure 38.11: Histograms of parameter samples and the resultant shoreline distances for 2020, 2080 and 2130 timeframes for cell 38H

Table 38.3: Coastal Erosion Hazard Zone Widths (m) Projected for 2020

Site		38. Whatuwhiwhi							
	Cell	38A*	38B	38C*	38D	38E	38F*	38G*	38H*
Probability of CEHZ (m) Exceedance	Min	0	-6	0	-6	-4	0	0	0
	99%	0	-7	0	-6	-5	0	0	0
	95%	0	-7	0	-7	-5	0	0	0
	90%	0	-8	0	-7	-5	0	0	0
	80%	0	-8	0	-8	-6	0	0	0
	70%	0	-9	0	-8	-6	0	0	0
	66%	0	-9	0	-8	-6	0	0	0
	60%	0	-9	0	-8	-7	0	0	0
	50%	0	-9	0	-9	-7	0	0	0
	40%	0	-10	0	-9	-7	0	0	0
	33%	0	-10	0	-9	-7	0	0	0
	30%	0	-10	0	-9	-7	0	0	0
	20%	0	-10	0	-10	-8	0	0	0
	10%	0	-11	0	-10	-8	0	0	0
	5%	0	-11	0	-10	-9	0	0	0
	1%	0	-12	0	-11	-9	0	0	0
	Max	0	-12	0	-11	-10	0	0	0

*Cliff projection method has been used, so cliff toe position has been tabulated, which has been assumed to be unchanged from the adopted 2019 baseline. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 38.4: Coastal Erosion Hazard Zone Widths (m) Projected for 2080

Site		38. Whatuwhiwhi															
Cell		38A				38B				38C				38D			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	0	0	0	0	-15	-16	-18	-20	0	0	0	0	6	5	4	2
	99%	-1	-1	-1	-1	-18	-19	-20	-23	-1	-1	-1	-1	2	1	-1	-4
	95%	-1	-1	-1	-1	-19	-20	-22	-25	-1	-1	-1	-1	0	-1	-4	-7
	90%	-2	-2	-2	-2	-20	-21	-23	-26	-2	-2	-2	-2	-2	-3	-5	-9
	80%	-2	-2	-2	-2	-21	-22	-24	-28	-2	-2	-2	-3	-3	-5	-7	-11
	70%	-3	-3	-3	-3	-22	-23	-25	-29	-3	-3	-3	-3	-5	-6	-9	-13
	66%	-3	-3	-3	-3	-22	-23	-26	-30	-3	-3	-3	-3	-5	-6	-9	-13
	60%	-3	-3	-3	-4	-22	-23	-26	-31	-3	-3	-4	-4	-6	-7	-10	-15
	50%	-4	-4	-4	-4	-23	-24	-28	-33	-4	-4	-4	-4	-7	-8	-11	-16
	40%	-4	-5	-5	-5	-24	-25	-29	-35	-4	-5	-5	-5	-8	-9	-13	-18
	33%	-5	-5	-5	-5	-24	-26	-30	-36	-5	-5	-5	-5	-8	-10	-14	-20
	30%	-5	-5	-5	-5	-24	-26	-31	-37	-5	-5	-5	-5	-9	-10	-15	-21
	20%	-6	-6	-6	-6	-25	-28	-33	-41	-6	-6	-6	-6	-10	-12	-17	-24
	10%	-7	-7	-7	-7	-27	-29	-36	-45	-7	-7	-7	-7	-12	-14	-20	-29
	5%	-7	-8	-8	-8	-28	-31	-38	-48	-8	-8	-8	-8	-13	-16	-22	-32
	1%	-8	-9	-9	-9	-30	-33	-41	-53	-9	-9	-9	-9	-16	-19	-26	-37
	Max	-9	-9	-10	-10	-33	-37	-45	-59	-9	-9	-10	-10	-20	-23	-32	-44
	CEHZ1	-3*				-26				-3*				-15			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Site		38. Whatuwhiwhi															
Cell		38E				38F				38G				38H			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	-7	-8	-10	-12	0	0	0	0	0	0	0	0	0	0	0	0
	99%	-10	-11	-13	-16	-1	-1	-1	-1	0	0	0	0	-1	-1	-1	-1
	95%	-12	-12	-15	-18	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	90%	-12	-13	-16	-19	-2	-2	-2	-2	-1	-1	-1	-1	-2	-2	-2	-2
	80%	-14	-15	-17	-21	-2	-2	-2	-3	-1	-1	-1	-2	-2	-2	-2	-3
	70%	-14	-16	-18	-22	-3	-3	-3	-3	-1	-2	-2	-2	-3	-3	-3	-3
	66%	-15	-16	-19	-23	-3	-3	-3	-3	-1	-2	-2	-2	-3	-3	-3	-3
	60%	-15	-17	-20	-24	-3	-3	-4	-4	-2	-2	-2	-3	-3	-3	-3	-4
	50%	-16	-17	-21	-26	-4	-4	-4	-4	-2	-2	-2	-3	-4	-4	-4	-4
	40%	-17	-18	-22	-28	-4	-5	-5	-5	-2	-2	-3	-3	-4	-4	-5	-5
	33%	-18	-19	-23	-30	-5	-5	-5	-5	-2	-2	-3	-3	-5	-5	-5	-5
	30%	-18	-20	-24	-30	-5	-5	-5	-5	-2	-2	-3	-3	-5	-5	-5	-5
	20%	-19	-21	-26	-34	-6	-6	-6	-6	-2	-3	-3	-4	-6	-6	-6	-6
	10%	-20	-23	-29	-38	-7	-7	-7	-7	-3	-3	-4	-4	-7	-7	-7	-7
	5%	-22	-24	-31	-41	-8	-8	-8	-8	-3	-3	-4	-5	-8	-8	-8	-8
	1%	-24	-27	-34	-46	-9	-9	-9	-9	-3	-4	-5	-5	-8	-9	-9	-9
	Max	-28	-32	-41	-53	-9	-10	-10	-10	-4	-4	-5	-6	-9	-9	-10	-10
	CEHZ1	-19				-3*				-2*				-3*			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 38.5: Coastal Erosion Hazard Zone Widths (m) Projected for 2130

Site		38. Whatuwhiwhi															
Cell		38A				38B				38C				38D			
RCP scenario		2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+	2.6	4.6	8.5	8.5+
Probability of CEHZ (m) Exceedance	Min	0	0	0	0	-23	-25	-31	-36	0	0	0	0	15	13	8	4
	99%	-1	-1	-1	-1	-26	-28	-35	-39	-1	-1	-1	-1	10	8	1	-4
	95%	-2	-2	-2	-2	-28	-30	-37	-42	-2	-2	-2	-2	7	4	-4	-10
	90%	-3	-3	-3	-3	-29	-32	-39	-44	-3	-3	-3	-3	4	1	-7	-13
	80%	-4	-4	-5	-5	-31	-33	-42	-48	-4	-5	-5	-5	1	-2	-11	-18
	70%	-5	-5	-6	-6	-32	-35	-44	-51	-5	-6	-6	-6	-1	-5	-15	-22
	66%	-6	-6	-6	-6	-32	-35	-45	-52	-6	-6	-6	-6	-2	-6	-16	-23
	60%	-6	-6	-7	-7	-33	-36	-47	-55	-6	-6	-7	-7	-3	-7	-17	-25
	50%	-7	-7	-7	-8	-34	-38	-50	-59	-7	-7	-8	-8	-5	-9	-21	-29
	40%	-8	-8	-9	-9	-35	-40	-53	-63	-8	-8	-9	-9	-7	-11	-24	-34
	33%	-9	-9	-9	-10	-36	-41	-56	-68	-9	-9	-10	-10	-8	-12	-27	-38
	30%	-9	-9	-10	-10	-37	-42	-58	-70	-9	-10	-10	-10	-8	-13	-28	-40
	20%	-11	-11	-11	-12	-38	-44	-63	-77	-11	-11	-11	-12	-11	-16	-34	-48
	10%	-12	-13	-13	-13	-41	-48	-71	-88	-12	-13	-13	-13	-14	-20	-41	-58
	5%	-14	-14	-15	-15	-43	-51	-76	-94	-14	-14	-15	-15	-16	-23	-47	-65
	1%	-16	-16	-17	-17	-46	-55	-83	-105	-15	-16	-16	-17	-21	-29	-56	-76
	Max	-17	-17	-19	-19	-51	-62	-94	-119	-17	-17	-19	-19	-28	-38	-68	-91
	CEHZ2	-15*				-76				-15*				-47			
	CEHZ3	-15*				-94				-15*				-65			

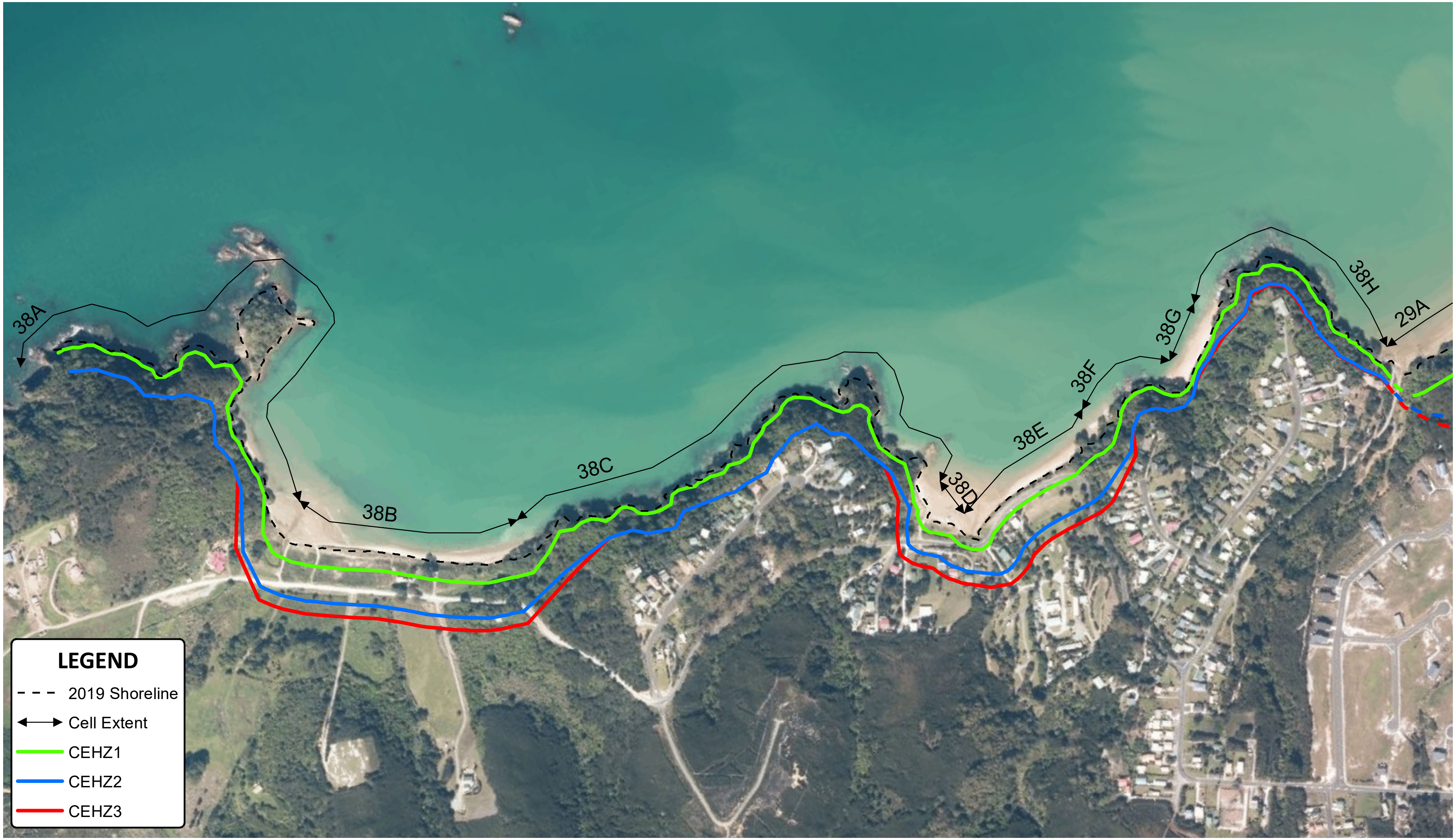
*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Site		38. Whatuwhiwhi															
Cell		**38E**				**38F**				**38G**				**38H**			
RCP scenario		**2.6**	**4.6**	**8.5**	**8.5+**	**2.6**	**4.6**	**8.5**	**8.5+**	**2.6**	**4.6**	**8.5**	**8.5+**	**2.6**	**4.6**	**8.5**	**8.5+**
Probability of CEHZ (m) Exceedance	**Min**	-10	-12	-18	-22	0	0	0	0	5	6	9	10	0	0	0	0
	0.99	-13	-15	-22	-27	-1	-1	-1	-1	3	4	6	8	-1	-1	-1	-1
	95%	-16	-18	-26	-31	-2	-2	-2	-2	2	3	4	5	-2	-2	-2	-2
	90%	-17	-20	-28	-33	-3	-3	-3	-3	1	2	3	4	-3	-3	-3	-3
	80%	-19	-22	-31	-37	-4	-4	-5	-5	0	0	1	2	-4	-4	-5	-5
	70%	-21	-24	-33	-40	-5	-5	-6	-6	-1	-1	0	0	-5	-5	-6	-6
	66%	-21	-25	-34	-42	-6	-6	-6	-6	-1	-1	-1	-1	-6	-6	-6	-6
	60%	-22	-26	-36	-44	-6	-6	-7	-7	-2	-2	-1	-1	-6	-6	-7	-7
	50%	-23	-27	-39	-48	-7	-7	-8	-8	-3	-3	-3	-3	-7	-7	-8	-8
	40%	-25	-29	-43	-53	-8	-8	-9	-9	-3	-3	-4	-4	-8	-8	-9	-9
	33%	-26	-31	-46	-57	-9	-9	-9	-10	-4	-4	-4	-5	-9	-9	-9	-10
	30%	-26	-31	-47	-59	-9	-10	-10	-10	-4	-4	-5	-5	-9	-9	-10	-10
	20%	-28	-34	-53	-67	-11	-11	-11	-11	-5	-5	-6	-7	-11	-11	-11	-11
	10%	-31	-38	-60	-77	-13	-13	-13	-14	-6	-7	-8	-9	-12	-13	-13	-13
	5%	-33	-41	-65	-83	-14	-14	-15	-15	-7	-8	-10	-10	-14	-14	-14	-15
	1%	-37	-45	-73	-94	-15	-16	-16	-17	-8	-9	-11	-13	-15	-16	-16	-17
	Max	-43	-53	-85	-109	-17	-17	-18	-19	-10	-11	-14	-16	-17	-18	-19	-19
	CEHZ2	-65				-15*				-10*				-14*			
	CEHZ3	-83				-15*				-10*				-15*			

*Cliff projection methodology used, so distance to future cliff toe position has been tabulated. Actual CEHZ width will be greater depending on cliff height and stable slope angle.

Table 38.6: Summary of CEHZ distances for cliff cells mapped using cliff projection method

	CEHZ1			CEHZ2			CEHZ3		
Cell	**Min (m)**	**Average (m)**	**Max (m)**	**Min (m)**	**Average (m)**	**Max (m)**	**Min (m)**	**Average (m)**	**Max (m)**
38A	-3	-5	-11	-17	-30	-41	-17	-30	-41
38C	-3	-6	-17	-16	-31	-46	-16	-31	-46
38F	-3	-4	-6	-16	-28	-34	-16	-28	-34
38G	-2	-4	-5	-9	-14	-44	-10	-16	-44
38H	-3	-5	-9	-15	-26	-32	-16	-27	-33



Path: P:\1012360\WorkingMaterial\GIS\CEHZ maps\1012360_CEHZ001_v2.mxd Date: 29/05/2020 Time: 6:10:49 am

Notes: Dashed CEHZ indicates greater uncertainty around stream mouths and backshore topography.
Northland 0.4m Rural Aerial Photos (2014-2016).

A4 SCALE 1:7,500

0 0.1 0.2 0.3 0.4 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JJOU	May.20
CHECKED		
APPROVED		

ARCFILE 1012360_CEHZ001_v2.mxd

SCALE (AT A4 SIZE) 1:7,500

PROJECT No. 1012360

NORTHLAND REGIONAL COUNCIL

Coastal Erosion Hazard Assessment

Whatuwhiwhi

Site: 38

FIGURE No. Figure 38-12

Rev. 1

Path: P:\1012360\WorkingMaterial\GIS\CEHZ maps\1012360_Historicv2.mxd Date: 9/06/2020 Time: 9:24:39 AM

Notes: Dashed CEHZ indicates greater uncertainty around stream mouths and backshore topography.
Northland 0.4m Rural Aerial Photos (2014-2016).

A4 SCALE 1:7,500

0 0.1 0.2 0.3 0.4 (km)

Tonkin+Taylor
105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JJOU	Jun.20
CHECKED		
APPROVED		

ARCFILE 1012360_Historicv2.mxd

SCALE (AT A4 SIZE) 1:7,500

PROJECT No. 1012360

NORTHLAND REGIONAL COUNCIL
Historic Shorelines
Whatuwhiwhi
Site: 38

FIGURE No. Figure 38-13

Rev. 1