Appendix E
Rainfall Data

Rainfall Depths – TR2013/035

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The design rainfall for treatment and detention has been obtained from **Figure 13** and **Figure 14** of TR2013/035 as follows.

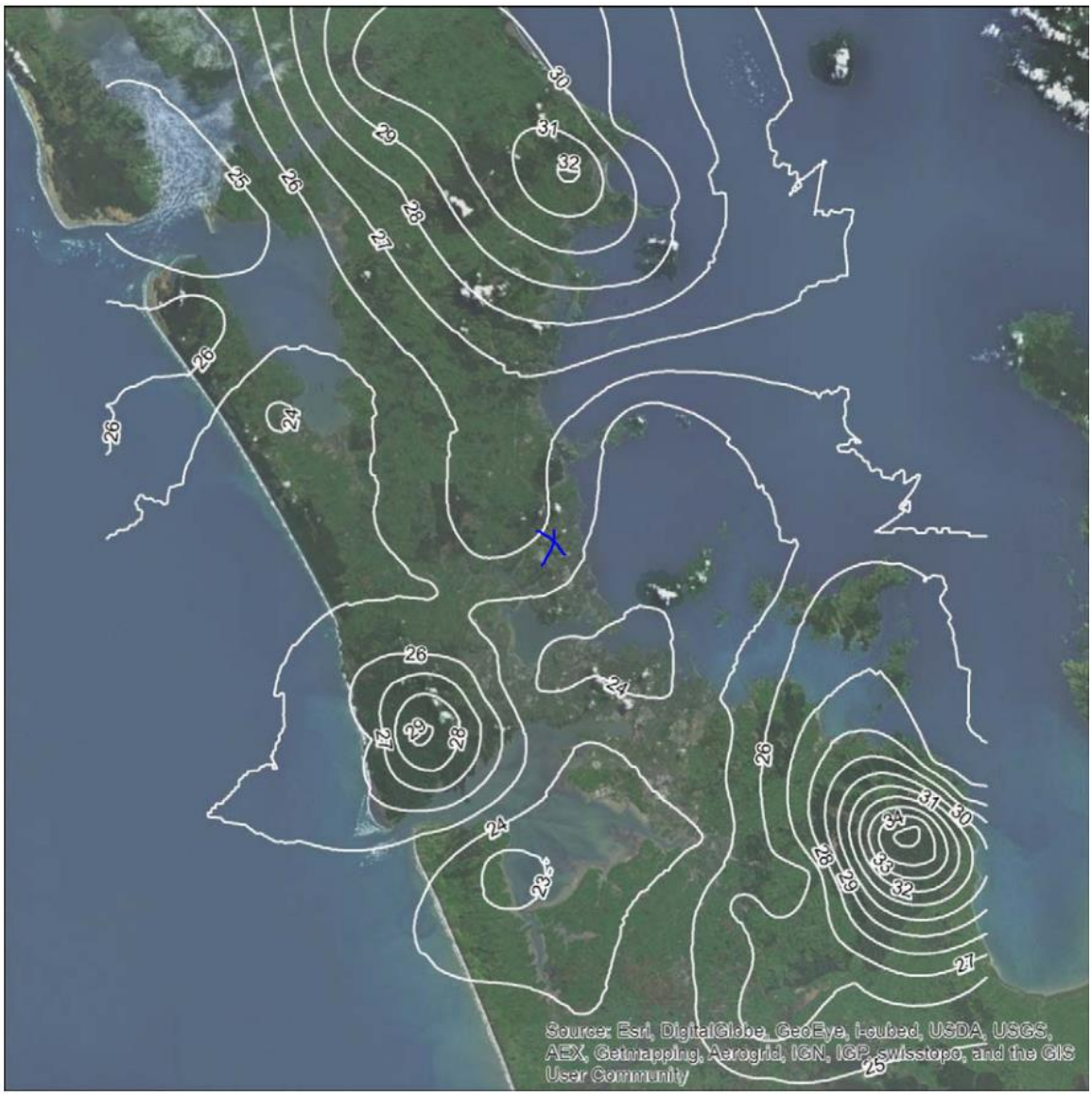


Figure 13. 90th percentile 24hr rainfall depth (mm)

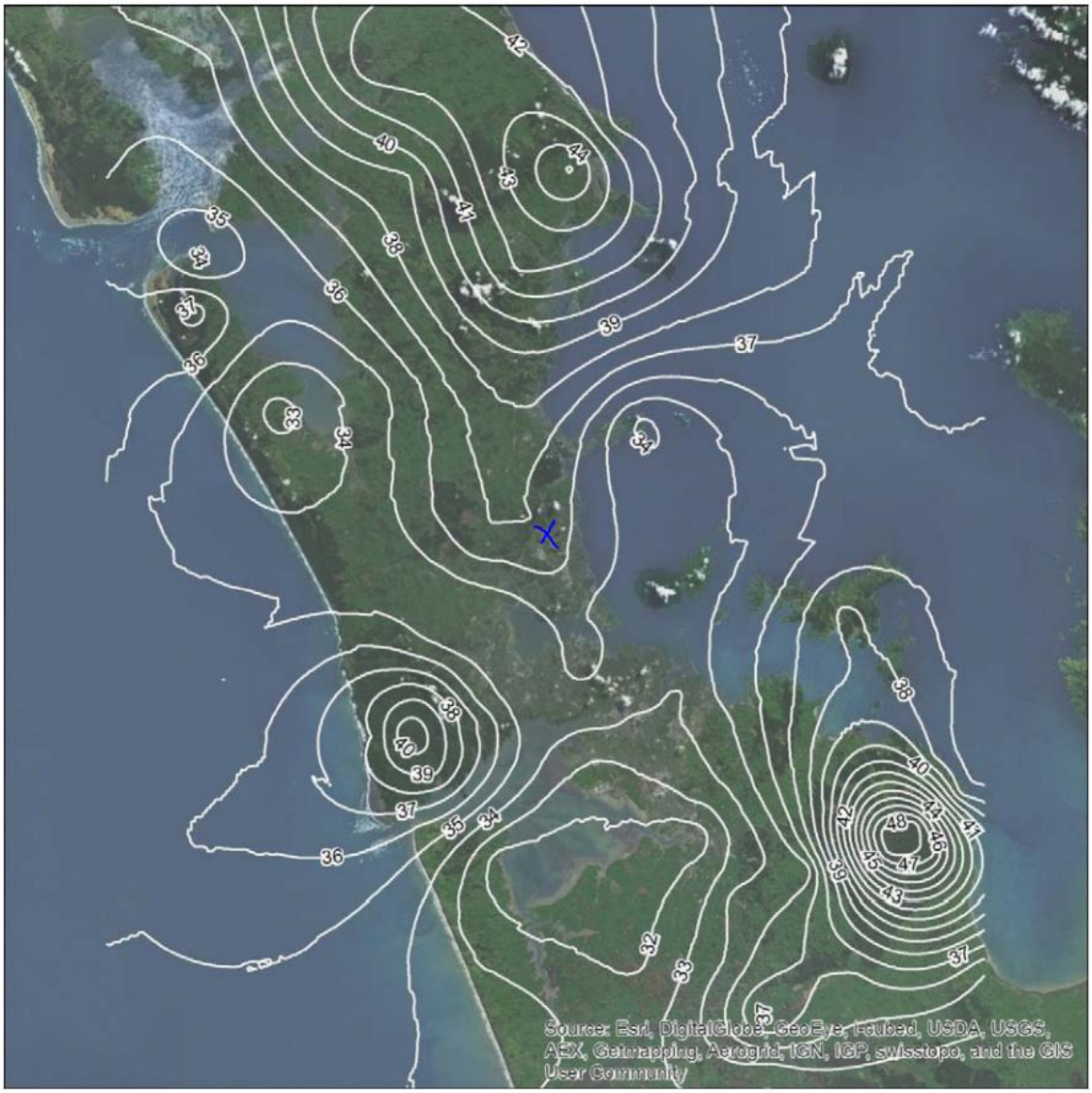
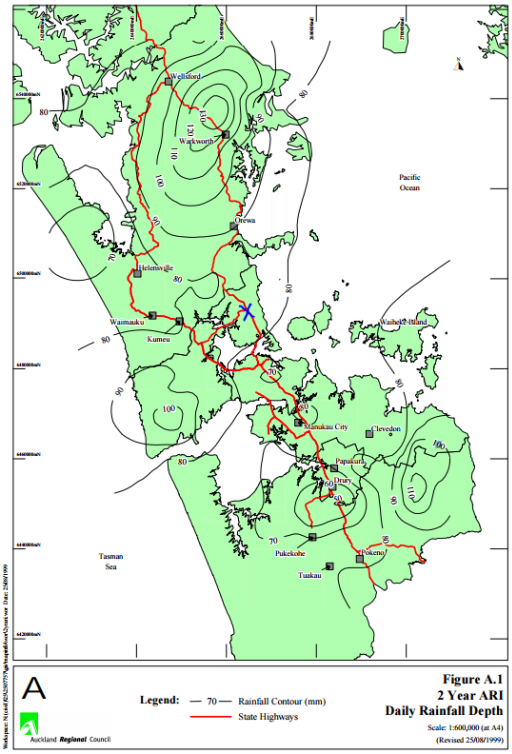
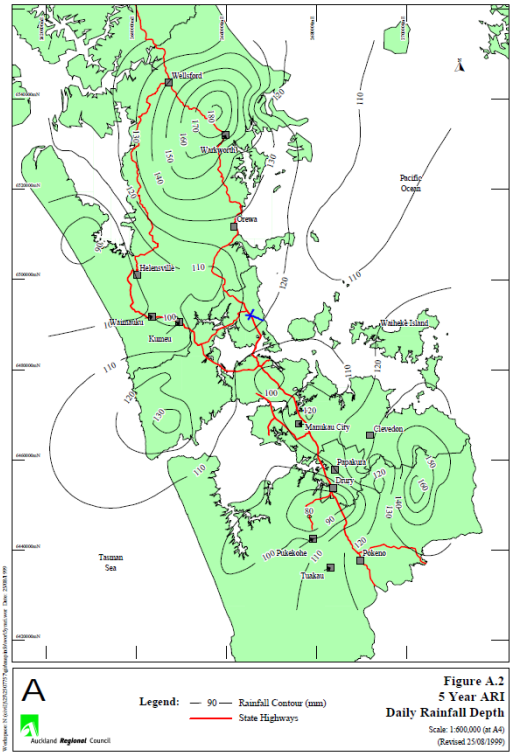


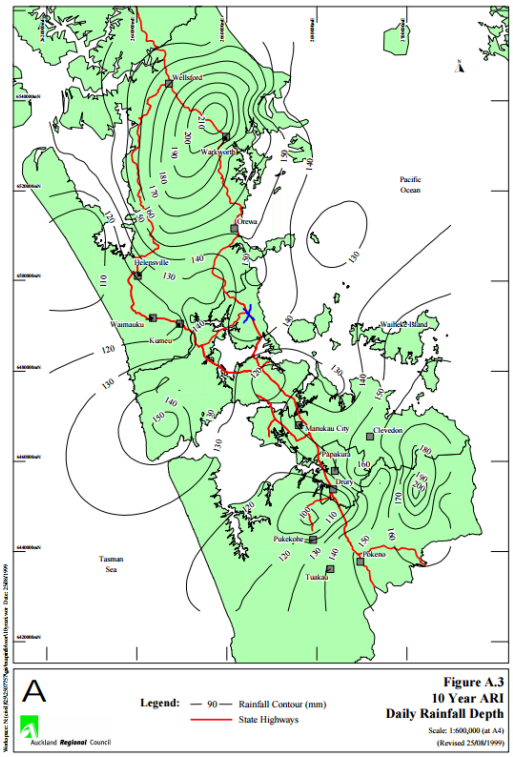
Figure 14. 95th percentile 24 hr rainfall depth (mm)

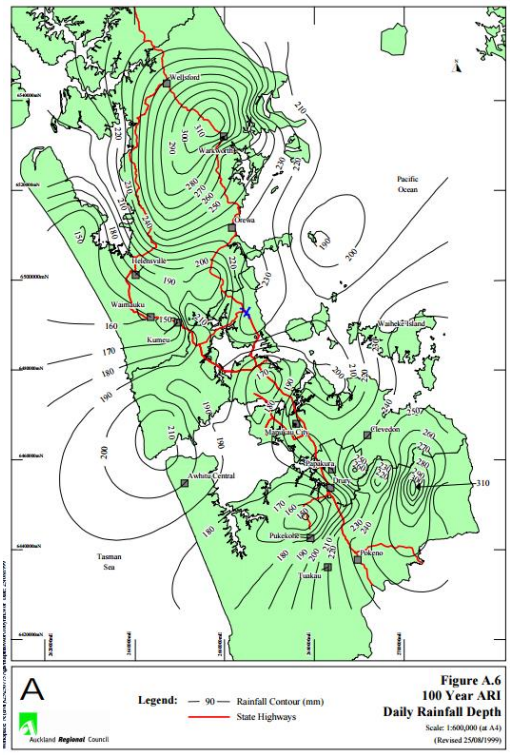
Rainfall Depths – TP108

The design rainfall for extreme rainfall events have been determined from TP108 as follows.









Climate Change Adjustment to Year 2121

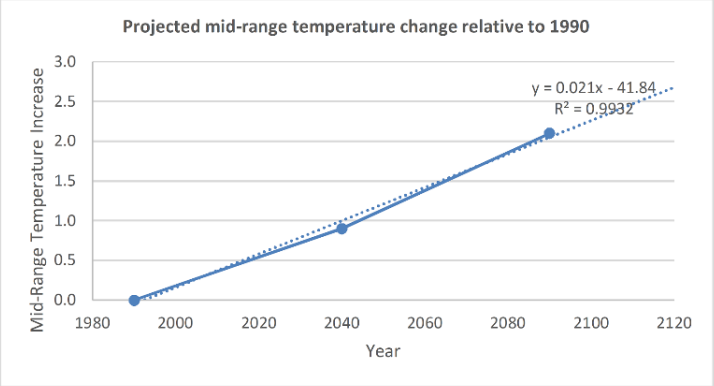
The design rainfalls have been adjusted for climate change to the year 2121 as follows.

NCI - Rainfall Parameters Adjustment for Climate Change

The TP108, PAUP and HIRDS rainfall data was multiplied by factors recommended in
"Preparing for climate change. A guide for local government in New Zealand" (Ministry for the Environment (MfE), 2008)
We applied linear interpolation (as illustrated in MfE Figure 4) of the 2040 and 2090 values in order to estimate the projected 2121 rainfall data

Step 1: Obtain projected mid-range temperature changes in Auckland (MfE Table 2) and apply linear extrapolation

Projected mid-range temperature change relative to 1990				
Region	Year 1990	Year 2040	Year 2090	Design Year 2121
Auckland	0.0	0.9	2.1	2.7



Step 2: Obtain multiplication factors for every degree C in temperature increase (MfE Table 7)

Percentage Increase for Every Degree C Increase						
Storm Duration	2-Year ARI	5-Year ARI	10-Year ARI	20-Year ARI	50-Year ARI	100-Year ARI
10 minutes or less	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
24 hours	4.3%	5.4%	6.3%	7.2%	8.0%	8.0%

Step 3: Apply multiplication factors to rainfall parameters from TP108, PAUP and HIRDS

Rainfall Parameters Adjusted for Climate Change				
Rainfall Event	**% Increase**	**Current Rainfall**	**Climate Change Adjusted Rainfall**	**Unit**
Network Drainage Rainfall Parameters				
2-year, 5-min (for aquaplaning - RRL method)	21.6%	87	106	mm/hr
2-year, 10-min	21.6%	62	75	mm/hr
5-year, 10-min	21.6%	77	93	mm/hr
10-year, 10-min	21.6%	89	108	mm/hr
20-year, 10-min	21.6%	101	123	mm/hr
50-year, 10-min	21.6%	121	147	mm/hr
100-year, 10-min	21.6%	138	168	mm/hr
Stormwater Management Rainfall Parameters				
WQF (Swales)	0.0%	10	10	mm/hr
WQV (Volume Based Devices) 90% of the annual rainfal	0.0%	26	26	mm/24hr
SMAF1 95th Percentile, 24-hour rainfall	0.0%	37	37	mm/24hr
SMAF2 90th Percentile, 24-hour rainfall	0.0%	26	26	mm/24hr
2-year ARI, 24-hour rainfall	11.6%	80	89	mm/24hr
5-year ARI, 24-hour rainfall	14.6%	121	139	mm/24hr
10-year ARI, 24-hour rainfall	17.0%	144	169	mm/24hr
20-year ARI, 24-hour rainfall	19.4%	170	203	mm/24hr
50-year ARI, 24-hour rainfall	21.6%	210	255	mm/24hr
100-year ARI, 24-hour rainfall	21.6%	222	270	mm/24hr

* Where 0% is shown, climate change adjustments are not required as rainfall parameters for stormwater managemen
in accordance with Auckland Council TR2013/035 has been used directly.

Rainfall Intensities – Climate Change to year 2121

Table A1 **Rainfall Intensity adopted for Climate Change to year 2121, using normalised Intensity profile from AC Stormwater Code of Practice (November 2015)**

Normalised Intensity Profile		Intensity (mm/h)					
Time	I/I24	2 year ARI	5 year ARI	10 year ARI	20 year ARI	50 year ARI	100 year ARI
0:00		0.000	0.000	0.000	0.000	0.000	0.000
6:00	0.33	1.228	1.907	2.317	2.791	3.511	3.712
9:00	0.73	2.716	4.218	5.125	6.174	7.767	8.212
10:00	0.95	3.534	5.489	6.670	8.035	10.108	10.686
11:00	1.4	5.209	8.089	9.829	11.841	14.896	15.748
11:30	2.2	8.185	12.711	15.446	18.607	23.408	24.747
11:40	3.82	14.212	22.071	26.820	32.308	40.645	42.970
11:50	4.86	18.082	28.080	34.122	41.103	51.710	54.669
12:00	8.86	32.963	51.191	62.206	74.933	94.270	99.664
12:10	16.65	61.946	96.200	116.899	140.817	177.156	187.292
12:20	5.95	22.137	34.378	41.775	50.322	63.308	66.930
12:30	4.24	15.775	24.498	29.769	35.860	45.114	47.695
13:00	2.92	10.864	16.871	20.501	24.696	31.069	32.846
14:00	1.7	6.325	9.822	11.936	14.378	18.088	19.123
15:00	1.19	4.427	6.876	8.355	10.064	12.662	13.386
18:00	0.75	2.790	4.333	5.266	6.343	7.980	8.437
0:00	0.39	1.451	2.253	2.738	3.298	4.150	4.387