Before the Expert Panel
I mua i te roopu tohunga

FTAA-2512-1157

Under	the Fast-track Approvals Act ('**FTAA**')
In the matter of	a substantive application under the FTAA for an alteration to an existing designation, resource consents, a wildlife approval, archaeological authorities and a complex freshwater fisheries activity, to construct, maintain and operate the Belfast to Pegasus Project
By	**New Zealand Transport Agency Waka Kotahi** Applicant

Second Statement of Evidence of David Patrick Delegarza (response to Expert Panel request for further information regarding climate change provisions in stormwater and flood models)

Dated 15 June 2026

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Second Statement of evidence of David Patrick Delegarza

1 Introduction

1.1 My full name is David Patrick Delegarza.

1.2 My qualifications and experience are set out in paragraphs 1.2 – 1.6 of my first statement of evidence (dated 15 May 2026), provided as part of the New Zealand Transport Agency Waka Kotahi ('**NZTA**') response to comments from invited parties.

1.3 I repeat the confirmation in my first statement of evidence, that I have read and am familiar with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023, and agree to comply with it.

2 Scope of evidence

2.1 This evidence is provided in response to the request for further information made by the Expert Panel on 12 June 2026[1] in relation to the climate change provisions in the stormwater and flood models for the State Highway 1 North Canterbury – Woodend Bypass Project (Belfast to Pegasus) ('the **Project**'). In particular, this evidence addresses the following:

a alternative representative concentration pathways ('**RCP**') scenarios; and

b the likely effect of alternative scenarios on the flooding assessment.

3 Response to the Panel RFI

3.1 Representative Concentration Pathways (RCPs) are climate change scenarios developed for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) that describe different possible levels of future greenhouse gas concentrations and associated warming. The four main scenarios, RCP2.6, 4.5, 6.0 and 8.5, range from low to very high emissions futures and are used to assess how climate variables such as temperature, rainfall and sea level may change over time, with higher RCP values reflecting more extreme climate change impacts.

3.2 Paragraph [2] of Minute 9 from the Expert Panel refers to recently published research (Van Vuuren et al, 2026[2]) being undertaken to support the next major

[1] Minute 9.
[2] Van Vuuren, D.P. et al. (2026). *The Scenario Model Intercomparison Project for CMIP7 (ScenarioMIP-CMIP7).* Geoscientific Model Development, Vol. 19, pp. 2627–2656. DOI: 10.5194/gmd-19-2627-2026.

IPCC assessment cycle. I have reviewed this paper and its conclusions which describe, in part that the RCP8.5 scenario has become implausible and will not be retained in future climate scenario modelling. On this basis, I acknowledge that RCP 8.5 may no longer be considered a likely future climate scenario.

3.3 Flood modelling for the Project was undertaken utilising rainfall and water level boundary conditions incorporated from Waimakariri District Council's ('**WDC**') regionwide flood model. The inputs to this model are documented in the Flood Hazard Models Update report (DHI 2020)[3]:

a The rainfall used in the WDC modelling is based on NIWA's High Intensity Rainfall Design System (HIRDS) version 4, using the RCP 8.5 emissions scenario, for the time period 2081-2100.

b The WDC model utilises a constant tailwater level boundary of 1.4mRL, which is intended to represent 1.0 metre of sea level rise ('**SLR**').

3.4 The site-specific HIRDS rainfall data includes historic statistics and the four RCP climate scenarios. The data is supplied for two time horizons, 2031-2050, and 2081-2100. These rainfall values, and a comparison table are shown in **Appendix A**:

a The rainfall depth difference between the RCP 8.5, 2081-2100 scenarios used in the flood modelling and historic statistics reflects future climate-driven increases between 12% and 36%, depending on rainfall duration and return period. Notably, the higher differences are observed in the shorter duration events, reflecting that short, high intensity events are expected to experience significantly higher intensification compared with long duration events.

b The less extreme RCP 6.0 2081-2100 rainfall depths are between 5% and 10% lower than the RCP 8.5 values. As above, these differences are much more pronounced for shorter duration events than longer duration events.

3.5 The flood modelling indicates that the predominant flooding effects across the Site are driven by accumulated volume, instead of peak flow rates. This volume is associated with the longer duration (6- to 24-hour) events. For RCP 6.0, the associated rainfall depths are in the range of 5% to 7% lower than for RCP 8.5. Accordingly, accumulated flood volume associated with using RCP 6.0 would be

[3] https://gisservices.waimakariri.govt.nz/resources/HazardsReports/DistrictFloodMappingDHI.pdf

approximately 93% to 95% of that of RCP 8.5, which I consider to be a minor difference.

3.6 The technical details for the development of HIRDS rainfall depths are described in the HIRDS V4 technical report (NIWA 2018)[4]. This report describes how rainfall values were extrapolated from temperature increases. The projected temperature increases are shown in **Appendix B**.

3.7 Importantly, HIRDS only provides rainfall depth values for the 2081-2100 timeframe, which allows for 2.58 degrees of warming under the RCP 8.5 scenario and 1.63 degrees under the RCP 6.0 scenario. The 2081-2100 projection represents climate conditions averaged over a 20-year period centred approximately on the year 2090. I note that this is somewhat out of alignment with the approximate 100-year design life of the proposed infrastructure.

3.8 The HIRDS technical report (NIWA 2018) also supplies temperature increase data (but not associated rainfall depths) for the 2101-2120 timeframe, which is more in line with the design life of new infrastructure. The RCP 8.5 and 6.0 temperature increases for this timeframe are 3.13 and 2.31 degrees, respectively.

3.9 While the HIRDS technical report notes that the 2101–2120 projections should be treated with caution due to the reduced number of climate model simulations available, the projected temperature increase under the RCP6.0 scenario for 2101–2120 (2.31°C) is similar to that projected under the RCP8.5 scenario for 2081–2100 (2.58°C). The difference between the two scenarios is approximately 0.27°C, or around 10% of the projected warming signal.

3.10 It is therefore my opinion that, whilst RCP 8.5 may no longer be considered a likely future climate scenario, the RCP 8.5 2081-2100 HIRDS rainfall values remain broadly representative of the level of rainfall intensification that could be expected over the design life of the proposed infrastructure. This is because the level of warming associated with the RCP8.5 2081–2100 scenario is similar to that projected under the RCP6.0 scenario for the subsequent 2101–2120 period.

3.11 SLR projections have recently been updated and can be visualised on the website Searise.nz. This website statistically combines SLR projections with vertical land movement ('**VLM**') to provide decadal projections for effective sea level. This website uses updated emissions pathway terminology of SSP (shared socioeconomic pathway) from the IPCC's Sixth Assessment Report (AR6) in lieu of the RCP terminology from the earlier fifth (AR5) report. The website also

[4] https://niwa.co.nz/sites/default/files/2018022CH_HIRDSv4_Final.pdf

provides standard deviation values (17th and 83rd percentiles) in addition to median values for each scenario.

3.12 Searise.nz projections for the Waimakariri River mouth are shown in **Appendix C**. These projections indicate that for the year 2120, median SLR is projected to be between 0.58m under the least extreme (SSP1-1.9) climate scenario and 1.24m under the most extreme (SSP5-8.5 scenario). The second most extreme scenario (SSP3-7.0) indicates a median SLR of 1.08m.

3.13 I note that the SSP3-7.0 scenario SLR value (1.08) is functionally similar to the value of 1.0 m adopted by the WDC modelling. The adopted value is also within the uncertainty range of all SSP scenarios presented by Searise.nz. On this basis, I consider the adopted 1.0 m SLR value remains appropriate for assessing long-lived infrastructure, even if the most extreme SSP5-8.5 scenario is not considered.

4 Conclusion

4.1 The RCP 8.5 scenario adopted for the hydraulic modelling represents the most conservative scenario, which results in the most significant modelled impacts. The principal alternative to the adopted RCP8.5 scenario is RCP6.0, which represents a less extreme future climate pathway and is more consistent with recent climate projections. Comparison of the projected rainfall data indicates that the RCP6.0 rainfall depths for the 2081–2100 period are generally between 5% and 10% lower than the corresponding RCP8.5 values, with the largest differences occurring for short-duration rainfall events.

4.2 The flood modelling indicates that flooding across the Site is primarily driven by accumulated runoff volume associated with longer duration rainfall events rather than short duration peak rainfall bursts. For the durations most relevant to the flood response of the Site, the difference between the RCP6.0 and RCP8.5 rainfall depths is approximately 5% to 7%. Consequently, if the flood modelling were repeated using RCP6.0 rainfall depths, a corresponding reduction in flood volume (total water volume generated during a flood event) would be expected, however, the magnitude of this reduction would be expected to be relatively minor and would not be expected to materially alter the flooding outcomes identified by the assessment.

4.3 The adopted sea level rise allowance of 1.0m remains broadly consistent with recent projections over the design life of the infrastructure. While the most extreme climate scenarios project higher sea level rise, the adopted value is similar to the median projection for the SSP3-7.0 scenario and remains within the projected uncertainty range of the lower emissions scenarios.

4.4 Therefore, while alternative climate scenarios could be adopted, it is my opinion that their use would not materially change the conclusions of the flooding assessment. The adopted RCP8.5 rainfall inputs and 1.0m sea level rise allowance remain reasonable and appropriately conservative assumptions given the long life of the proposed infrastructure.

David Delegarza
15 June 2026

Appendix A

HIRDS V4 Rainfall Data Comparison for future RCP Emissions Scenarios

HIRDS V4 100 Year Rainfall Depths (mm) for Kaiapoi North for Various SSP Scenarios												
Event Duration	**10m**	**20m**	**30m**	**1h**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**	**96h**	**120h**
Historical Data	11.6	16.0	19.5	28.0	40.3	70.9	98.3	131.0	166.0	185.0	197.0	205.0
RCP2.6 2081-2100	12.6	17.3	21.1	30.2	43.4	75.7	104.0	138.0	173.0	193.0	205.0	213.0
RCP4.5 2081-2100	13.6	18.6	22.8	32.6	46.7	80.8	110.0	145.0	181.0	201.0	213.0	220.0
RCP6.0 2081-2100	14.2	19.5	23.9	34.2	48.9	84.2	114.0	149.0	186.0	206.0	218.0	226.0
RCP8.5 2081-2100	15.7	21.6	26.4	37.8	53.9	91.9	124.0	160.0	198.0	218.0	230.0	238.0

HIRDS V4 250 Year Rainfall Depths (mm) for Kaiapoi North for Various SSP Scenarios												
Event Duration	**10m**	**20m**	**30m**	**1h**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**	**96h**	**120h**
Historical Data	14.3	19.5	23.7	33.6	48.1	83.5	115.0	152.0	191.0	212.0	225.0	234.0
RCP2.6 2081-2100	15.4	21.0	25.6	36.3	51.8	89.2	122.0	160.0	200.0	221.0	234.0	242.0
RCP4.5 2081-2100	16.6	22.7	27.6	39.1	55.7	95.1	129.0	168.0	208.0	230.0	243.0	251.0
RCP6.0 2081-2100	17.4	23.8	28.9	41.1	58.4	99.2	134.0	173.0	214.0	236.0	249.0	257.0
RCP8.5 2081-2100	19.3	26.3	32.0	45.4	64.3	108.0	145.0	186.0	228.0	250.0	263.0	270.0

Appendix B

New Zealand land average temperature increases for future RCP Emissions Scenarios

	2031—2050	2056—2075	2081—2100	2101—2120	
RCP 2.6	0.59	0.67	0.59	0.59	(4 model avg)
RCP 4.5	0.74	1.05	1.21	1.44	(5 model avg)
RCP 6.0	0.68	1.16	1.63	2.31	(CESM1-CAM5 only)
RCP 8.5	0.85	1.65	2.58	3.13	(3 model avg)

Source: NIWA 2018, Table 8

Appendix C

Selected sea level rise (SLR) values from Searise.nz, at the Waimakariri River mouth for future SSP emissions scenarios.

Scenario	Year	p17	p50	p83
SSP1-1.9 + VLM (medium confidence)	2120	0.12	0.58	1.04
SSP1-2.6 + VLM (medium confidence)	2120	0.19	0.67	1.16
SSP2-4.5 + VLM (medium confidence)	2120	0.39	0.86	1.34
SSP3-7.0 + VLM (medium confidence)	2120	0.6	1.08	1.6
SSP5-8.5 + VLM (medium confidence)	2120	0.69	1.24	1.83

Source: searise.nz