BEFORE THE WAIMAKARIRI DISTRICT COUNCIL HEARINGS PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Submissions 8 and 250 to the Proposed Waimakariri District Plan

BRIEF OF EVIDENCE OF DANIEL HAYDEN MCMULLAN ON BEHALF OF ANDREW J McALLISTER

03 July 2024

QUALIFICATIONS AND EXPERIENCE

1. My name is Daniel Hayden McMullan and I hold the position of Civil Engineer with e2Environmental Ltd. I have a Bachelor of Engineering with First Class Honours in Natural Resources Engineering.

2. My experience includes ten years of working as a professional civil engineer specialising in flood risk management and environmental engineering. My relevant experience includes undertaking flood risk assessments, undertaking design, and providing advice for both private clients and local authorities.

3. I confirm that I have prepared this evidence in accordance with the Code of Conduct for Expert Witnesses Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. The issues addressed in this statement of evidence are within my area of expertise except where I state that I am relying on the evidence or advice of another person. The data, information, facts and assumptions I have considered in forming my opinions are set out in the part of the evidence in which I express my opinions. I have not omitted to consider material facts known to me that might alter or detract from the opinions I have expressed, and I have stated where I am relying on the expertise of specialist evidence.

SUMMARY OF REBUTTAL EVIDENCE FOR BLOCK A – 1379, 1401 & 1419 TRAM ROAD

4. I prepared the Tram Road Block A, Swannanoa Flood Risk Assessment dated 29 September 2023 attached as **Appendix 1.** Supporting calculations for this latest evidence are also attached as **Appendix 3**.

5. Paragraph 197 of Waimakariri District Council's (WDC) S42A report notes that there are uncertainties around the disposal of stormwater and notes the existing flood and groundwater resurgence issues downstream of the site.

6. I accept that the provided flood risk assessment did not provide much detail on how stormwater is proposed to be managed on site. This was because the assessment focussed on the site's existing flood hazard (i.e., overland flow paths as modelled by Waimakariri District Council (WDC)), however, I accept all these issues are inter-related.

7. Paragraph 14 and 15 of the engineering assessment provided Appendix D of the S42A report states that the applicant proposes to discharge stormwater into ground, and that e2Environmental assumes that on-site treatment and attenuation of stormwater runoff can be achieved by disposal of stormwater into ground. I disagree with these statements, as outlined in paragraph 8.

8. The flood risk assessment for Block A stated that dependent on site specific groundwater levels, on-site stormwater could be managed either via soak holes or rainwater roof tanks. As on-site stormwater management was not a focus of the flood risk assessment, no assessment had been undertaken to confirm which approach would be appropriate to progress, only that one of those approaches was expected to be feasible. I had also not assessed or proposed any stormwater treatment approach.

9. I accept that there are groundwater resurgence issues in the downstream catchment.

10. Given the groundwater resurgence issues, I propose that stormwater is not discharged to ground via soak holes but is managed via attenuation and retention with limited infiltration to ground. This would be sized for the 2% annual exceedance probability (AEP) rainfall event including the effects of climate change out to 2081-2100 (scenario RCP8.5).

11. Stormwater from roofs would be collected in appropriately sized rainwater roof tanks with a control office. These tanks are expected to be 30 m^3 in storage volume dependent upon future detailed design and the size of the dwelling. Two thirds of the tank's storage volume can be used as retention (i.e., 20 m^3 per lot), with stored water available for residents to use for flushing toilets, doing laundry, and watering gardens etc. This would be an amended version of the Dual Purpose Tank shown on WDC's standard drawing 251 issue B.

12. The retention volume would be at the bottom of the tank with the control orifice located above that to provide some attenuation functionality. The attenuation functionality of the tanks is most beneficial during higher intensity rainfall events, and it gets less beneficial as the duration of the rainfall event increases (with lower average rainfall intensities). So, the attenuation functionality of the tanks has not been relied upon to ensure the development has hydraulic neutrality.

13. The retention volume would also help minimise pressure on the wider catchment's water supply network.

14. Stormwater runoff that is discharged from roofs can be discharged across a wide area of land (i.e., 5 – 10 m) using a "level spreader" which prevents the concentration of stormwater discharges. This mimics natural stormwater runoff that would occur as a sheet flow and will minimise the risk of erosion from stormwater discharges.

15. The tank would include an overflow pipe with flows discharging via the level spreader. The rainwater roof tank's storage volume and orifice would be sized to ensure that the subdivision's post-development peak discharge rate of stormwater is not greater than the pre-development discharge rate. The orifice would have a minimum size of 15 mm to reduce the risk of blockage unless a self-cleaning orifice is approved by WDC at the time of subdivision consent.

16. Runoff from hardstand areas can be collected in filtration swales with control orifices to reduce the runoff rate such that the site's post-development discharge rate is equal to or less than the site's pre-development discharge rate. These are effectively elongated filtration basins providing filtration treatment and attenuation storage. Stormwater that filters through the swale's subsoil mix can be collected in subsoil drains and conveyed to the appropriate discharge location. The total attenuation storage volume in the filtration swales would be at least 1,600 m^3. These filtration swales would need to be located next to the road and away from the site's overland flow paths. Initially, it is expected that they could be located where there is less than 0.1 m of water in the 1% AEP flood event.

17. If on-site investigations indicate that the assumed 0.5 m depth of the filtration swale is not appropriate, the depth can be decreased and the filtration swale width can be increased to achieve an equivalent storage volume.

18. The first flush volume has been estimated to be 354 m^3 based on the road and unsealed accessway's catchment area and a first flush depth of 25 mm. This is less than the required attenuation storage volume next to the road which ensures that the first flush volume can be captured in the filtration swales and treated through a sand / topsoil mix with a design infiltration rate of 20 – 100 mm/hr. First flush water would then be collected in subsoil drains and would be conveyed to the appropriate discharge point.

19. The proposed solution described in this evidence would:

a. Decrease the volume of stormwater discharged to ground (due to the addition of impervious areas) thereby ensuring downstream groundwater resurgence issues are not exacerbated;
b. Ensure that the post-development discharge rates are equal to or less than the site's pre-development discharge rates; and
c. Use the roof tank's retention volume to help mitigate the increase in runoff volume from the proposed subdivision (59% - 15% of additional runoff volume in the 1-hr and 24-hr 2% AEP rainfall events respectively assuming 50% of the retention volume is available).
d. Treat contaminated runoff from the road in filtration swales.

SUMMARY OF REBUTTAL EVIDENCE FOR BLOCK B – 1275 TRAM ROAD

20. I prepared the Tram Road Block B, Swannanoa Flood Risk Assessment dated 14 December 2023 attached as **Appendix 2.** Supporting calculations for this latest evidence are also attached as **Appendix 4**.

21. Paragraph 197 of Waimakariri District Council's (WDC) S42A report notes that there are uncertainties around the disposal of stormwater and notes the existing flood and groundwater resurgence issues downstream of the site.

22. I accept that the provided flood risk assessment did not provide much detail on how stormwater is proposed to be managed on site. This was because the assessment focussed on the site's existing flood hazard (i.e., overland flow paths as modelled by Waimakariri District Council (WDC)), however, I accept all these issues are inter-related.

23. Paragraph 14 and 15 of the engineering assessment provided Appendix D of the S42A report states that the applicant proposes to discharge stormwater into ground, and that e2Environmental assumes that on-site treatment and attenuation of stormwater runoff can be achieved by disposal of stormwater into ground. I disagree with these statements, as outlined in paragraph 24.

24. The flood risk assessment for Block B stated that dependent on site specific groundwater levels, on-site stormwater could be managed either via soak holes or rainwater roof tanks. As on-site stormwater management was not a focus of the flood risk assessment, no assessment had been undertaken to confirm which approach would

be appropriate to progress, only that one of those approaches was expected to be feasible. I had also not assessed or proposed any stormwater treatment approach.

25. I accept that there are groundwater resurgence issues in the downstream catchment.

26. Given the groundwater resurgence issues, I propose that stormwater is not discharged to ground via soak holes but is managed via attenuation and retention with limited infiltration to ground. This would be sized for the 2% annual exceedance probability (AEP) rainfall event including the effects of climate change out to 2081-2100 (scenario RCP8.5).

27. Stormwater from roofs would be collected in appropriately sized rainwater roof tanks with a control office. These tanks are expected to be 30 m^3 in storage volume dependent upon future detailed design and the size of the dwelling. Two thirds of the tank's storage volume can be used as retention (i.e., 20 m^3 per lot), with stored water available for residents to use for flushing toilets, doing laundry, and watering gardens etc. This would be an amended version of the Dual Purpose Tank shown on WDC's standard drawing 251 issue B.

28. The retention volume would be at the bottom of the tank with the control orifice located above that to provide some attenuation functionality. The attenuation functionality of the tanks is most beneficial during higher intensity rainfall events, and it gets less beneficial as the duration of the rainfall event increases (with lower average rainfall intensities). So, the attenuation functionality of the tanks has not been relied upon to ensure the development has hydraulic neutrality.

29. The retention volume would also help minimise pressure on the wider catchment's water supply network.

30. Stormwater runoff that is discharged from roofs can be discharged across a wide area of land (i.e., 5 – 10 m) using a "level spreader" which prevents the concentration of stormwater discharges. This mimics natural stormwater runoff that would occur as a sheet flow and will minimise the risk of erosion from stormwater discharges.

31. The tank would include an overflow pipe with flows discharging via the level spreader. The rainwater roof tank's storage volume and orifice would be sized to ensure that the subdivision's post-development peak discharge rate of stormwater is not greater than the pre-development discharge rate. The orifice would have a minimum size of 15 mm

to reduce the risk of blockage unless a self-cleaning orifice is approved by WDC at the time of subdivision consent.

32. Runoff from hardstand areas can be collected in filtration swales with control orifices to reduce the runoff rate such that the site's post-development discharge rate is equal to or less than the site's pre-development discharge rate. These are effectively elongated filtration basins providing filtration treatment and attenuation storage. Stormwater that filters through the swale's subsoil mix can be collected in subsoil drains and conveyed to the appropriate discharge location. The total attenuation storage volume in the filtration swales would be at least 2,490 m^3. These filtration swales would need to be located next to the road and away from the site's overland flow paths. Initially, it is expected that they could be located where there is less than 0.1 m of water in the 1% AEP flood event.

33. If on-site investigations indicate that the assumed 0.5 m depth of the filtration swale is not appropriate, the depth can be decreased and the filtration swale width can be increased to achieve an equivalent storage volume.

34. The first flush volume has been estimated to be 589 m^3 based on the road and unsealed accessway's catchment area and a first flush depth of 25 mm. This is less than the required attenuation storage volume next to the road which ensures that the first flush volume can be captured in the filtration swales and treated through a sand / topsoil mix with a design infiltration rate of 20 – 100 mm/hr. First flush water would then be collected in subsoil drains and would be conveyed to the appropriate discharge point.

35. The proposed solution described in this evidence would:

    a. Decrease the volume of stormwater discharged to ground (due to the addition of impervious areas) thereby ensuring downstream groundwater resurgence issues are not exacerbated;
    b. Ensure that the post-development discharge rates are equal to or less than the site's pre-development discharge rates; and
    c. Use the roof tank's retention volume to help mitigate the increase in runoff volume from the proposed subdivision (50% - 13% of additional runoff volume in the 1-hr and 24-hr 2% AEP rainfall events respectively assuming 50% of the retention volume is available).
    d. Treat contaminated runoff from the road in filtration swales.

Spreadsheet to assess the proposed stormwater management approach for Block A

Site area:		16.36 ha	
Site length:		400 m	
Site slope:		0.53 %	
Site Horton's n:		0.10	*Short grass (WWDG)*
Estimated time of concentration:		82 minutes	*Friend equation (WWDG)*
Soils:	Moderately well drained		*S-Maps*
# of proposed lots:		28	
Assumed roof area / lot:		300 m²	
Assumed unsealed road per lot:		300 m²	

Existing Landuse	**Area (ha)**	**Runoff coefficient**	**A x C**
Buildings	0.0653	0.9	0.06
Unsealed roads	0.267	0.5	0.13
Pervious soils	16.03	0.25	4.01
Weighted runoff coefficient:	0.26		

Proposed Landuse	**Area (ha)**	**Runoff coefficient**	**A x C**
Buildings	0.84	0.9	0.76
Unsealed roads	0.84	0.5	0.42
Hardstand	0.735	0.85	0.62
Pervious soils	14.68	0.25	3.67
Weighted runoff coefficient:	0.33		

First Flush Volume Calculations

First flush rainfall depth:	25 mm
Contributing first flush catchment:	1.58 ha
Discharge coefficient:	0.9
First flush volume:	354 m³

Peak flow estimation (Rational Method)

Duration (2% AEP RCP8.5 2081-2100)	**Rainfall Intensity (mm/hr)**	**Rainfall Depth (mm)**	**Existing Peak Flow (L/s)**
1h	37.5	37.5	438
2h	26.1	52.2	305
6h	14.4	86.4	168
12h	9.62	115.4	112
24h	6.21	149.0	73

Note: events < 1-hr duration were not considered due to site's and wider catchment's time of concentration.

Duration (2% AEP RCP8.5 2081-2100)	**Post Development Peak Flow (no attenuation) (L/s)**	**Required attenuation (L/s)**	**Approx storage volume required (m³)**
1h	570	133	477
2h	397	92	664
6h	219	51	1100
12h	146	34	1469
24h	94	22	1897

Assumed retention volume per roof tank:	20	m³	*assuming 30m3 tanks are used*
Assumed available storage per roof tank:	10	m³	*50% of retention volume*
Total retention volume in development:	280	m³	
Min. percentage of additional runoff vol:	59%		
Max. percentage of additional runoff vol:	15%		
Storage from roof tanks (max):	280.0	m³	
Storage required in road:	1617	m³	
Storage per metre of road:	3.0	m³/m	
Assumed depth of storage:	0.5	m	
Freeboard:	0.2	m	
Top width of filtration swales:	9.6	m	*1:4 side slopes assumed*

Spreadsheet to assess the proposed stormwater management approach for Block B

Site area:		21.73	ha	
Site length:		280	m	
Site slope:		0.61	%	
Site Horton's n:		0.10		*Short grass (WWDG)*
Estimated time of concentration:		71	minutes	*Friend equation (WWDG)*
Soils:	Imperfectly drained			*S-Maps*
# of proposed lots:		36		
Assumed roof area / lot:		300	m²	
Assumed unsealed road per lot:		300	m²	

Existing Landuse	**Area (ha)**	**Runoff coefficient**	**A x C**
Buildings	0.072	0.9	0.06
Unsealed roads	0.25	0.5	0.13
Pervious soils	21.41	0.3	6.42
Weighted runoff coefficient:	0.30		

Proposed Landuse	**Area (ha)**	**Runoff coefficient**	**A x C**
Buildings	1.08	0.9	0.97
Unsealed roads	1.08	0.5	0.54
Hardstand	1.272	0.85	1.08
Pervious soils	19.57	0.3	5.87
Weighted runoff coefficient:	0.39		

First Flush Volume Calculations

First flush rainfall depth:	25	mm
Contributing first flush catchment:	2.35	ha
Discharge coefficient:	0.9	
First flush volume:	529	m³

Peak flow estimation (Rational Method)

Duration (2% AEP RCP8.5 2081-2100)	**Rainfall Intensity (mm/hr)**	**Rainfall Depth (mm)**	**Existing Peak Flow (L/s)**
1h	38.6	38.6	710
2h	26.7	53.4	491
6h	14.8	88.8	272
12h	9.89	118.7	182
24h	6.41	153.8	118

Note: events < 1-hr duration were not considered due to site's and wider catchment's time of concentration.

Duration (2% AEP RCP8.5 2081-2100)	**Post Development Peak Flow (no attenuation) (L/s)**	**Required attenuation (L/s)**	**Approx storage volume required (m³)**
1h	908	199	715
2h	628	137	990
6h	348	76	1646
12h	233	51	2200
24h	151	33	2851

Assumed retention volume per roof tank:	20	m³	*assuming 30m3 tanks are used*
Assumed available storage per roof tank:	10	m³	*50% of retention volume*
Total retention volume in development:	360	m³	
Min. percentage of additional runoff vol:	50%		
Max. percentage of additional runoff vol:	13%		
Storage from roof tanks (max):	360.0	m³	
Storage required in road:	2491	m³	
Storage per metre of road:	2.2	m³/m	
Assumed depth of storage:	0.5	m	
Freeboard:	0.2	m	
Top width of filtration swales:	8.0	m	*1:4 side slopes assumed*