APPENDIX F – Fluent Solutions Water and Wastewater Report

Fluent Infrastructure | Experience

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REF: GL-260127ACS-980

27 January 2026

Fulton Hogan Land Development Ltd
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Silverdale
AUCKLAND

Attention: Tim James

Dear Tim

Parkburn Development – Water Supply and Wastewater Flow Estimates and Other Associated Works

As requested, please find our report on the estimation of water and wastewater flows for the proposed Parkburn Development and the impacts that they would have on infrastructure sizing. As requested we have also investigated the impact of the addition of the HWR development on the proposed infrastructure and the impact that both proposed developments may have on the existing infrastructure serving the Pisa Moorings Development.

1.0 Scope of Works

The proposed Parkburn Development is to be located to the north of the existing Pisa Moorings development. Information supplied by WFH Ltd and their surveyors – Landpro, identifies the potential for up to 1003 new houses along with a school and commercial area.

It is proposed to stage the development over 16 stages (1A, 1B, 2, … 15) as shown in Figure 1 below. For the purposes of this report the stages have been grouped together into 5 overall construction stages based on when they would most likely be constructed. The assumed breakdown is presented below:

- Stage 1 = stages 1A, 1B and 2
- Stage 2 = stage 3, 4, 5
- Stage 3 = stages 6 and 13 (includes school and commercial areas)
- Stage 4 = stages 7, 8, 9
- Stage 5 = stages 10, 11, 12, 14, 15

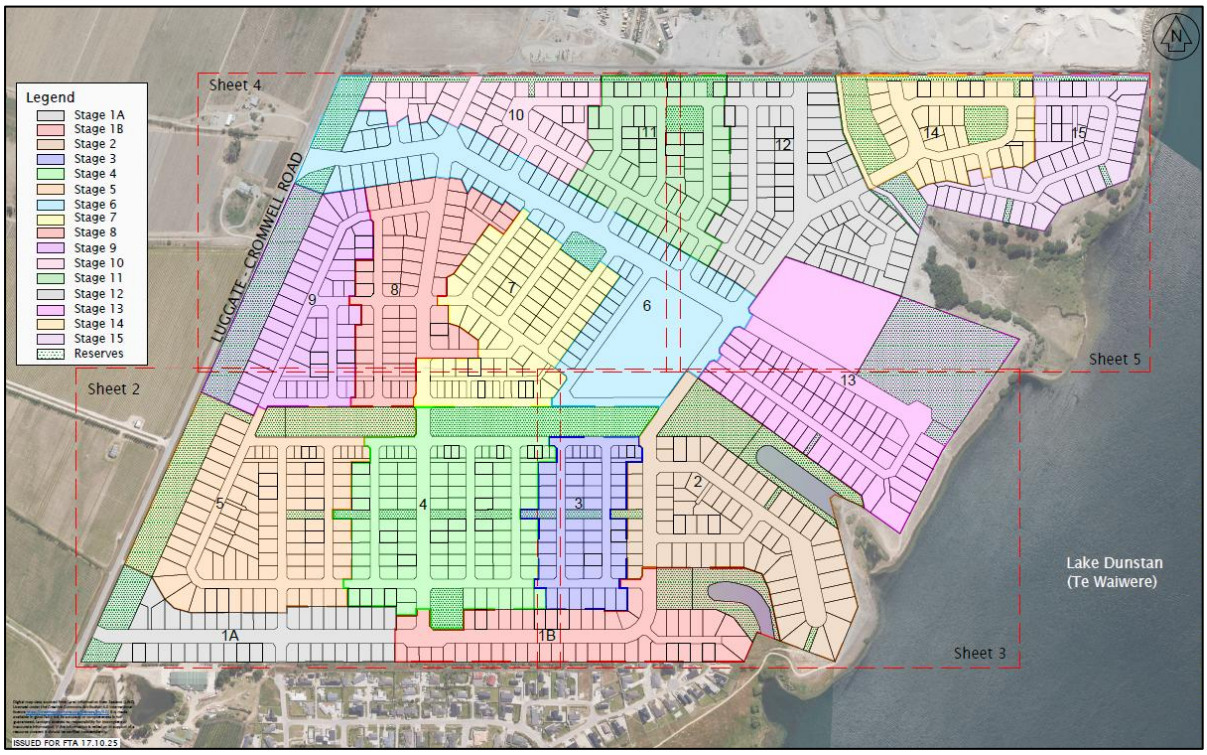


Figure 1.1: Proposed Parkburn Development Stages

2.0 Parkburn Development Flow Estimates

Flows presented in Tables 2.1 and 2.2 have been calculated using the Central Otago District Council standards. Table 2.1 presents the estimated water supply demands and Table 2.2 presents the estimated wastewater flows for each stage of the development.

2.1 Estimated Water Supply Demands

The estimated water supply flows have been calculated using the following criteria:

Residential Demands

- Occupancy: 3 persons per lot
- Average Daily consumption: 500 l/person/day
- Peak Day Factor: 3 x Average Day demand
- Peak Hour Factor: 5 x Average Day demand

School: Equivalent to 26 lots

Commercial Area Demands

- 0.7 l/sec/Ha inclusive of peaking factors

Table 2.1: Parkburn Development Water Supply Flow Estimates

Parkburn – Stage	No. of Residential Lots	Area of Residential Lots (ha)	Water Supply (l/s)		
			Daily Flow (l/s)	Peak Daily Flow (l/s)	Peak Hourly Flow l/s)
1A	42	2.9176	0.73	2.19	3.65
1B	50	3.5490	0.87	2.60	4.34
2	68	5.8148	1.18	3.54	5.90
3	52	2.7659	0.90	2.71	4.51
4	105	5.6183	1.82	5.47	9.11
5	94	6.2510	1.63	4.90	8.16
6	64	3.9867	1.11	3.33	5.56
7	77	4.4076	1.34	4.01	6.68
8	65	4.2459	1.13	3.39	5.64
9	53	3.8452	0.92	2.76	4.60
10	42	2.7251	0.73	2.19	3.65
11	61	3.8864	1.06	3.18	5.30
12	88	5.8896	1.53	4.58	7.64
13	55	4.6359	0.95	2.86	4.77
14	36	2.4166	0.63	1.88	3.13
15	51	3.7004	0.89	2.66	4.43
School	26	2.6354	0.45	1.35	2.26
Commercial Area	-	2.8080	-	-	1.97
TOTAL	**1029**	**72.1**	**17.9**	**53.6**	**91.3**

2.2 Estimated Wastewater Flows

The estimated wastewater flows have been calculated using the following criteria:

Residential Flows

- Occupancy: 3 persons per lot
- Average Dry Weather Flow: 250 l/person/day
- Peak Dry Weather Factor: 2.5 x Average Dry Weather Flow
- Peak Wet Weather Flow: 2 x Peak Dry Weather Flow

School: Equivalent to 26 lots

Commercial Area Flows

- 0.7 l/sec/Ha inclusive of peaking factors

Table 2.2: Parkburn Development Wastewater Flow Estimates

Parkburn – Stage	No. of Residential Lots	Area of Residential Lots (ha)	Wastewater (l/s)		
			Avg Dry Weather Flow (l/s)	Peak Dry Weather Flow (l/s)	Peak Wet Weather flow (l/s)
1A	42	2.9176	0.36	0.91	1.82
1B	50	3.5490	0.43	1.09	2.17
2	68	5.8148	0.59	1.48	2.95
3	52	2.7659	0.45	1.13	2.26
4	105	5.6183	0.91	2.28	4.56
5	94	6.2510	0.82	2.04	4.08
6	64	3.9867	0.56	1.39	2.78
7	77	4.4076	0.67	1.67	3.34
8	65	4.2459	0.56	1.41	2.82
9	53	3.8452	0.46	1.15	2.30
10	42	2.7251	0.36	0.91	1.82
11	61	3.8864	0.53	1.32	2.65
12	88	5.8896	0.76	1.91	3.82
13	55	4.6359	0.48	1.19	2.39
14	36	2.4166	0.31	0.78	1.56
15	51	3.7004	0.44	1.11	2.21
School	26	2.6354	0.23	0.56	1.13
Commercial Area	-	2.8080	-	1.97	3.93
TOTAL	**1029**	**72.1**	**8.9**	**24.3**	**48.6**

As can be seen in Table 2.2 the peak weather flow estimate for the commercial area is slightly conservative as a 2x peaking factor has been applied.

3.0 Additional Developments Flow Estimates

To understand the impact on existing and proposed infrastructure, water and wastewater flows were also calculated for the Pisa Moorings development and the proposed HWR development to the north of the Parkburn development.

A draft plan of the HWR development given to us by WFH was used in the calculations. The number of dwellings in the Pisa Moorings development was calculated based on counting off an aerial photograph.

Tables 3.1 and 3.2 presented below show the water and wastewater flow estimates for each development and have been calculated using the same criteria presented above.

Table 3.1: Existing Pisa Moorings Estimated Water and Wastewater Flows

Pisa Moorings	No. of Lots	Water Supply (l/s)			Wastewater (l/s)		
		Daily Flow (l/s)	Peak Daily Flow (l/s)	Peak Hourly Flow (l/s)	Avg Dry Weather Flow (l/s)	Peak Dry Weather Flow (l/s)	Peak Wet Weather Flow (l/s)
Northern area feeding down to gravity manhole ID 9223 on Pisa Moorings Rd that feeds down to Pisa Moorings PS	403	7.00	20.99	34.98	3.50	8.75	17.49
Southern area feeding down to Pisa Moorings PS	82	1.42	4.27	7.12	0.71	1.78	3.56
TOTAL	**485**	**8.42**	**25.26**	**42.10**	**4.21**	**10.53**	**21.05**

Please note, the peak wet weather wastewater flow presented above is very close to the figure that the Pisa Moorings pump station was designed for in 1994.

Table 3.2: Proposed HWR Development Estimated Water and Wastewater Flows

HWR Quarry – Parkburn	Area of each Lot (m^2)	No. of Lots	Water Supply (l/s)			Wastewater (l/s)		
			Daily Flow (l/s)	Peak Daily Flow (l/s)	Peak Hourly Flow (l/s)	Avg Dry Weather Flow (l/s)	Peak Dry Weather Flow (l/s)	Peak Wet Weather Flow (l/s)
Large Lots	1500 – 2000	28	0.49	1.46	2.43	0.24	0.61	1.22
Medium Lots	650 – 850	287	4.98	14.95	24.91	2.49	6.23	12.46
Comprehensive	200	86	1.49	4.48	7.47	0.75	1.87	3.73
Terrace apartments	-	48	0.83	2.50	4.17	0.42	1.04	2.08
Waterside apartments	-	17	0.30	0.89	1.48	0.15	0.37	0.74
TOTAL		**466**	**8.09**	**24.27**	**40.45**	**4.05**	**10.11**	**20.23**

In the calculations presented below it has been assumed that the HWR development will progress at the same rate as the Parkburn development. The number of lots being developed at each stage of the HWR development has been based on a similar number of houses being built in each of the five stages as shown below.

HWR Development assumed construction stages:

- Stage 1 = 94 houses
- Stage 2 = 93 houses
- Stage 3 = 93 houses
- Stage 4 = 93 houses
- Stage 5 = 93 houses
- **Total 466 houses**

4.0 Wastewater Infrastructure Implications

4.1 Existing Wastewater Infrastructure

Figure 4.1 below presents the existing wastewater infrastructure that services the Pisa Moorings development taken from CODC's GIS mapping system.

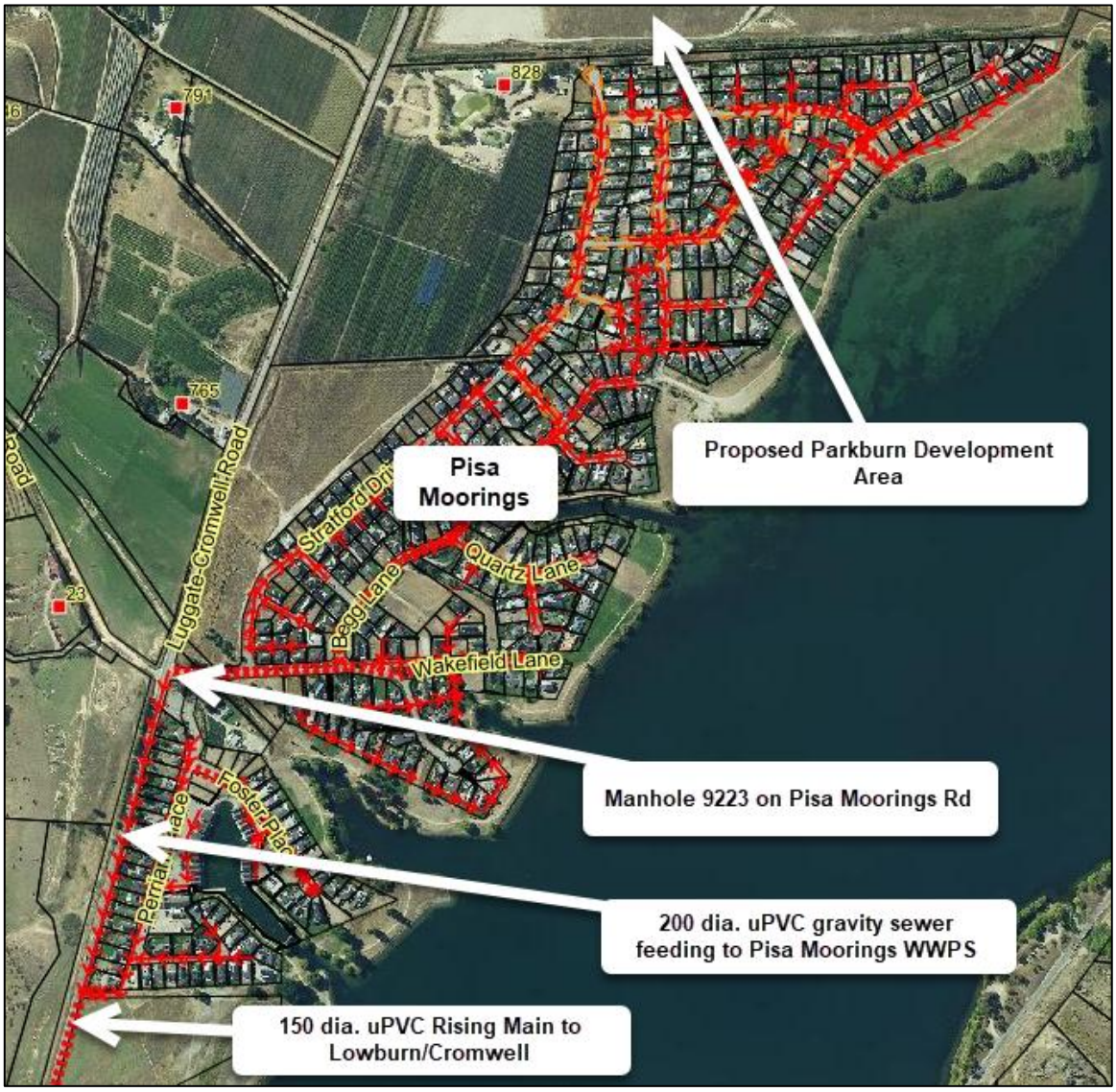


Figure 4.1: Pisa Moorings Wastewater Infrastructure

4.2 Wastewater Infrastructure Investigations

Investigations were undertaken to assess the impact of the addition of wastewater flows from the Parkburn development solely and the combined Parkburn and HWR developments on the sizing of new wastewater infrastructure and the impact on the existing wastewater infrastructure at various stages of the development(s). The areas addressed were:

- The ability or otherwise to utilise the existing 200 dia. gravity main from Pisa Moorings Road to the existing Pisa Moorings WWPS

- The sizing of the new wastewater rising main(s) and pump to feed wastewater down to the Pisa Moorings WWPS
- The impact on the existing 150 uPVC rising main feeding from the Pisa Moorings WWPS down to Lowburn.

Each of these areas are addressed separately in the next sections of this report.

4.3 Utilising the Existing 200 Dia. Gravity Main Starting at Manhole 9223

To try and reduce the amount of new rising main required from the Parkburn development feeding down to the Pisa Moorings WWPS, the potential of utilising the existing 200 dia. uPVC gravity sewer starting at Pisa Moorings Road to convey wastewater flows down to the site of the existing Pisa Moorings WWPS was investigated.

Using CODC's GIS, the theoretical capacity of the gravity main based on the pipeline gradient and size was assessed to be 39.9 l/sec.

As can be seen in Table 3.1 above, the current Pisa Moorings peak wet weather flow being conveyed by this pipeline is estimated to be 17.49 l/sec (the first row of the table). This is less than the pipeline's capacity. It should be noted that there are some wastewater pumping stations upstream of this pipeline that may push larger flows through the system that may change the peak flow arriving at Manhole 9223.

Tables 4.1 and 4.2 show the estimated peak wet weather wastewater flows for the five construction stages for the Parkburn development flows only and the Parkburn plus HWR development flows respectively and whether they can be conveyed in the gravity main.

Table 4.1: Parkburn's Peak Wet Weather Flows into Manhole 9223

Parkburn Stages	Parkburn Cumulative Flows (l/s)	Suitability for existing Sewer?
Pisa Moorings	17.49	
1	24.44	
2	35.33	
3	45.55	
4	54.02	
5	66.08	

Table 4.2: HWR + Parkburn Peak Wet Weather Flow into Manhole 9223

Total Stages	Parkburn Cumulative Flows (l/s)	HWR Cumulative Flows (l/s)	Total Flows (l/s)	Suitability for existing Sewer?
Pisa Moorings	-	-	17.49	
1	6.94	4.08	28.52	
2	17.84	8.12	43.45	
3	28.06	12.15	57.71	
4	36.53	16.19	70.21	
5	48.59	20.23	86.31	

The green boxes indicate the stages of development where the estimated flows could be conveyed along with the existing flows from Pisa Moorings in the existing 200 dia. gravity main.

As can be seen in Table 4.1, based on the staging assumptions described in Section 1 above the existing gravity main should be able to convey flows from construction stages 1 and 2 from the Parkburn development i.e. Stages 1A, 1B, 2, 3, 4 and 5 from the staging plan or 411 lots/houses.

When the additional staged flows are included from the HWR development, it effectively reduces the number of Parkburn development stages able to feed into the gravity main to the first stage only as shown in Table 4.2.

4.4 Parkburn Development Wastewater Rising Main(s)

4.4.1 General

Investigations have been made into the sizing of the wastewater rising main(s) to service the Parkburn development. As discussed with the developer it has been assumed that a terminal pumping station would be constructed near the proposed boat ramp and the rising main(s) follow the route shown in Figure 4.2 below.

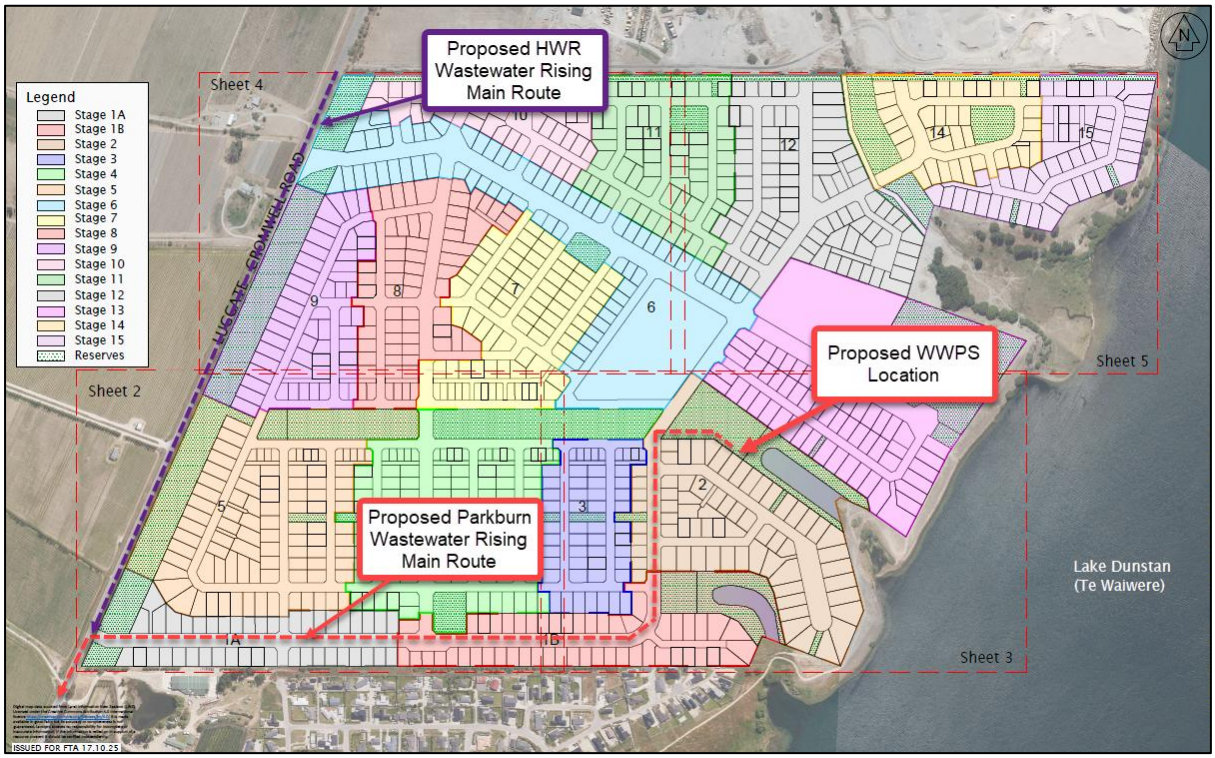


Figure 4.2: Parkburn Development Trunk Wastewater Infrastructure

In order to maintain flushing velocities in the new wastewater rising main over the development period, it is recommended that two rising mains be constructed such that one can be used in the initial stages of development and then two pipes be used to convey the larger flows coming through the system during later stages of development.

Potential rising main sizes for each of the five Parkburn development stages have been determined based on achieving flushing velocities between 0.7m/s and 2.2m/s, assumed pipeline friction factors, the 2480m rising main length from the Parkburn development boat ramp to the existing Pisa Moorings pumping station and normal submersible centrifugal pump operating ranges.

Combined flows from both the Parkburn and HWR developments were also considered separately and the impact on the overall hydraulics where the flows would combine at the southern Parkburn entrance as shown on Figure 4.2.

These two scenarios are presented in the next sections.

4.4.2 Parkburn WWPS Rising Main Size(s) – Parkburn Development Only

A range of rising main pipe sizes from 125OD to 250OD PE100 PN16 pipes were considered to carry the estimated peak wet weather flows from each of the five Parkburn development stages. The optimum rising main sizes were determined to be 180OD pipe for Stages 1 – 3 and 2 x 180OD pipes for Stages 4 and 5 as shown in Figures 4.3 and 4.4.

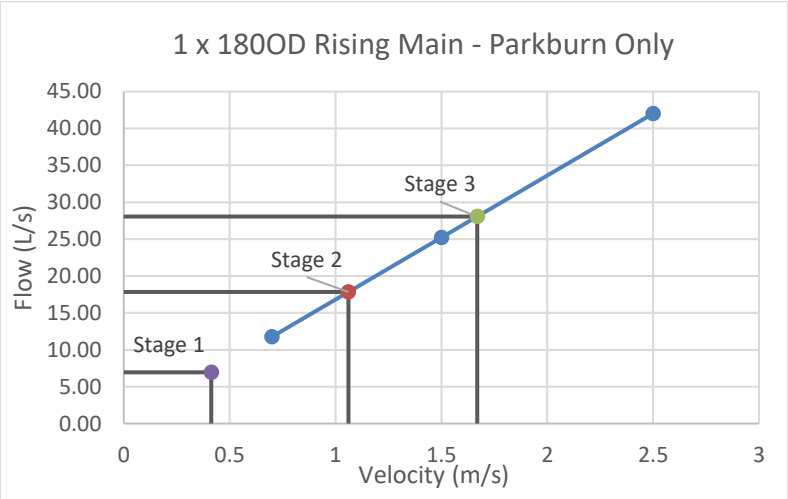


Figure 4.3: Parkburn Development Rising Main – Stages 1 to 3

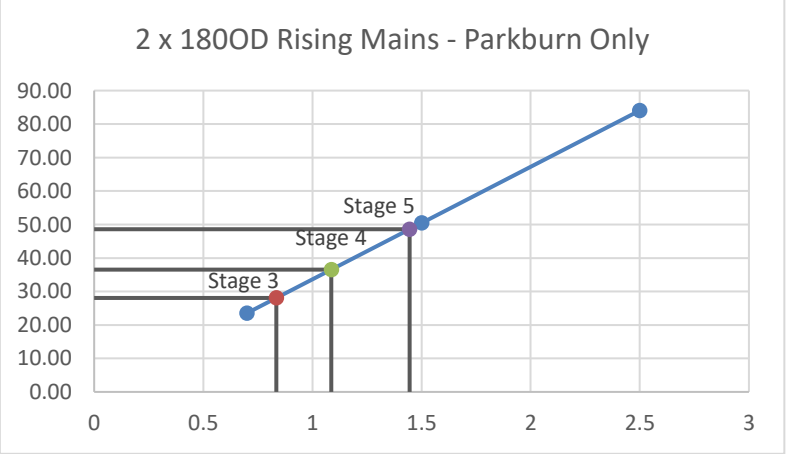


Figure 4.4: Parkburn Development Rising Mains – Stages 3 to 5

As can be seen in Figures 4.3 and 4.4 a single 180OD rising main will be able to cope with the estimated pumped peak wet weather flows for Stages 1-3, but a second 180OD pipeline will be required to convey the additional flows coming from Stages 4 and 5. This approach will maintain adequate flushing velocities in the pipelines and be able to be delivered by standard submersible centrifugal wastewater pumps.

The rising main flow velocity for Stage 1 of the Parkburn development is the exception at approximately 0.4m/sec. It is recommended that the wastewater pumps be configured to pump higher than the Stage 1 flows for this scenario to maintain adequate flushing velocities in the pipeline.

4.4.3 Impact of the HWR Development Flows on the Parkburn Rising Main(s)

The impact of the additional flows arriving from the HWR development were also assessed on the rising main sizes determined above for the Parkburn development flows. It was assumed that the HWR flows would feed into the rising main at the southern Parkburn entrance as shown on Figure 4.2.

Figures 4.5 and 4.6 below show the impact of the addition of the HWR flows into the proposed Parkburn rising main(s).

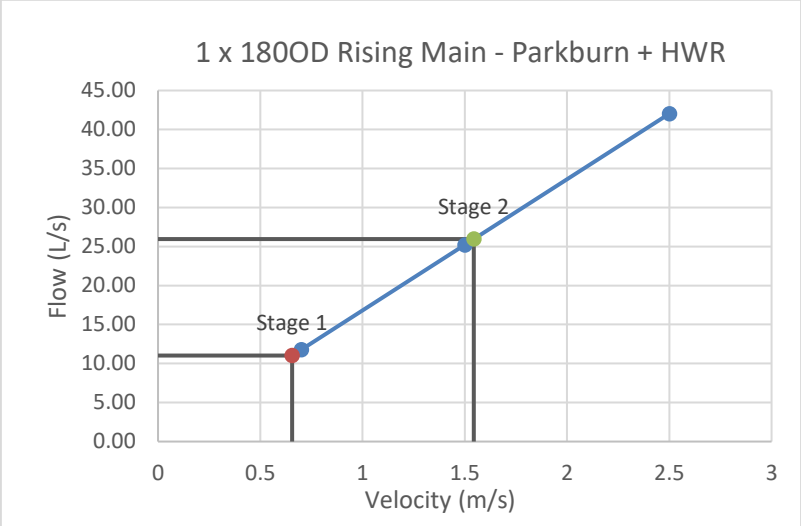


Figure 4.5: Parkburn and HWR Development Rising Main – Stages 1 to 2

As can be seen in Figure 4.5 the combined estimated flows from Stages 1 and 2 should be able to be conveyed in a single 180OD pipeline. Once the Stage 3 flows are added to the single pipeline, the increase in velocity causes a significant increase in the head that the Parkburn pumps will see.

As can be seen in Figure 4.6 the two 180OD pipes will be able to convey the Stages 3-5 flows with the combined Stage 5 flow resulting in a pipeline velocity of 2.05m/s.

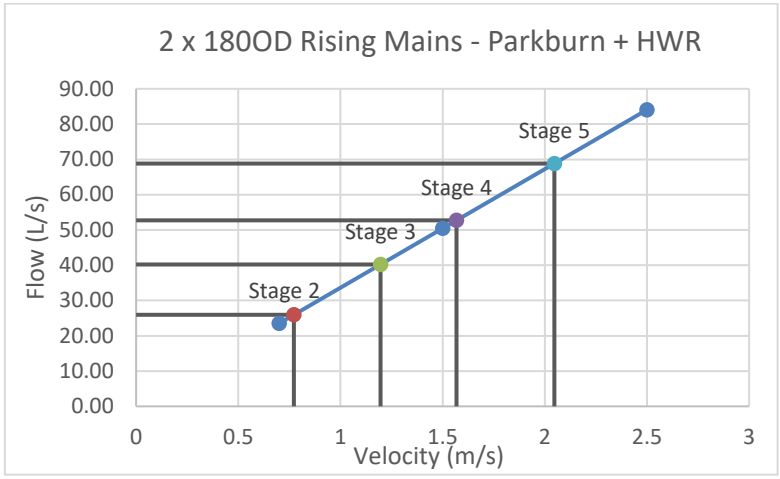


Figure 4.6: Parkburn and HWR Development Rising Mains – Stages 3 to 5

4.5 Parkburn Development Pump Sizing

The sizing of rising mains and the pumps feeding into them go hand-in-hand. Albeit that we were not asked to in the scope, we have also investigated the potential pumps that could be used to pump the Parkburn Development wastewater flows in the rising main down to the Pisa Moorings WWPS.

Suitable Flygt pumps were sized based on the rising main design that could cope with the staged growth, the single and dual rising main options and the ability to pump the Parkburn flows in a dedicated rising main(s) or in combination with flows entering the pipeline(s) from the HWR development at the south entrance to the Parkburn site.

Figures 4.7 and 4.8 show that a Flygt NP3202 SH3 – Smartrun 271 pump operating on a variable frequency drive will be able to undertake the following:

- pump the Parkburn development flows through a single 180OD rising main up to Stage 3 of the development (running at 45Hz as shown on Figure 4.7)
- pump the Stage 2 Parkburn development flows with Stage 2 HWR flows arriving in the second portion of a single 180OD rising main (running at 37 Hz as shown in Figure 4.7)
- pump the Stage 5 Parkburn development flows through a dual 180OD rising mains (running at 40Hz as shown on Figure 4.8)
- pump the ultimate Stage 5 Parkburn development flows with Stage 5 HWR flows arriving in the second portion of the dual 180OD rising mains (running at 47 Hz as shown in Figure 4.8)

As noted earlier in Section 4.4.2 it is recommended that the Parkburn pumps pump greater than the Stage 1 peak wet weather flows to ensure flushing velocities are maintained in the rising main and the pump is operating in its normal variable speed operating range.

Note: It is recommended that a standby pump be also installed in the pumping station wet well. Furthermore, this report presents a preliminary design. The pumps will need to be confirmed during detailed design.

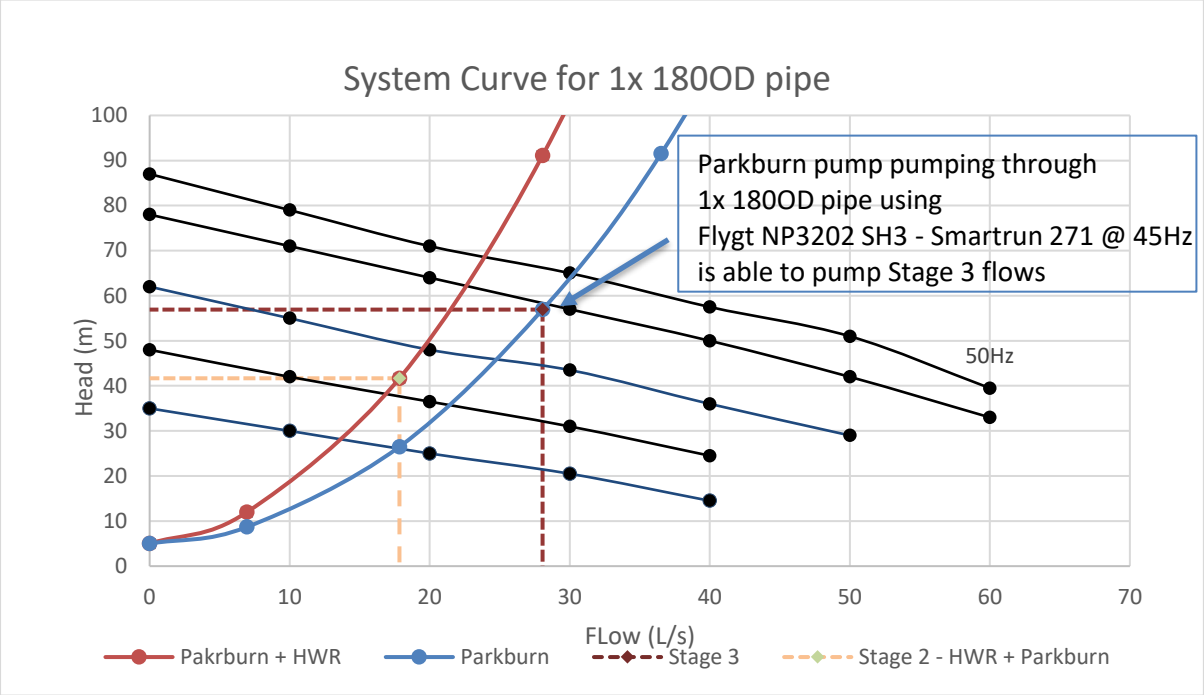


Figure 4.7: Parkburn WWPS Pump and System Curves – 1 x 180OD Rising Main

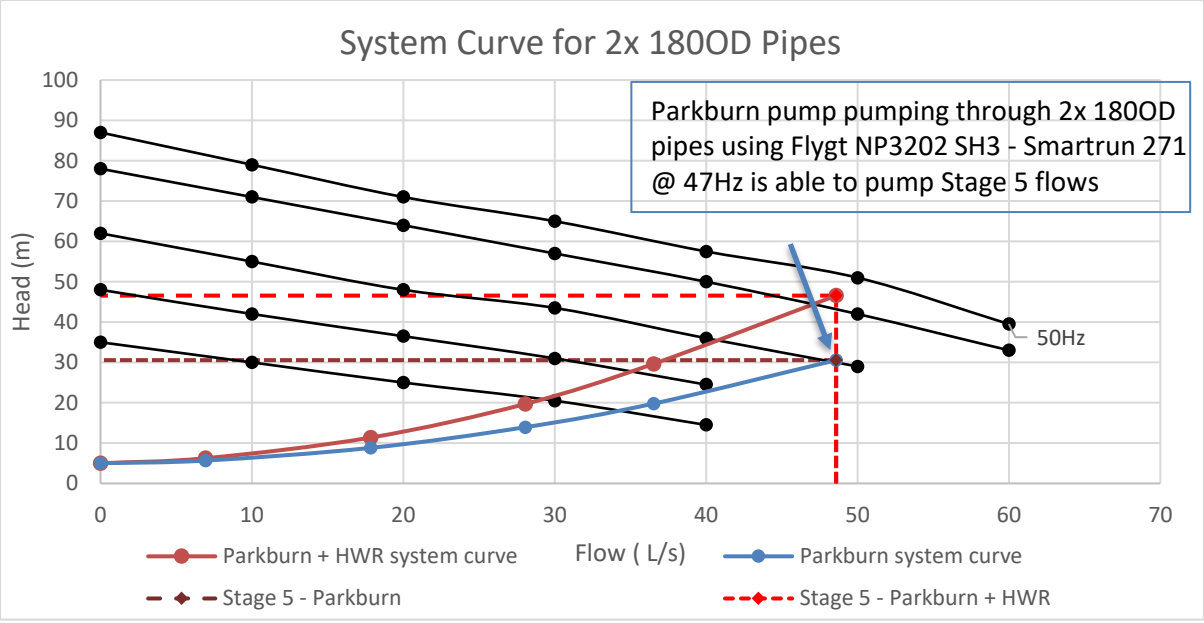


Figure 4.8: Parkburn WWPS Pump and System Curves – 2 x 180OD Rising Mains

4.6 Wastewater Calculations – South of Pisa Moorings

A review of the existing rising main leading from the Pisa Moorings WWPS down to Lowburn was also completed to assess the impact of the additional Parkburn development and Parkburn/HWR development flows on the infrastructure.

Currently a 3594m long, 150 uPVC rising main carries the estimated Pisa Moorings development peak wet weather wastewater flows of 21.05 l/sec (see Table 3.1) down to the Lowburn Hall WWPS before they are then pumped further into the Cromwell wastewater reticulation. Table 4.3 shows the combined estimated peak wet weather wastewater flows for the Pisa Moorings, Parkburn and HWR developments at the various stages of development that would need to be pumped by the Pisa Moorings pumping station.

The velocity in the existing 150 uPVC pipeline for the Pisa Moorings flows is approximately 1.2m/sec and the head that the existing pumps see is approximately 48m. Any increase in flow due to the addition of the Parkburn and/or Parkburn plus HWR flows will significantly raise the velocity and friction loss in the pipeline and hence impact the capacity of the pumps.

Table 4.3: Estimated Peak Wet Weather Flows to be Pumped by Pisa Moorings WWPS

Total Stages	Parkburn Cumulative Flows (l/s)	Pisa + Parkburn Cumulative Flows	HWR Cumulative Flows (l/s)	Total Cumulative Flows (l/s)
Pisa Moorings	-	21.05	-	21.05
1	6.94	27.99	4.08	32.07
2	17.84	38.89	8.12	47.00
3	28.06	49.11	12.15	61.27
4	36.53	57.58	16.19	73.77
5	48.59	69.64	20.23	89.87

A proposed solution for the increase in flow demands is to run second rising main parallel to the current 150 uPVC pipe. Figure 4.9 presented below shows the impact of running an additional 250OD PE100 PN16 pipe parallel to the 150 uPVC pipeline.

As can be seen, the 250OD pipeline can be used by itself to convey the Parkburn and Pisa Moorings wastewater flows up to Stage 4 of the Parkburn development (57.58 l/sec @ 50m – light blue dashed line in Figure 4.9).

The single 250OD pipeline can be used by itself to convey the Parkburn, HWR and Pisa Moorings wastewater flows up to Stage 2 of the Parkburn and HWR developments (47.00 l/sec @ 35m – the solid purple line in Figure 4.9).

The existing 150 uPVC rising main or future equivalent could then be used in parallel with the 250OD pipeline to convey wastewater flows from the later stages of development (the solid brown and dark blue dashed lines in Figure 4.9).

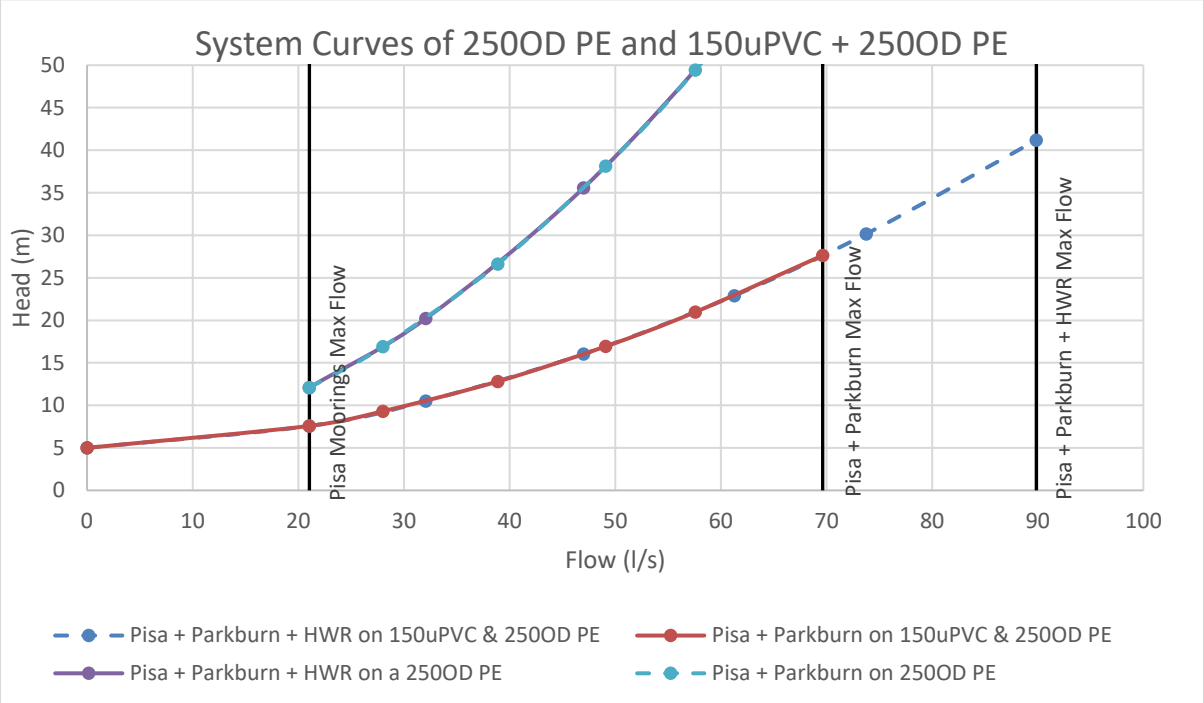


Figure 4.9: Pisa Moorings WWPS Rising Main(s) – Stages 1 to 5

Of further note is that the Pisa Moorings WWPS and the subsequent pumping stations (and subsequent rising mains) will most likely require upgrades to allow for the additional flows. It is understood that CODC's modellers are currently assessing the impacts of both the developments along with the potential "Dippie" development on the existing infrastructure and that their report is due in a few months.

5.0 Water Supply Infrastructure Implications

5.1 Existing Wastewater Infrastructure

Figure 5.1 below presents the existing water supply infrastructure that services the Pisa Moorings development taken from CODC's GIS mapping system.



Figure 5.1: Pisa Moorings Water Supply Infrastructure

It is understood that Pisa Moorings has two water supplies; the original bore supply and a 250 dia. PVC pipeline supplying water to the development from Cromwell. Whether the original water supply is still being used is unknown at this stage as the appropriate person in CODC to give the information has been away on leave over the Christmas break.

5.2 Water Supply Infrastructure Investigations

It is understood that CODC are proposing a new treated water reservoir to service the entire area on the hill above Clark Road on the western side of State Highway 6.

The preliminary sizing of a new gravity falling main to feed the Parkburn and HWR developments and potentially Pisa Moorings as well is dependent on the worst-case scenario of either the estimated peak hourly demands or 60% of the estimated peak daily flows plus fire-fighting water demands as stipulated in SNZ PAS 4509_2008 Fire Fighting Supply.

It is recommended that an FW3 fire risk classification be implemented for the Parkburn development to enable enough water to be available through hydrants for the Fire Service to use to fight fires in the proposed commercial area. This equates to 50 l/sec through the hydrants.

The ultimate peak daily flows and peak hourly flows for each of the developments are presented in Table 5.1 below:

Table 5.1: Peak Daily and Peak Hourly Water Demands

Development	Peak Daily Flows (l/s)	Peak Hourly Flows (l/s)	60% Peak Daily flows (l/s)
Parkburn	53.59	91.30	32.15
HWR	24.27	40.45	14.56
Pisa Moorings	25.26	42.00	15.16
Total	**103.12**	**173.75**	**61.87**

As can be seen in Table 5.1 the worst flow scenario for the Parkburn development solely being fed water is the peak hourly flow figure of 91.3 l/sec (> 32.15 + 50 = 82.15 l/sec).

The worst-case flow scenario for the combined Parkburn and HWR developments is the peak hourly flow figure as well at 131.75 l/sec (> 46.71 + 50 = 96.71 l/sec).

The worst-case flow scenario for the combined Pisa Moorings, Parkburn and HWR developments is the peak hourly flow figure of 173.75 l/sec
(> 61.87 + 50 = 111.87 l/sec).

Assuming a 90m level difference between the new reservoir and the bulk of the development, a 2.4km long falling main to the Parkburn development southern entrance from the reservoir and a minimum residual pressure at the houses of 30m it has been assumed that a maximum velocity in the pipeline during a peak hourly event should not exceed not much more than 2.5m/sec.

On this design basis the falling mains required for each option would be as follows:

- Parkburn development only = 280OD PE100 PN16 or 2 x 200OD PE100 PN16 pipes
- Parkburn + HWR developments = 315OD PE100 PN16 or 2 x 225OD PE100 PN16 pipes
- Parkburn + HWR + Pisa Moorings developments = 355OD PE100 PN16 or 2 x 250OD PE100 PN16 pipes

6.0 Recommendations

It is recommended that Fulton Hogan Land Development Ltd consider the points raised in this report and then use it if required to cross-check against what CODC are proposing once their modellers have completed their assessments and report.

If you have any questions please do not hesitate getting in touch.

Yours faithfully
FLUENT INFRASTRUCTURE SOLUTIONS LTD
Per:



Anthony Steel
Director – Principal Civil-Water Engineer

APPENDIX G – Woods Stormwater & Flood Management Report



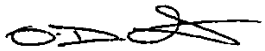
Stormwater & Flood Management

Parkburn Development

Cromwell, Central Otago
Fulton Hogan Land Development Ltd

Final

Document Control

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Statement of Qualifications and Experience

Pranil Wadan (Flowstate Consulting)

I am a Director of Flowstate Consulting LP and act as a Technical Consultant to Wood and Partners Consultants Limited, trading as Woods.

I hold a Bachelor of Engineering from the University of Auckland, completed in 2007. I am a Chartered Professional Engineer and a member of Engineering New Zealand and Water New Zealand. My additional professional qualifications and appointments include International Professional Engineer (IntPE(NZ)), Certified Independent Hearing Commissioner, and a Certificate in Company Direction and Governance.

I have more than 18 years' experience in stormwater design, hydrodynamic modelling, flood risk assessment, water infrastructure, and stormwater management for land development projects. I have acted as principal author and lead stormwater engineer for a wide range of stormwater management plans and flood modelling assessments prepared for projects across New Zealand.

My experience includes the development of catchment-scale flood models, detailed stormwater network models, and integrated catchment management plans for both private sector clients and territorial and regional authorities.

In my role as originator and reviewer of this report, I confirm that I have read and comply with the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Boniface Kinnear

I am a Principal Engineer in the Water Infrastructure & Planning at Wood and Partners Consultants Limited ("Woods"). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since 2020.

I hold a Bachelor of Science in Environmental Engineering from the University of Southern California, Los Angeles, California which I obtained 2004. I also hold Master of Engineering Studies and a Master of Engineering in Environmental Engineering both from the University of Auckland completed in 2007 and 2008 respectively. I am a Chartered Professional Engineer (CPEng), a chartered member of Engineering New Zealand (CMEngNZ) and an International Professional Engineer (IntPE)/APEC Engineer. Additionally, I am a member of the Environment Institute of Australia and New Zealand (EIANZ) as well as a member of the Rivers Group NZ.

I have over 18 years of experience in environmental management, contaminated land, impact assessments, stormwater design and modelling, flood risk assessments, water infrastructure and stormwater management. I have authored several stormwater management plans, flood modelling reports, infrastructure assessment/design reports, earthworks reports and detailed site investigation reports to support numerous projects.

I confirm that, in my capacity as contributor of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Simran Bassan

I am an Engineer at Wood and Partners Consultants Limited (Woods), holding a Bachelor of Engineering from the University of Auckland, completed in 2021. I am a member of Engineering New Zealand and Water New Zealand.

I have four years' experience in hydrodynamic modelling, flood risk assessment, and stormwater management for land development projects. This experience encompasses catchment-scale flood models, detailed stormwater network models, and stormwater management plans spanning a range of projects across New Zealand, for both private sector clients and territorial and regional authorities.

I confirm that, in my capacity as contributor of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Executive Summary

This Stormwater Management Plan has been prepared to support a substantive application under the Fast-track Approvals Act 2024 for the Parkburn Development at 922 Luggate-Cromwell Road, Cromwell. The development is being progressed by Fulton Hogan Land Development Ltd and will enable a large-scale residential and mixed-use subdivision across approximately 118 ha of land currently used for quarrying, fronting Lake Dunstan.

The stormwater strategy has been informed by site-specific hydrological and hydraulic modelling. It has been prepared in accordance with Central Otago District Council and Otago Regional Council requirements.

The overall approach is to manage stormwater in a way that responds to the site conditions, supports the proposed land use change, protects development areas from flood risk, and provides appropriate treatment before discharge towards Lake Dunstan.

Stormwater Management Approach

The development has been divided into two main stormwater catchments based on proposed levels, ground conditions, and available discharge options.

Catchment 1 covers approximately 24.42 ha of the higher parts of the site. Stormwater in this area can be managed through in-ground soakage, consistent with established practice in Cromwell, where ground conditions support this approach.

Catchment 2 covers approximately 92.19 ha of the lower parts of the site, where soakage is not suitable as the primary disposal method. Stormwater from this catchment will be collected through a reticulated piped network, treated, and discharged through the proposed stormwater management system. Four stormwater management zones have been identified within Catchment 2 to reflect differences in land use, drainage arrangement, discharge location, and treatment requirements.

Stormwater quality will be managed through a combination of source control and treatment devices. All buildings will use low-contaminant roofing and spouting materials to reduce contaminant generation at source. For Zone A, vegetated swales are proposed along both sides of the central conveyance channel and have been sized to convey the water quality design flow, with a target contaminant removal efficiency of at least 75 % in accordance with GD01. For Zones B to D, treatment will be provided through an at-source and network-based toolbox, which may include bioretention devices, tree pits, catchpit filters, gross pollutant traps, and proprietary devices. Final device selection and sizing will be confirmed at detailed design stage in consultation with CODC.

The primary stormwater network will be designed to convey the minimum 5-year ARI event in accordance with CODC engineering standards and NZS 4404:2004. Larger events will be managed through the secondary network, with overland flow paths generally provided within road corridors and the central drainage corridor. The central drainage corridor will provide the main flood conveyance function for the site and includes two major culverts and a bridge crossing to connect the northwestern part of the development with the balance of the site. Overland flow paths will be maintained free of obstruction and designed so that the development does not create or worsen flooding effects on neighbouring properties.

Flood and Natural Hazard Assessment

Hydrological and hydraulic modelling has been undertaken using HEC-HMS and HEC-RAS, with design rainfall derived from NIWA HIRDS V4 and allowance for the RCP8.5 climate change scenario projected to 2100.

The catchment-wide modelling confirms that, for the 100-year ARI event including climate change, flood flows from the wider Mount Pisa catchment are contained within the central drainage corridor and do not overtop into the proposed development areas. The post-development modelling also accounts for the reduced floodplain area within the neighbouring Bonisch site and confirms that the development does not create adverse flooding effects on upstream properties.

Internal flood modelling for the 5-year, 10-year, and 100-year ARI events, including climate change, shows that flood flows within the development are generally contained within road corridors and the central drainage corridor. The ARR flood hazard assessment confirms that the maximum hazard classification within the developed areas, including road corridors, is H1, which is generally safe for people, vehicles, and buildings. Higher hazard areas are limited to the drainage corridors, where flood conveyance is expected and where habitable development is not proposed.

Minimum finished floor levels will be set 0.5 m above the modelled 1 % AEP flood level, including climate change, in accordance with CODC Engineering Standards and NZS 4404:2004.

Otago Regional Council alluvial fan mapping identifies a small part of the northeastern development area as being within an active, floodwater-dominated fan extending from Mount Pisa towards Lake Dunstan. A conservative sensitivity assessment, based on three times the 100-year ARI discharge, confirms that flood flows remain contained within the revised drainage corridor and do not inundate the proposed development platforms. Habitable buildings have been located outside the active fan corridor, with infrastructure and open space proposed within the fan area. This provides a risk-proportionate response to the mapped hazard.

The flood and alluvial fan hazard assessment demonstrates that the development is consistent with the National Policy Statement for Natural Hazards 2025. Flood hazard risk across the proposed development platforms is assessed as Low to Negligible under the NPS-NH risk matrix. No Very High risk areas have been identified within the proposed habitable development footprint.

Conclusion

The proposed stormwater management strategy represents the Best Practicable Option for the Parkburn Development. It provides a practical and site-responsive framework for managing the change from quarrying and rural land use to urban development.

The strategy provides for stormwater collection, treatment, conveyance, and disposal in a way that protects people and infrastructure, manages flood risk, avoids adverse effects on neighbouring properties, and provides appropriate stormwater quality treatment before discharge towards Lake Dunstan.

On this basis, the proposed stormwater management approach is considered appropriate to support the substantive Fast-track Approvals Act application.

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1. Introduction

The site is approximately 118ha in area and located at 922 Luggate-Cromwell Road, Mt Pisa, Cromwell, approximately 8.5km from Cromwell, as illustrated in (Figure 1).

The majority of the site is, or has historically been, utilised as the Parkburn Quarry, which is being progressively quarried from south to north, with rehabilitation works already undertaken in some areas. The northern end of the site accommodates a range of small-scale yard-based industrial activities.

The site occupies a low-lying, modified area within the rural environment, situated outside any identified Outstanding Natural Landscape or Significant Amenity Landscape. It is positioned on a terrace landform forming part of the lake-edge area between Mount Pisa and Lake Dunstan / Te Wairere. At its western boundary, the site runs parallel to SH6, from which vehicular access is obtained. The eastern boundary adjoins the riparian edge of Lake Dunstan / Te Wairere, providing a strong landscape and ecological interface. To the south, the site directly adjoins the existing urban area of Pisa Moorings, while the northern boundary adjoins rural-zoned land that also accommodates an operational quarry.

The character of the site is predominantly industrial, with machinery, infrastructure, and stockpiling associated with quarry operations. Due to the existing ground levels, bunding, and peripheral vegetation (including along the SH6 frontage), visibility of on-site activities from adjoining areas is limited. Views into the site are generally only available from elevated locations further afield.



Figure 1: Site location

1.1. Purpose

This Stormwater Management Plan (SMP) has been prepared in support of the substantive FTAA application by Fulton Hogan Land Development Ltd.

The purpose of this report is to outline the stormwater management strategy for the Development, and to demonstrate how the requirements of the Central Otago District Council (CODC) and Otago Regional Council (ORC) have been met. The overarching objectives are as follows:

- Demonstrate that the proposed stormwater management meets the requirements of CODC and ORC;

- Incorporate a water-sensitive urban design approach that manages the impact of land use change from rural to urban;
- Ensure stormwater runoff is conveyed safely to the receiving environment through appropriately designed primary and secondary networks;
- Provide appropriate stormwater quality treatment for the receiving environment, including avoidance of high contaminant-generating roof and cladding materials. This will ensure the water quality of Lake Dunstan/Te Wairere and areas if Iwi interest are protected and not degraded;
- Identify flood risk areas and provide for development outside the 1% AEP floodplain without creating adverse flooding effects on upstream or downstream properties; and
- Account for climate change in the design of stormwater infrastructure, using NIWA HIRDS V4 with RCP8.5 scenario in accordance with CODC and ORC guidelines.
- Recognise and have regard to Lake Dunstan/Te Wairere as a Statutory Acknowledgement Area under the Ngai Tahu Claims Act 1998.

2. Description of Application Site

The site is located at 922 Luggate-Cromwell Road, Cromwell, Central Otago. The Development comprises a large landholding of approximately 118 ha in total, owned by Fulton Hogan Land Development Ltd. The site is situated to the west and southwest of the existing Cromwell township, with Lake Dunstan / Te Wairere forming the eastern boundary.

The site is generally bounded by State Highway 6 (Luggate-Cromwell Road) to the west , existing residential area to the south, and Lake Dunstan / Te Wairere to the east. The site is currently used for rural purposes, predominantly quarrying activities.

The site is legally described as:

- Part Section 62-63 Block IV Wakefield Survey District and Part Section 63;
- Block IV Wakefield Survey District and Section 1 Survey Office Plan 365897 and Section 4 Survey Office Plan 557380;
- Section 64-65 Block IV Wakefield Survey District.

2.1. Description of the Receiving Environment

The receiving environment comprises the site and Lake Dunstan /Te Wairere. Lake Dunstan/Te Wairere is a Statutory Acknowledgment Area and is of significant cultural significance to Kāi Tahu whānui, Approximately 7km to the south of the site is the Nohoanga entitlement at McNulty Inlet (This is a central meeting point for many trails that traversed inland Otago).

2.2. Summary of Data Sources and Dates

A summary of key background data sources used in the development of this SMP is provided in Table 1.

Table 1: Data sources

Existing Site Appraisal Item	Source and Date of Data Used
Topography	LP2000 & NZVD16 survey data, Landpro Ltd, April 2026; LiDAR, LINZ Data Service
Soakage / infiltration testing	Infiltration test results reviewed by Landpro Ltd, Drawing No. 24113/109_01, draftV2, May 2026
Existing stormwater network	Central Otago District Council GIS / IntraMaps
Existing hydrological features	Otago Regional Council GIS; Drains and Waterways; Lake Dunstan / Te Wairere boundary conditions 195.6mRL - Source: Contact Energy
Flooding and flow paths	Inflows from 922A Luggate-Cromwell Rd, Mt Pisa provided by Bonisch (February 2025)
Ecological / environmental areas	Ecological Impact Assessment (Draft – April 2026), Viridis
Geotechnical and Earthworks	Geotechnical Assessment for 922 Luggate-Cromwell Road (SH6), Cromwell (June 2026), Insight Engineering

2.3. Topography

The site topography has been established using LP2000 and NZVD16 survey data prepared by Landpro Ltd (Figure 2). The site generally falls from north to south, and from west to east toward Lake Dunstan / Te Wairere. Ground levels range from approximately 215 mRL at the northern extent of the site to approximately 196 mRL at the lake margin.

Contour data indicates a broadly undulating landform, with localised ridgelines and shallow drainage depressions across the site.

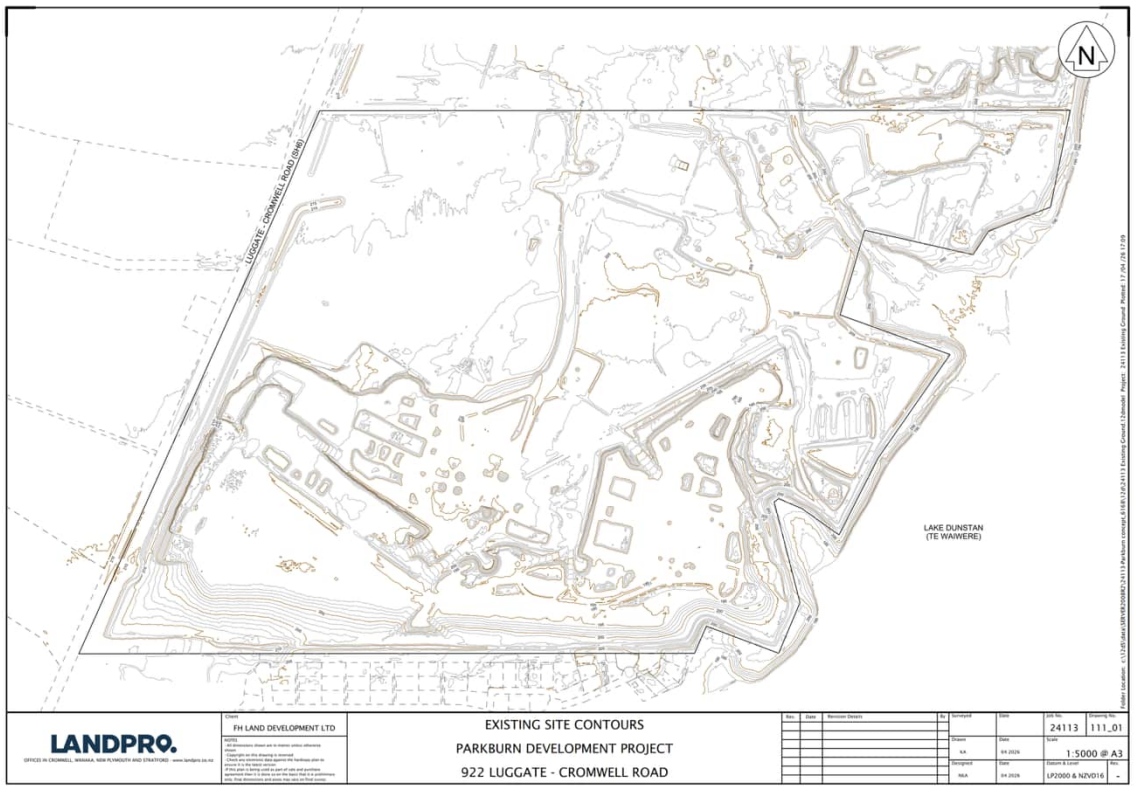


Figure 2: Existing Site Contours (Landpro Drawing 24113/111_01)

2.4. Existing Stormwater Network

The site is currently used for rural and mining/quarry activities and does not contain any existing reticulated stormwater infrastructure. The nearest public stormwater infrastructure forms part of the existing Cromwell residential stormwater network, located to the south of the site.

Although no existing stormwater network is available within the site, the proposed development will provide its own primary stormwater network in areas where soakage is not adopted. Stormwater discharges from the site will be managed independently of the existing public network. As such, the proposed stormwater management system will operate as a standalone system and will not rely on the existing stormwater network.

2.5.Existing Hydrological Features and Waterways & Ecology

Lake Dunstan / Te Wairere forms the eastern boundary of the site. The lake is a significant water body and forms the primary receiving environment for surface runoff from the lower portions of the site. The lake is managed by Contact Energy Ltd as part of the Clutha / Mata-Au hydroelectric scheme.

An Ecological Impact Assessment (EcIA) was prepared by Viridis Limited (April 2026) to assess the ecological values of the site and the effects of the proposed development. The site is located within the Pisa Ecological District and has been heavily modified through approximately 40 years of quarrying, with ecological values within the site largely limited to lizard habitat and intermittent use by native birds.

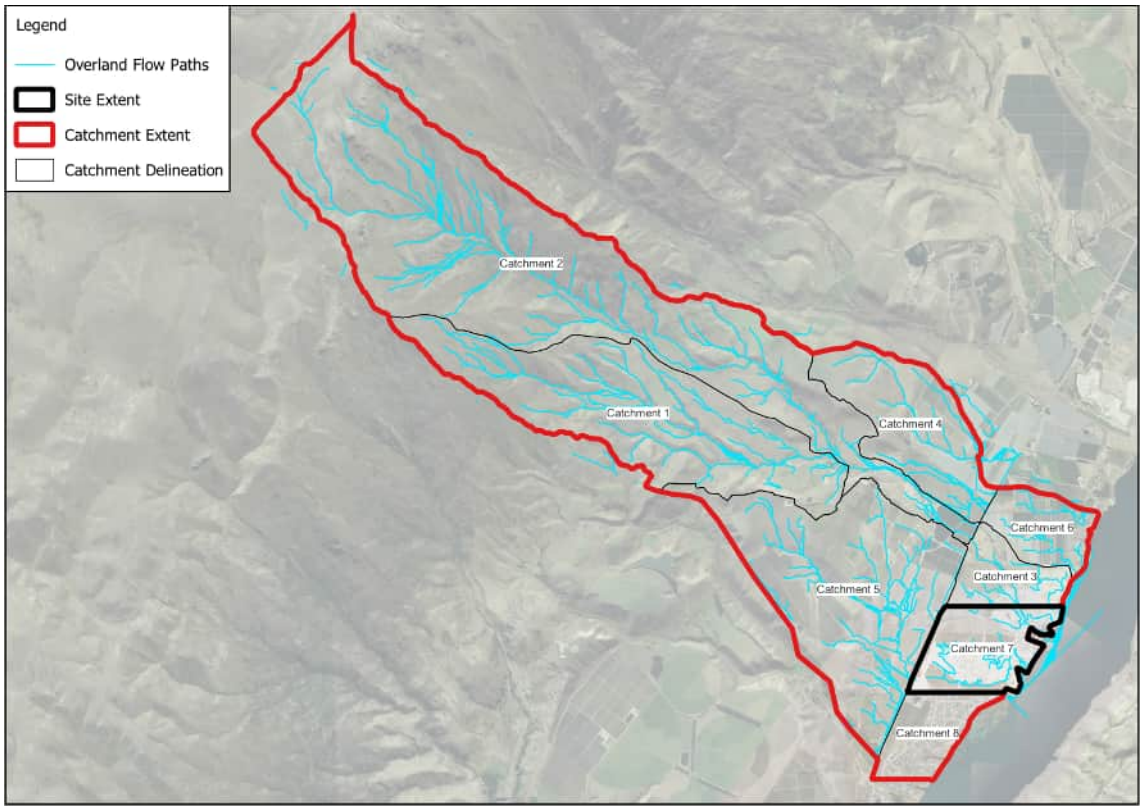
The Parkburn flows through the northeastern corner of the site, classified as an intermittent stream with moderate ecological value. Macroinvertebrate sampling indicated degraded but functional water quality, consistent with the agriculture and horticulture-dominated catchment. Lake Dunstan / Te Wairere forms the eastern boundary of the site and is assigned high ecological value, providing habitat for a range of Threatened and At-Risk bird and fish species.

No natural inland wetlands (as defined under the NPS-FM) are present within or within 100 m of the site. Several areas of non-natural wetland associated with the margins of Lake Dunstan / Te Wairere are present and provide limited habitat values.

2.6. Flooding and Overland Flow Paths

Overland flow paths have been mapped based on LiDAR-derived topographic data. The Catchment Plan identifies external catchment areas and overland flow path alignments across the wider catchment (Figure 3). The map shows large upstream catchment areas originating from Mount Pisa, through extensive farmland and funnelling runoff past the development site via a floodway that leads to Lake Dunstan / Te Wairere.

Internal overland flow paths (Figure 4) characterised by the existing quarry activities will be altered as the landform is modified by the proposed earthworks.



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Figure 3: Existing overland flow paths (wider catchment)

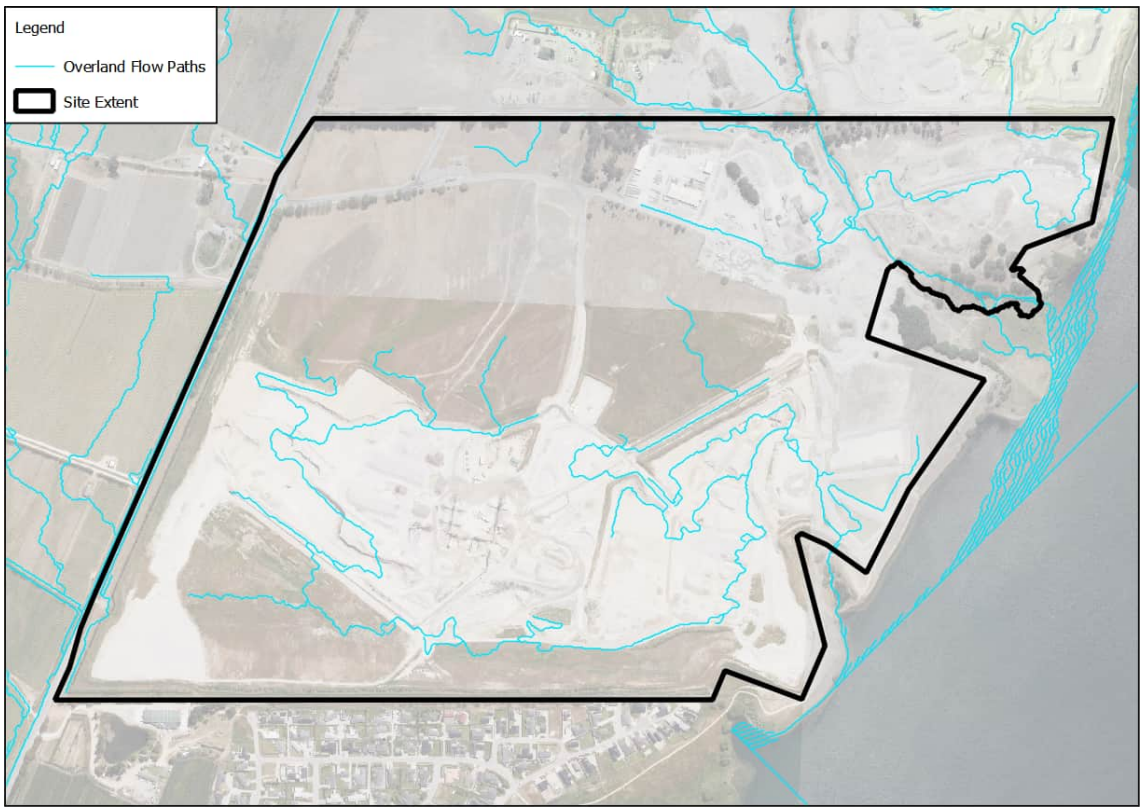


Figure 4: Existing overland flow paths (development site)

3. Development Summary and Planning Context

A review of the relevant stormwater guidelines, policies, and planning instruments has been undertaken to determine appropriate stormwater and flooding requirements for this SMP. The documents reviewed and their relevance are summarised in Table 2.

Table 2: Development documents summary

Guidance Document	Summary	Relevance
Fast-track Approvals Act 2024 (FTAA)	Primary approval pathway for this application, administered by the EPA.	Yes - sets application process and expert evidence requirements
NPS for Freshwater Management 2020 (NPS-FM)	National policy for managing and improving New Zealand's freshwater systems.	Yes - Te Mana o te Wai obligations; water quality and quantity objectives
NES for Freshwater (NES-F) 2020	Establishes permitted activity conditions for activities in or near waterbodies.	Yes
Otago Regional Policy Statement (RPS)	Strategic policy direction for the Otago region including natural hazards and freshwater.	Yes - flood hazard, stormwater management, and receiving environment policies
Otago Regional Plan: Water	Rules governing stormwater discharges to water and land in the Otago region.	Yes
Central Otago District Plan	District Plan provisions for subdivision, land use, and stormwater infrastructure.	Yes - flood hazard overlay, minimum floor levels, infrastructure standards
CODC Land Development and Subdivision Engineering Standards	CODC engineering standards for subdivision infrastructure design.	Yes - primary network design standards, NZS 4404:2004 referenced; GD01 adopted as superseding ARC TP10
NZS 4404:2004 Land Development and Subdivision Infrastructure (including 2008 Addendum)	NZ standard for subdivision infrastructure. CODC references NZS 4404:2004 which draws on ARC TP10.	Yes - NZS 4404:2004 referenced by CODC. ARC TP10 has been superseded by GD01; GD01 adopted for stormwater performance criteria in this SMP
Auckland Council Guideline Document GD01 (2017)	Updated guidance on stormwater management devices, superseding ARC TP10. Adopted for water quality device sizing in this SMP as the current best-practice standard.	Yes - used for sizing of vegetated swales, bioretention devices, and tree pits Note: GD01 adopted as superseding ARC TP10
NIWA HIRDS V4	High-intensity rainfall design system providing design rainfall depths by AEP event and climate change projections.	Yes - rainfall inputs for hydrological modelling including climate change

Note: The CODC Land Development and Subdivision Engineering Standards reference NZS 4404:2004, which in turn draws on ARC TP10. ARC TP10 has since been superseded by GD01. Accordingly, the stormwater performance criteria and device sizing in this SMP are based on GD01 as the current best-practice standard.

4. Stakeholder Engagement and Consultation

This section summarises the stormwater-related consultation and review process undertaken with Central Otago District Council (CODC) and Otago Regional Council (ORC) as part of the Fast-track Approvals Act application.

Table 3: Consultation Summary

Stakeholder	Date	What Engagement Has Been Completed?
Central Otago District Council (CODC) / Otago Regional Council (ORC)	14 July 2026 (comments received) 20 July 2026 (responses issued)	ORC (Nick Keenan) reviewed the SW and Flood Management report (Woods, 24 June 2026) and the Draft EMP (LandPro, 20 June 2026) and raised 25 review comments. Woods has reviewed and responded to each comment. The full comment-by-comment record is provided in the Comments Register attached as Appendix E. A high-level summary of the key themes raised and Woods' response is provided below.

ORC provided 25 comments on the Stormwater Management Plan (SMP). The comments have been reviewed and responded to. The complete comment register, including responses to each item, is provided in Appendix A.

Of the 25 comments received, 15 relate to matters that are appropriately addressed through further design development during the detailed engineering design of the relevant infrastructure. These items are identified in the comment register.

The remaining 10 comments have either been addressed using information contained in the current SMP and supporting Model Build Memo or relate to straightforward documentation updates that will be incorporated into the next revision of this report.

A high-level summary of the key themes raised during the review, together with Woods' response to each, is provided in the table below.

Table 4: Response Summary

Theme	Summary of Query	Summary of Response
Hydrological & hydraulic modelling methodology	Clarification sought on the software and methods used to build the hydrology and hydraulic models, including the time of concentration method, curve number assumptions, rainfall data, subcatchment delineation, and the top elevation of the Parkburn catchment.	HEC-HMS and HEC-RAS (v7) are confirmed as the modelling software, coupling a 1D preliminary pipe network to a 2D surface model (5 m grid, refined to 2 m along road/drainage corridors), with rainfall-runoff applied as inflow at discrete subcatchment loading nodes - this approach is considered appropriate at the current stage, with further 1D network refinement at the subsequent design phase. A comparison against alternative time-of-concentration methods has now been added to the Model Build Memo (Appendix C), with the adopted TP108 method falling within the average range; boundary hydrographs reflecting future upstream development and SH6 culvert blocked/unblocked scenarios are considered beyond the scope of the SMP and will be reviewed if required at detailed design. Figure 2 has been updated to label subcatchments and show flow direction arrows, and the SMP is being updated to include the top-of-catchment elevation/profile.

		The CN=60 assumption for upper catchments is confirmed as conservative, noting the corridor cross-section referenced by the reviewer sits within the neighbouring Bonisch site, not Parkburn.
Lake Dunstan boundary conditions	Evidence requested for the Contact Energy dam operating range, spillway and Probable Maximum Flood (PMF) levels used to set the downstream lake boundary condition.	The adopted model boundary of 196.5 mRL is confirmed as conservative, sitting above Contact Energy's normal operating range of approximately 193.5-194.5 mRL (as reported by LandPro). The Contact Energy information is included in Appendix C and will be revisited during the subsequent design phase, alongside detailed design of the lake-edge infrastructure and outlet structures.
Flood conveyance - culverts, bridge & SH6 interface	Hydraulic calculations and hydraulic grade line through the culverts and bridge, a concept bridge design, and clarification of how the SH6 frontage and perimeter lots (including a ponding area) interface with NZTA drainage.	The culverts and bridge are confirmed as sized to convey the 1% AEP event, with results in Appendix B/C. Detailed hydraulic grade line calculations, structure design and scour protection will follow at the subsequent design phase. Long-section, velocity and discharge hydrograph information requested for the corridor and bridge is likewise to be provided at detailed design, noting the design already adopts the conservative 196.5 mRL lake level; Woods has requested clarification from ORC on the extent of erosion/scour assessment considered necessary ahead of that stage. The SH6/perimeter lot drainage interface, including the southwest ponding area, will be confirmed at detailed design in consultation with NZTA/Waka Kotahi.
Secondary network, freeboard & blockage risk	Confirmation of freeboard assumptions, typical cross sections, long section drawings for Zones A-D relative to lake levels and Parkburn hydraulic grade line, and how blockage risk at catchpits, pipes, culverts and the bridge is managed.	A minimum 0.5 m freeboard above the 1% AEP flood level is confirmed, and the preliminary model already adopts a conservative blocked-pipe assumption (<600 mm excluded) - noted as a proof-of-concept assessment only. Typical cross sections, Zone A-D long sections, and structure-specific blockage management measures (e.g. maximised pipe/inlet sizing, maintenance access) will be developed at the subsequent design phase.
Alluvial fan, sediment & debris hazard	Further assessment requested of sediment transport capacity at the SH6 culverts, design flow velocities, channel gradient and buffer allowance for channel migration within the alluvial fan corridor, and consideration of blockage/avulsion risk.	Sediment/debris risk from the upper catchment is confirmed as a matter more appropriately addressed through the neighbouring Bonisch application; the SH6-to-1034 Luggate-Cromwell Road corridor is unaffected by the Parkburn proposal. The 3x100-year sensitivity assessment confirms the corridor safely contains an extreme event with habitable buildings located outside the fan corridor, which is considered adequate to confirm corridor width at this planning stage (the Figure 23 cross-section is illustrative only - the actual design grade is gentler than shown). Woods has queried with ORC whether the full extent of further sediment/velocity/migration

		assessment requested is necessary ahead of detailed design, at which stage this would in any case be refined.
Catchment 1 - soakage design	A typical Caudwell pit detail, stated level of service, and further conceptual detail on soakage disposal for private lots and the public road corridor, including groundwater and operation/maintenance considerations.	The 203 mRL FSL contour is confirmed as a conservative Catchment 1 boundary, with site-specific infiltration testing required for final sizing. Typical soakage details, level of service, private lot/road corridor arrangements, groundwater/O&M considerations and secondary overland flow paths are confirmed as best addressed at the subsequent (relevant) design stage.
Water quality treatment, toolbox & O&M	Clarity sought on O&M responsibilities for treatment devices, evidence of Council engagement/acceptance of the treatment approach, and conceptual long section drawings for the Zone A central conveyance channel and swale connectivity.	Table 5 confirms private devices are maintained by lot owners/body corporate and public devices by Council, with final device selection, sizing and O&M to be confirmed with CODC at the subsequent design stage. For Zone A, LandPro has confirmed the 0.74 m channel lowering and swale connectivity, and the preliminary network already demonstrates hydraulic connectivity to the swale inlets; long section drawings with levels/gradients relative to lake levels will be prepared once the pipe network and swale catchments are finalised.
Earthworks, land use areas, lot assumptions & primary network level of service	Typical earthworks cross sections relative to floor levels and SH6/lake levels; a breakdown of land use areas by type with associated runoff coefficients; confirmation of the primary network level of service against the site's proposed zoning; and a typical residential lot/building platform drawing demonstrating the 60% impervious assumption.	Typical earthworks cross sections will be developed at the subsequent design phase once floor levels are confirmed. The primary network assessment has been extended to include both the 5-year and 10-year ARI events and the SMP updated accordingly, confirming the Development's urban residential/mixed-use zoning (not rural residential); the network will be extended across the balance of the Development at detailed design. A land use area/runoff coefficient table will be provided once finalised at detail design stage, noting the adopted 60% imperviousness is not expected to materially change given lower-imperviousness catchments elsewhere.
Documentation updates - figures, mapping	Labelled subcatchment areas and contours on existing figures, additional flood model output figures (velocity, combined flood extent mapping),	Figure 4 has been updated to show overland flow paths, labelled subcatchment boundaries and LandPro contours together, and Figure 2 has been updated to show subcatchments with flow direction arrows. Additional flood model output figures have been added to the SMP in response to the ORC request. No further action is required in response to the EMP review comment.

5. Proposed Development

The Parkburn Development Project (the Project) involves the staged subdivision and development of land at 922 Luggate-Cromwell Road (State Highway 6), Cromwell, located approximately 8 kilometres north of the Cromwell township and adjoining Lake Dunstan / Te Wairere. The site includes part of the existing Parkburn Quarry. The Project provides for the establishment of a mixed-use urban development, including quarry rehabilitation, residential development, supporting commercial and community activities, open space, and associated infrastructure. Works are also proposed within the State Highway 6 (SH6) road reserve. The proposed masterplan is illustrated in Figure 5.

The project comprises the following components:

- Bulk earthworks to backfill and rehabilitate part of the existing Parkburn Quarry.
- Subdivision and development to enable approximately 1,000 residential allotments, supporting the construction of approximately 1,000 residential units across a range of housing densities.
- Subdivision and development to establish a neighbourhood centre, including retail, commercial, medical, and early childhood education activities, together with land for a primary school.
- Landscaping and development of an open space network, including recreation reserves, esplanade reserves, and restoration along the margins of Parkburn Stream and Lake Dunstan / Te Wairere.
- Formation of two coves extending into Lake Dunstan / Te Wairere.
- Construction of associated infrastructure, including three waters infrastructure, internal transport networks, and external access works connecting the site to State Highway 6.



Figure 5: Parkburn Illustrative Masterplan (April 2026)

6. Stormwater Management

This section describes the proposed stormwater management strategy for the Parkburn Development. The strategy has been developed in accordance with CODC and ORC requirements and best-practice guidance and is designed to ensure stormwater runoff is managed to avoid, remedy, or mitigate adverse effects on the receiving environment.

The overall stormwater management approach seeks to:

- Develop a set of best practicable options (BPO) for stormwater treatment that can be incorporated into the Development;
- Emphasise a water-sensitive urban design approach that manages the impact of land use change from its current state to urban;
- Minimise or mitigate adverse effects on water quality, freshwater systems, and ecological values of the receiving environment; including Lake Dunstan / Te Wairere; through the implementation of appropriate stormwater management devices;
- Minimise the generation and discharge of contaminants and sediment into the receiving environment;
- Facilitate urban development and protect key infrastructure, people, and the environment from significant flooding events; and
- Account for climate change using the NIWA HIRDS V4 dataset and an RCP 8.5 scenario in accordance with CODC and ORC guidelines.
- Recognise and have regard to Lake Dunstan/Te Wairere as a Statutory Acknowledgement Area under the Ngai Tahu Claims Act 1998.

6.1. Stormwater Catchment Areas

The Development has been divided into two primary catchments for the purposes of stormwater disposal, as detailed in Table 5. Catchment 1 will be drained to in ground soak pits and Catchment 2 will be drained via a piped reticulation network. Within Catchment 2, four separate stormwater management zones (Zones A through D) have been identified based on discharge locations, land use characteristics, and the appropriate treatment devices for each area. Catchment areas have been illustrated in Figure 6.

Table 5: Stormwater Catchment Areas

Catchment/ Zone	Area	Primary Discharge	Description
Catchment 1	24.42 ha	In-ground soak pits	Stormwater soaked to ground via in-ground soak. This catchment generally encompasses the higher-elevation areas of the site above the 203mRL FSL contour. Test pits in this area indicate sandy gravels with cobbles and other coarse-grained material. Site specific testing will be required for sizing of soakholes/trenches.
Catchment 2	92.19 ha	Piped reticulation network	Stormwater conveyed to discharge point via piped network. This catchment encompasses the lower-elevation areas of the site where soakage is not feasible. The stormwater management strategy for Catchment 2 is subdivided into Zones A through D, detailed in the sections below



Figure 6: Catchment Plan

6.2. Stormwater Management Toolbox

A stormwater management toolbox has been prepared to summarise the Best Practicable Options (BPO) for the proposed stormwater devices for each stormwater management zone. The toolbox, included in Table 6, has been prepared to provide guidance on the types of devices that are to be used for the management of stormwater.

Devices in the toolbox has been reviewed against the proposed preliminary layout for the plan change to determine the best practicable option. Consideration is given to the following:

- Receiving Environment
- Existing drainage characteristics and topography
- Land use characteristics
- Ability to meet objectives and best practice guidance, and
- Constructions and maintenance

The following table presents a range of stormwater management devices that may be adopted to meet the stormwater management requirements of the development. Device selection, sizing and placement will be confirmed at detailed design. All devices are to be designed in accordance with relevant design standards and industry best practice.

Details of the water quality management approach within each catchment is discussed in the subsequent sections.

Table 6: Stormwater Management Toolbox

Device	Applicable Catchment & Zone	Private Applications	Public Applications	Design Details	Performance Standard TSS Removal*	Key Considerations
Bioretention Devices (rain gardens / tree pits)	Catchment 2 Zones B–D	Private roads, accessways, carparks	Public roads, parking bays, footpaths	Possible devices include, but are not limited to, rain gardens (individual or communal) and tree pits. Indicative sizing has been conducted on a per unit area basis, and is included in Appendix B.	> 75%	Preferred primary at source treatment device for public and private roads. To be integrated into landscape and planting schemes, providing opportunities for biodiversity and habitat. Good contaminant removal performance makes these appropriate for meeting reduction targets for sensitive receiving environments. Pre-treatment via structural devices to trap sediment, litter and debris to be considered at detailed design. Private devices maintained by lot owners or body corporate; public devices maintained by Council.
Communal Device (wetland)	Catchment 2 Zones D	Residential hardstand, private roads, accessways, carparks	Roads, parking bays, footpaths	A single device can be placed within the downstream areas of Catchment 2 - Zone D, prior to discharge into the stream. The device will be sized to treat the water quality flow and will comprise a footprint of approximately 3-5% of the contributing impervious area, in accordance with appropriate design standards.	> 75%	Communal treatment can be provided in areas draining to a single discharge point. Devices are to be placed within downstream sections of the catchment, to maximise runoff capture from the upstream area. To be integrated into landscape and planting schemes with opportunities for biodiversity and habitat. Public devices maintained by Council.
Swales	Catchment 2 Zone A	Residential and commercial hardstand, private roads, accessways, carparks	Roads, parking bays, footpaths	Preliminary device sizing has been conducted for swales within Catchment 2 - Zone A. A total of 6 swales have been sized to treat the water quality flow from this management zone, with calculations provided in Appendix B.	> 75%	Can collect both roof and hardstand runoff. To be integrated into landscape and planting schemes with opportunities for biodiversity and habitat.
Gross Pollutant Traps	Catchment 1 and Catchment 2 Zones B–D	Residential and commercial hardstand, private roads, accessways, carparks	Roads, parking bays, footpaths	A list of possible devices is included below, with indicative drawings (where possible) included in Appendix B: - Hynds Downstream Defender - Atlan Vortceptor - Atlan Baffle Box	< 73% - 93%	Used to remove contaminants including litter, debris and gravel. Numerous commercial products available. Private devices maintained by lot owners or body corporate; public devices maintained by Council.
Catchpit Inserts	Catchment 1 and Catchment 2 Zones B–D	Residential hardstand (small areas)	Passive applications	A list of possible devices is included below, with indicative drawings (where possible) included in Appendix B: - Atlan Stormsack - Stormwater 360 EnviroPod - Stormwater 360 LittaTrap	< 45% - 50%	Suitable for capturing runoff from small hardstand areas that are low contaminant generating. Simple, low-cost passive device.
Inert Roofing Materials	Catchment 1 and Catchment 2 Zones A–D	Residential and commercial roofing	Not applicable	Not applicable	-	Buildings to incorporate low-contaminant generating roofing and spouting materials to minimise contaminant generation at source. A source control measure rather than a treatment device.
Proprietary Treatment Devices	Catchment 1 and Catchment 2 Zones A–D	Private roads, accessways, carparks and commercial areas	Roads, parking bays	A list of possible devices is included below, with indicative drawings (where possible) included in Appendix B: - Hynds Upflow Filter or similar - Stormwater 360 Jellyfish Filter - Stormwater Storm Filter	< 80% - 90%	To be considered where other options have been assessed and found to be unsuitable or impractical for a specific catchment. Can be used as part of a treatment train in conjunction with bioretention devices or infiltration where subsurface conditions allow. Numerous commercial products available. Specific design required for each application.

*Removal efficiency rates have been obtained from currently available manufacturer data. Performance criteria as per CODC Standards that references TP10 and therefore minimum 75% TSS removal efficiency.

6.3. Catchment 1 Management

Catchment 1 encompasses the higher-elevation areas of the Development, generally above the 203 mRL FSL contour. For this catchment (24.42 ha), stormwater is proposed to be disposed of via in-ground soak pits, which is consistent with established practice in Cromwell for properties at this elevation.

Based on information provided by Landpro, it is understood that traditional Caudwell pits (6 m deep with 1 m of cover) have been used historically in Cromwell for soakage disposal. Based on soakage infiltration testing reviewed by Landpro Ltd and, the infiltration rate at RL 196 was found to be minimal. By adopting the 203 mRL FSL contour as the upper catchment boundary, the base of soak pits within Catchment 1 will not be below approximately RL 196, providing confidence that soakage will perform as required. Furthermore, test pits as discussed in the geotechnical report by Insight Engineering show the material in this area to be sandy gravels with cobbles and other course-grained material that is generally well draining. Site specific testing will be required for detailed sizing of disposal pits.

Note it is understood that it may be possible to extend the in-ground soakage area if alternative soak pit systems (not requiring the same depth as traditional Caudwell pits) are adopted. However, the current design conservatively reticulates Catchment 2, ensuring the worst-case is addressed.

6.3.1. Water Quality Management

All buildings within the Development are to incorporate low-contaminant generating roofing and spouting materials (e.g. colour-steel, zinc-free materials) to minimise contaminant generation at source across all zones.

This catchment will adopt an at-source treatment approach utilizing a toolbox of stormwater management devices specific to the characteristics of each catchment area. This approach prioritizes treating runoff as close to its source as possible before discharge to the receiving environment.

Treatment devices will be selected from the stormwater toolbox based on site-specific constraints, land use characteristics, contaminant generation potential, available space, and integration with the development layout. Final device selection for each catchment area will be determined through detailed design in consultation with CODC, with specific devices and supporting design calculations documented in the Stormwater Treatment Toolbox appended to this report.

The stormwater management approach for the entire development is summarised in Section 7.5.

6.4. Catchment 2 Management

Catchment 2 encompasses the lower-elevation areas of the Development (92.19 ha), generally below the 203 mRL FSL contour, where soakage is not feasible. For this catchment, stormwater will be collected via a reticulated piped network and conveyed to appropriate treatment devices and a point of discharge.

6.4.1. Water Quality Management

The stormwater management strategy for Catchment 2 is divided into four zones, Zone A through D, based on the nature of the receiving environment and the proposed treatment approach for each area. The delineation of the stormwater management zones is detailed in Table 7 and Figure 6.

All buildings within Catchment 2 of the development are to incorporate low-contaminant generating roofing and spouting materials (e.g. colour-steel, zinc-free materials) to minimise contaminant generation at source across all zones.

Table 7: Catchment 2 Stormwater Management Zones

Catchment	Area	Land use	Description
Zone A	40.30 ha	Residential	Zone A covers the central portion of the Development and is characterised by a central conveyance channel running roughly east-west through the site. Runoff from adjacent residential catchments is discharged into the central conveyance channel.
Zone B	27.99 ha	Residential	Zone B covers residential areas and the immediate lakefront precinct that do not drain to the central conveyance channel. Stormwater runoff will be conveyed via the piped reticulation network directly to the discharge location into the lake.
Zone C	10.44 ha	Commercial	Zone C covers the commercial and mixed-use precincts of the Development, including the neighbourhood centre, preschool precinct, and lakeside commercial areas
Zone D	9.29 ha	Residential	Zone D covers the eastern residential area of the Development adjacent to the SH6 landscape buffer. Zone D stands as an isolated catchment where stormwater runoff will be conveyed via the piped reticulation network directly to the stream.

The stormwater management across Catchment 2 is further discussed in the subsequent sections and summarised in Section 6.6.

6.4.1.1. Zone A (Catchment 2)

Zone A covers the central portion of the Development and is characterised by a central conveyance channel running roughly east-west through the site. Runoff from adjacent residential catchments is intercepted by vegetated swales along both banks of the central conveyance channel before discharge into the channel.

Landpro Ltd has confirmed that the stormwater reticulation can discharge to the proposed swale locations within Zone A. To facilitate this, the invert level of the central conveyance channel has been lowered by 0.74 m to ensure that the vegetated swales can drain into it.

Six vegetated swales (Swales 1 through 6) are proposed, each serving a discrete sub-catchment as shown in the Swale Catchment Plan (Figure 7). Swales 3 and 5 are located along the north bank of the central conveyance channel, and Swales 1, 2, 4, and 6 are located along the south bank.



Figure 7: Swale Catchment Plan

Vegetated swales are the primary water quality treatment device for Zone A. The swales will be sized to convey the water quality design flow in accordance with appropriate design standards, based on a design rainfall intensity of 10 mm/hr. The indicative swale design parameters are included in Table 8.

Table 8: Vegetated Swale Sizing

Parameter	Value
Slope	1%
Base width	2.0 m
Top width	5.0 m
Depth	0.3 m
Side slopes	1V:5H
Design rainfall intensity (water quality flow)	10 mm/hr (Water Quality Flow)
Target contaminant removal efficiency	Minimum 75% (Best Practicable Option)

The design will target a minimum 75% contaminant removal efficiency, consistent with the BPO under appropriate design standards. The final contributing catchment areas to each swale are subject to confirmation following completion of the detailed stormwater pipe network design by Landpro Ltd.

6.4.1.2. Zones B – D (Catchment 2)

Where runoff is not being treated communally via the vegetated swales (Zones A), the Development will adopt an at-source treatment approach utilizing a toolbox of stormwater management devices specific to the characteristics of each catchment area. This approach prioritizes treating runoff as close to its source as possible before discharge to the receiving environment.

Treatment devices will be selected from the stormwater toolbox based on site-specific constraints, land use characteristics, contaminant generation potential, available space, and integration with the development

layout. Final device selection for each catchment area will be determined through detailed design in consultation with CODC, with specific devices and supporting design calculations documented in the Stormwater Treatment Toolbox appended to this report.

6.4.2. Alternative Approach

Where adequate pipe cover cannot be achieved, alternative stormwater treatment approaches may be adopted, including roadside channels, tree pits, catchpit filters, or proprietary treatment devices. Proprietary devices may also be suitable for areas with higher contaminant generation, subject to stakeholder agreement.

Where proprietary devices are not feasible or preferred, alternative treatment solutions such as tree pits, catchpit filters, or other compliant measures may be considered, depending on the final site layout, land availability, and approval requirements.

6.5. Primary and Secondary Networks

6.5.1. Primary Network Design

The primary stormwater network is to be designed to a minimum 10-year ARI, in accordance with the applicable Central Otago District Council (CODC) and National Engineering Design Standards (NZS 4404:2004 – refer 2008 Addendum) in effect at the time detailed design plans are prepared for Engineering Acceptance.

A preliminary pipe network been developed as part of the flood modelling exercise to demonstrate how primary flows are expected to be conveyed and is shown in Figure 8. Further discussion of the network design is provided in Section 7.5. The primary network design incorporates the following elements:

- A piped network with catchpits for stormwater collection;
- Swales (planted or grassed); and
- Soakage systems, where appropriate.

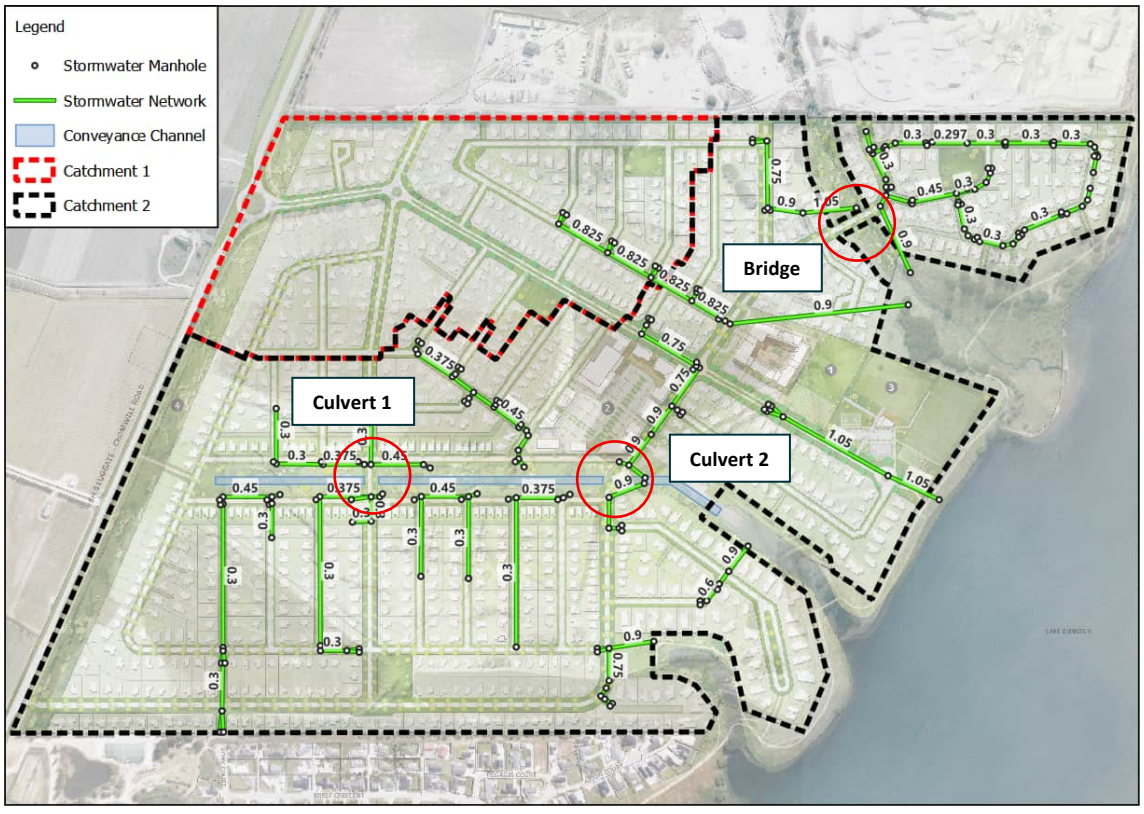


Figure 8: Preliminary stormwater pipe network

6.5.2. Culverts and bridges

As part of the overall conveyance strategy, two major culverts are proposed within the central drainage corridor (Figure 8). Culvert 1 measures 1.2mH x 4mW while culvert 2 measures 1.2mH x 6mW.

In addition to the culverts, a bridge is also proposed over the floodway to connect the northwestern part to the rest of the development.

The proposed conveyance infrastructure has been sized and modelled to convey the 100-year ARI storm event, inclusive of climate change allowance.

6.5.3. Secondary Network Design

Habitable floor levels will be set in accordance with NZS4404, with adequate freeboard above the design flood level.

The secondary flow, events greater than a 5-year ARI storm event and up to a 100-year ARI storm, will be conveyed along road corridors as overland flow paths. Overland flow path alignments will be dependent on the overall built environment and maintain existing discharge locations as far as practicable. As part of the overall design, large pipes and high-capacity catchpits will be incorporated into the network to ensure adequate drainage is achieved.

The overland flow paths should meet the following design criteria: Overland flow paths will be designed with sufficient capacity to accommodate the 100-year ARI storm event for the MPD, including RCP8.5 future climate change.

- They will be unobstructed, and convey runoff without creating significant hazards
- They will not create/exacerbate flooding at neighbouring properties.

Preliminary flood modelling has been provided in Section 8.

6.6. Stormwater Management Summary

The stormwater management approach for the entire development is summarised in Figure 9.

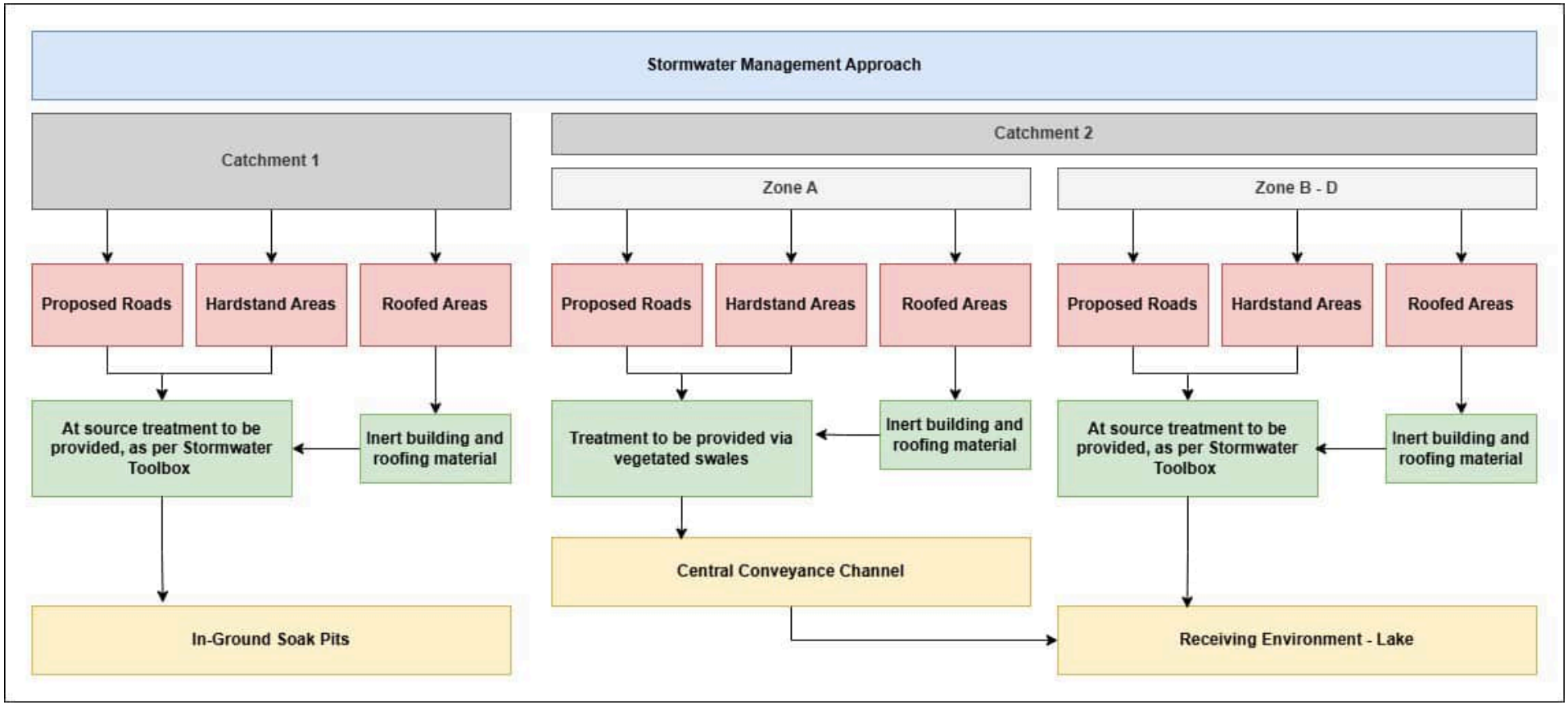


Figure 9: Stormwater Management Summary

7. Flooding and Overland Flow Paths

7.1. Modelling Summary

7.1.1. Hydrology Model

Using LiDAR and design surface provided by LandPro and GIS/SAGA tools, the contributing catchment to the site and adjacent areas were delineated. Using soils map data, curve numbers for the various subcatchments were assumed. Time of concentration for each subcatchment was calculated using the equal area method as adopted from ARC TP108. Rainfall depths (5, 10, and 100-year ARI events for 24-hour duration) for the area were extracted from HIRDS v4 (with allowance for future rainfall based on RCP8.5 projected to year 2100). Utilising the SCS methodology and using HEC-HMS, flows generated by each of the subcatchments were calculated. For the post development scenario, the internal (proposed site) subcatchments were delineated based on the design surface.

Hydrographs generated by the HEC-HMS models were used as inputs into the hydraulic method.

Refer to the model build report for additional details (Appendix C).

7.1.2. Hydraulic Model

For the hydraulic model, HEC-RAS (v7) was used. The LiDAR and design surface was used to create a digital elevation model to route the flows through the catchment. The neighbouring site to the north of the proposed development site is also to be developed by third parties and based on conversation with the consultant (Bonisch – correspondence in Appendix D), it is understood that that the drainage corridor through that site is to be altered. The existing corridor, which is linked to the development site, measures approximately 200m and will be constricted to approximately 40m. In building the HEC-RAS model, the surface in neighbouring site was modified to create the smaller corridor.

As noted previously, hydrographs calculated from the HEC-HMS model were used as direct inputs (inflow boundary conditions) to the hydraulic model. Various Manning's coefficients were applied for the different land covers within the catchment. The downstream boundary was set based on the projected Lake Dunstan / Te Wairere levels (information from Contact Energy which operates the lake) and set at 196.5mRL. The model domain was characterised by grids of varying sizes from 5m x 5m (within the development area) to 25m x 25m (in the wider catchment). Breaklines were applied along streams corridors, channels and stop banks (also with smaller grid sizes) for better model representation.

For the post-development scenario, two models were built, (1) for the wider catchment and (2) for the internal/site catchment.

As shall be discussed below, the internal/site catchment model is more detailed to allow for analysis of flows within the site. For this exercise, a cutdown site model was created. The development was broken down into internal subcatchments and flows generated from these subcatchments were introduced into the hydraulic model. The grid was further refined to 2m x 2m to better capture flooding behaviour. The model also incorporates pipe networks to ensure the potential ponding zones are drained. It is noted that external boundary conditions were extracted from the wider catchment model for use in the cutdown model. For the 100-year ARI run, pipes less than 600mm were not included to mimic blockage conditions which is deemed conservative. High-capacity inlets were incorporated to increase/improve collection and conveyance of runoff.

Additional details provided in the model build memo (Appendix C).

7.2. External Flooding

Two catchment wide models were created i.e., pre and post development. As discussed above, the Bonisch site to the north is being redeveloped and as part of that development, the floodplain is to be reduced, and this was incorporated into the post development model surface. Figure 10 and Figure 11 show the pre and post development results respectively.

The results indicate that for the 100-year ARI event (plus RCP8.5) the reduced corridor within the Bonisch site does not create a negative flooding effect at the property further north (Figure 12 and Figure 13). At the Parkburn Development site, it has been observed that the flows will be contained within the existing corridor without overtopping in the proposed development areas (Figure 14).

It should be noted that for the post development model, the catchment wide model does not incorporate the proposed pipe network within the site. Therefore, flood levels within the site have been assessed using the internal model as discussed in section 7.3.

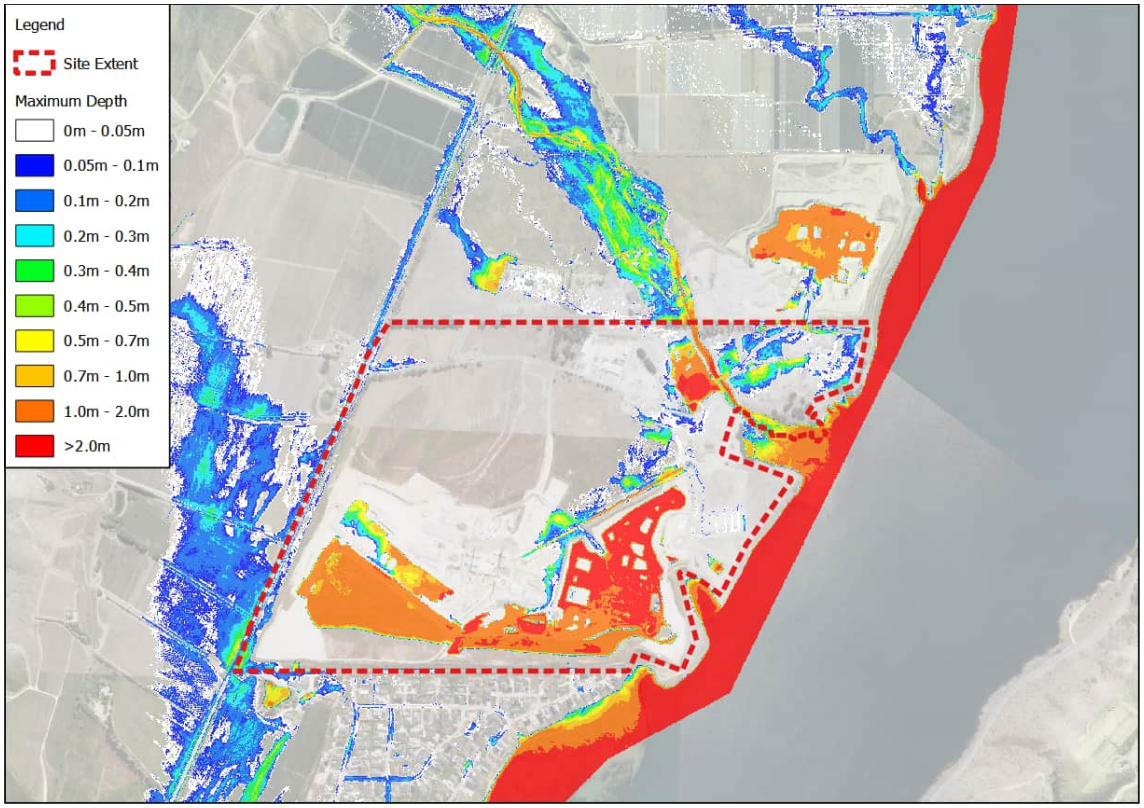


Figure 10: Predevelopment 100-year ARI RCP8.5

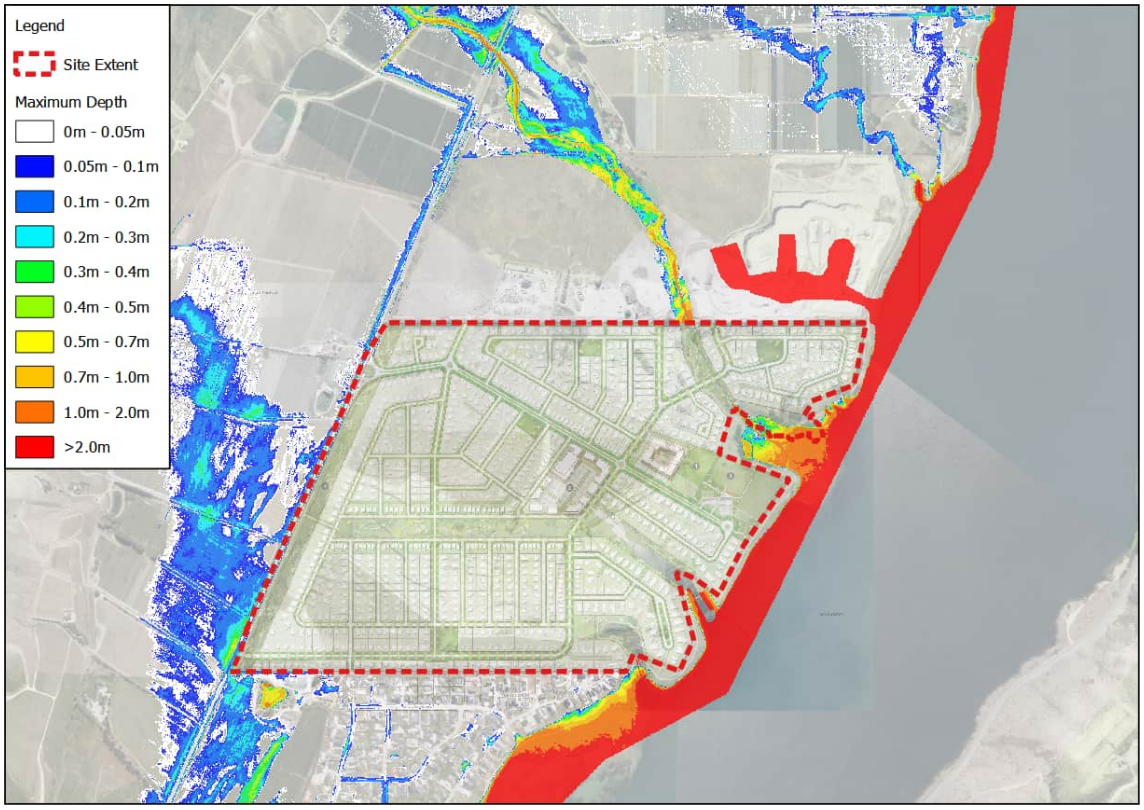


Figure 11: Post development 100-year ARI RCP8.5

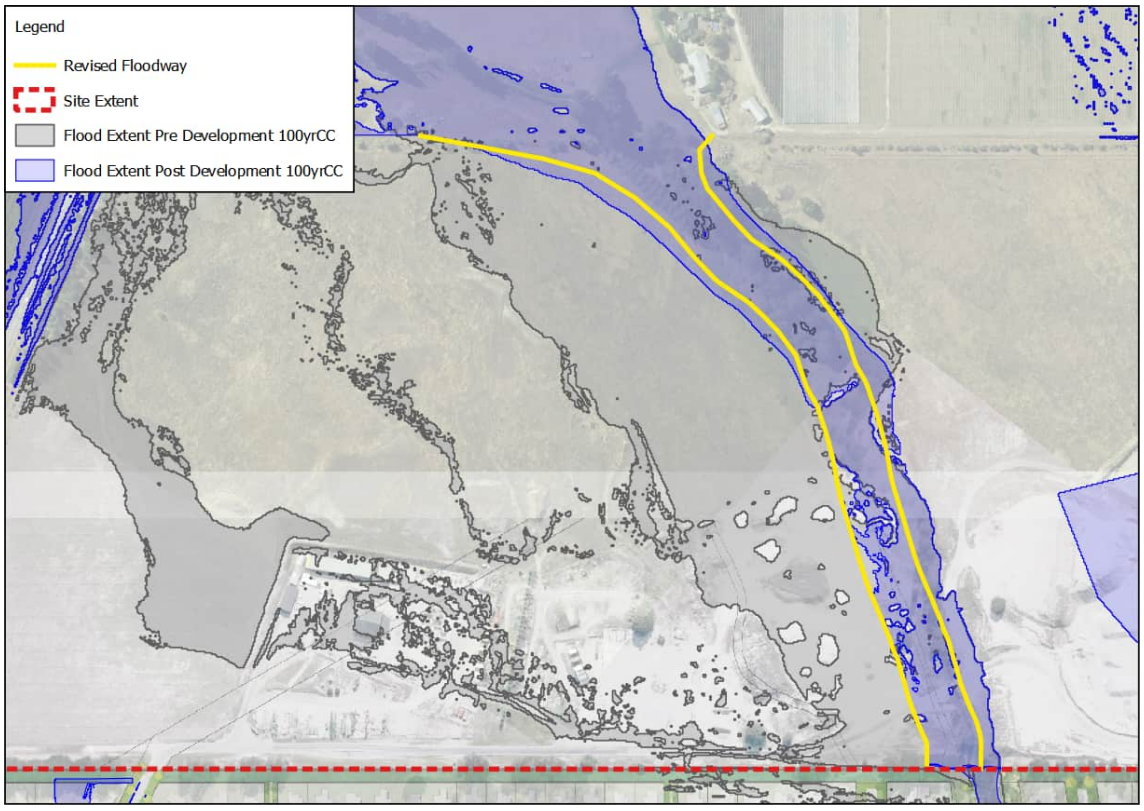


Figure 12: Flooding upstream Bonisch Site

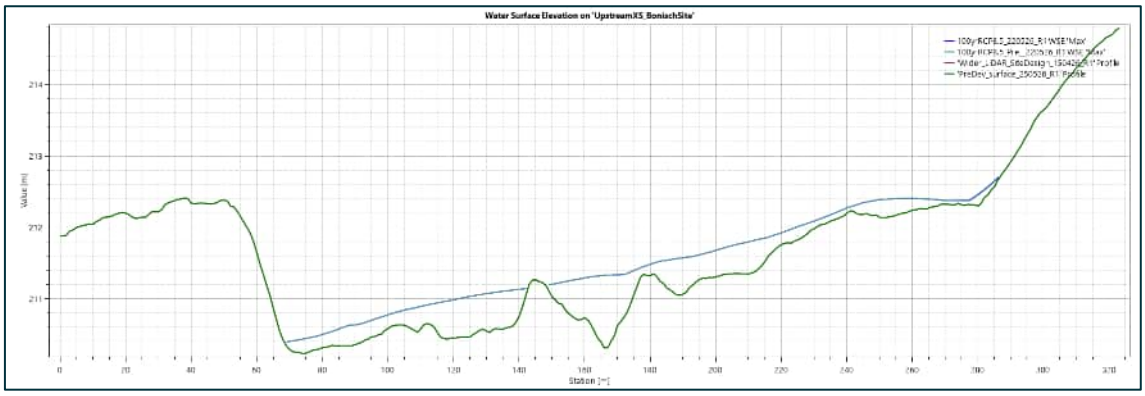


Figure 13: XS upstream Bonisch Site

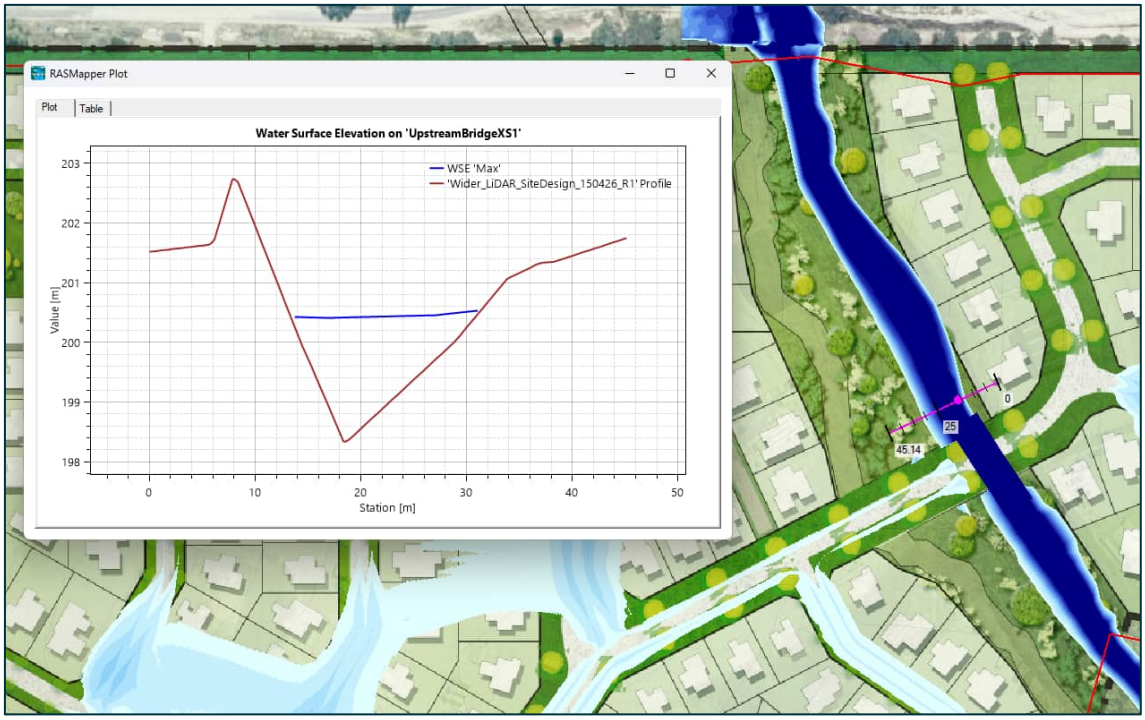


Figure 14: Flooding within Parkburn Site along corridor

7.3. Internal Flooding and Overland Flow Assessment

As previously noted, a cutdown model was created for assessing flooding behaviour for the 5-year, 10-yearand 100-year ARI (with RCP8.5). As shown on Figure 15, Figure 16 and Figure 17, for all the events, the flooding is mainly contained within the road corridors and central drainage corridor. While some inundation has been observed on some of the lots, it is expected that in the detailed flood model when the full pipe network (and soakage where it is proposed), lot inundation will be reduced. For those lots where the 100-year ARI levels cannot be reduced by the network (general assumption that most of the pipe network is blocked), adequate finished floor levels will be recommended.

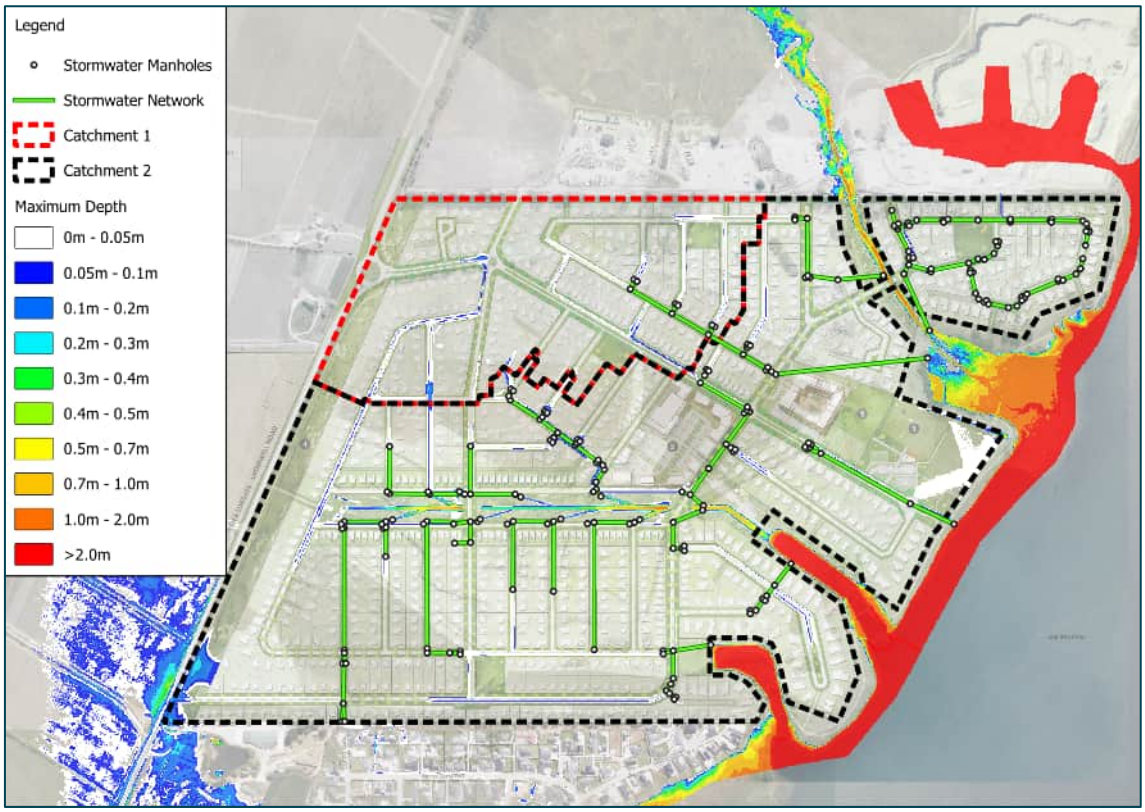


Figure 15: 5-year ARI internal flooding



Figure 16: 10-year ARI internal flooding

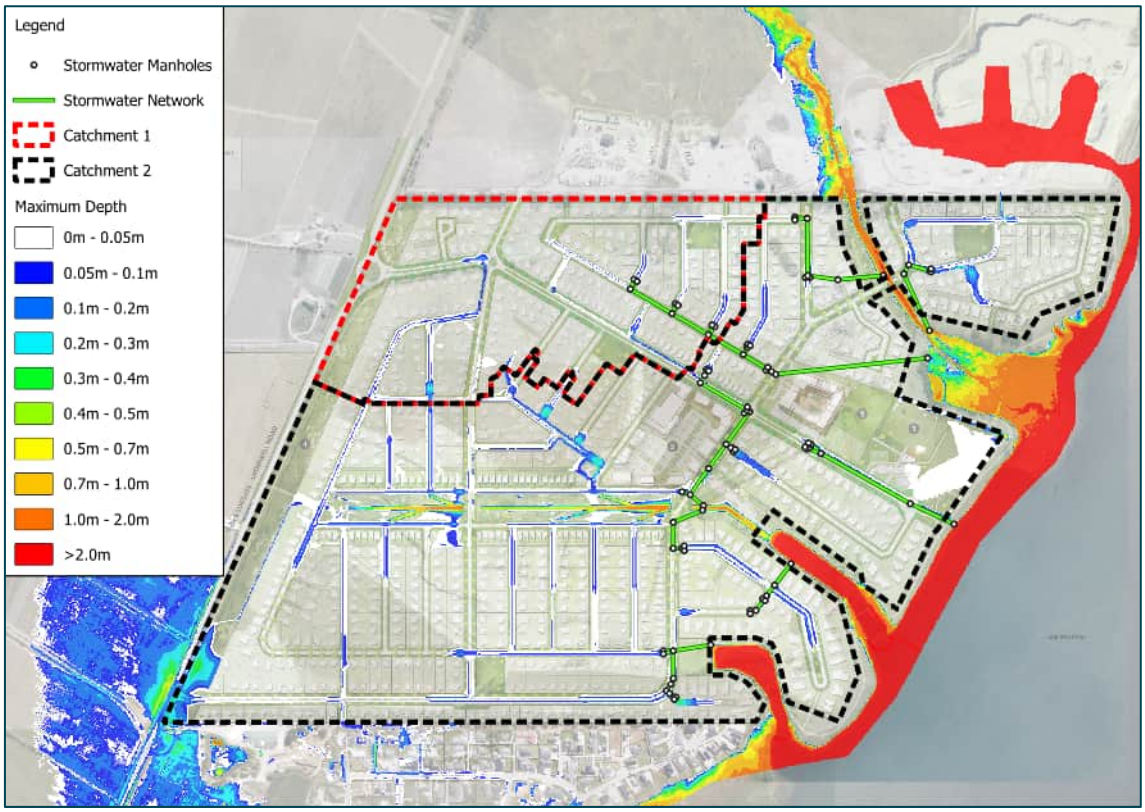


Figure 17: 100-year ARI internal flooding

7.3.1. ARR Hazard Assessment

A hazard assessment using the Australian Rainfall Runoff (ARR) Flood Hazard classification has been undertaken. This is a nationally recognised quantitative assessment tool that utilises modelled depths and velocity to identify areas of risk. It classifies flood hazards vulnerability into six categories as follows:

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles.
- H3: Unsafe for vehicles, children and the elderly.
- H4: Unsafe for vehicles and people.
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6: Unsafe for vehicles and people. All building types considered vulnerable to failure.

Figure 18 and Table 9 respectively, show the flood hazard vulnerability curves and criteria.

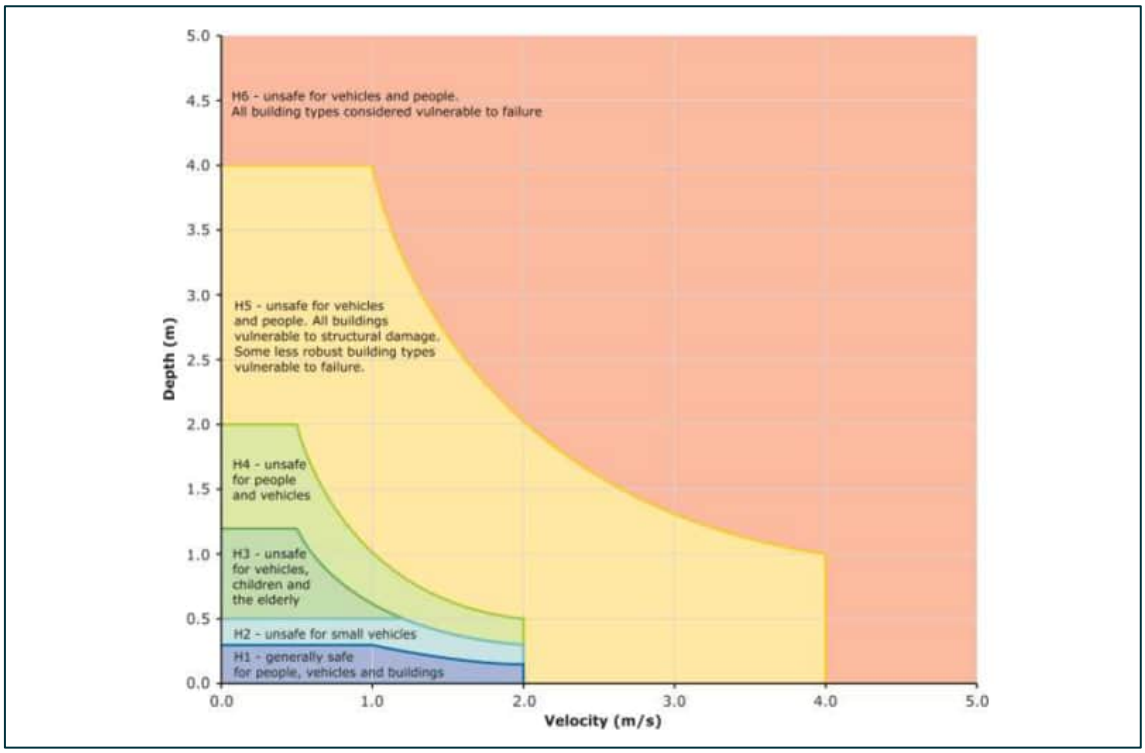


Figure 18: ARR flood hazard vulnerability curves

Table 9: Hazard Curves – vulnerability thresholds classification limits

Hazard Vulnerability Classification	Classification limit (D & V in combination) m2/s	Limiting Still Water Depth (D) m	Limiting Velocity (V) m/s
H1	D*V≤0.3	0.3	2.0
H2	D*V≤0.6	0.5	2.0
H3	D*V≤0.6	1.2	2.0
H4	D*V≤1.0	2.0	2.0
H5	D*V≤4.0	4.0	4.0
H6	D*V>04.0	-	-

Results for the 100-year are shown on Figure 19 and indicate that within the development (along the road corridors), the maximum hazard identified is H1. Hazards exceeding H1 have only been noted along drainage corridors thus do not pose an immediate danger to future occupants. Based on the modelling assumptions and preliminary designs, the hazards are considered acceptable.

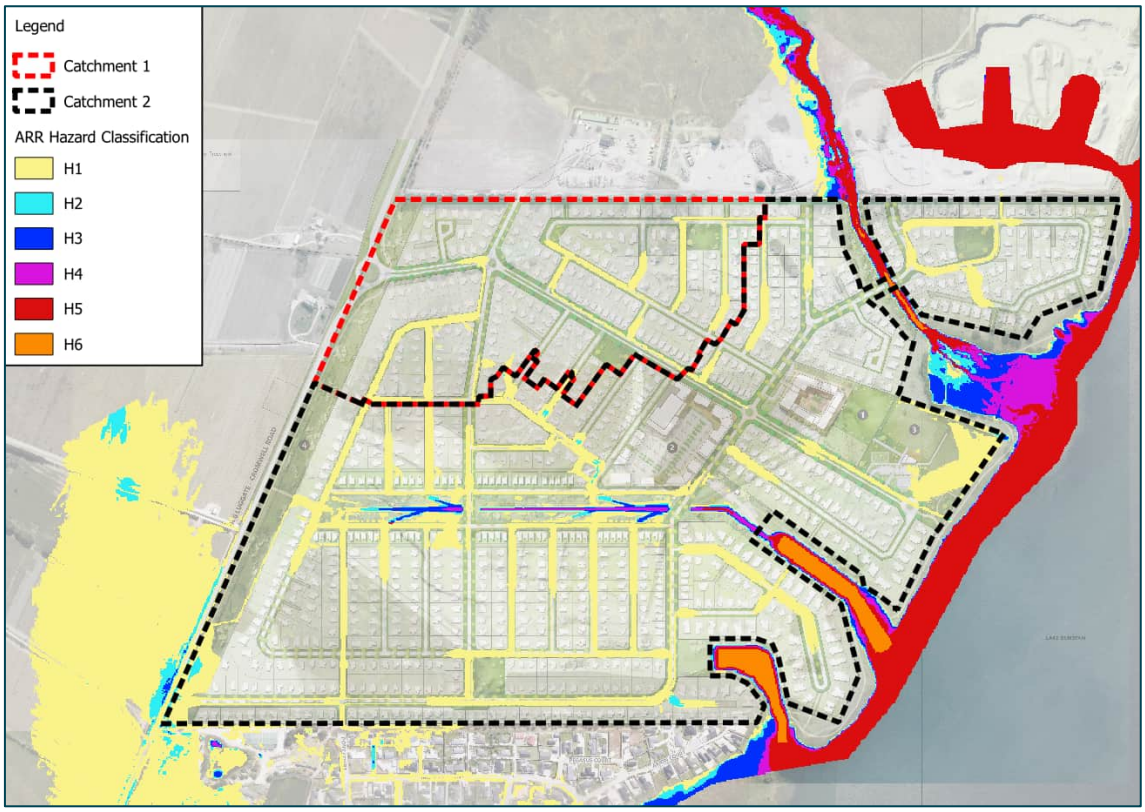


Figure 19: 100-year ARI ARR Hazards

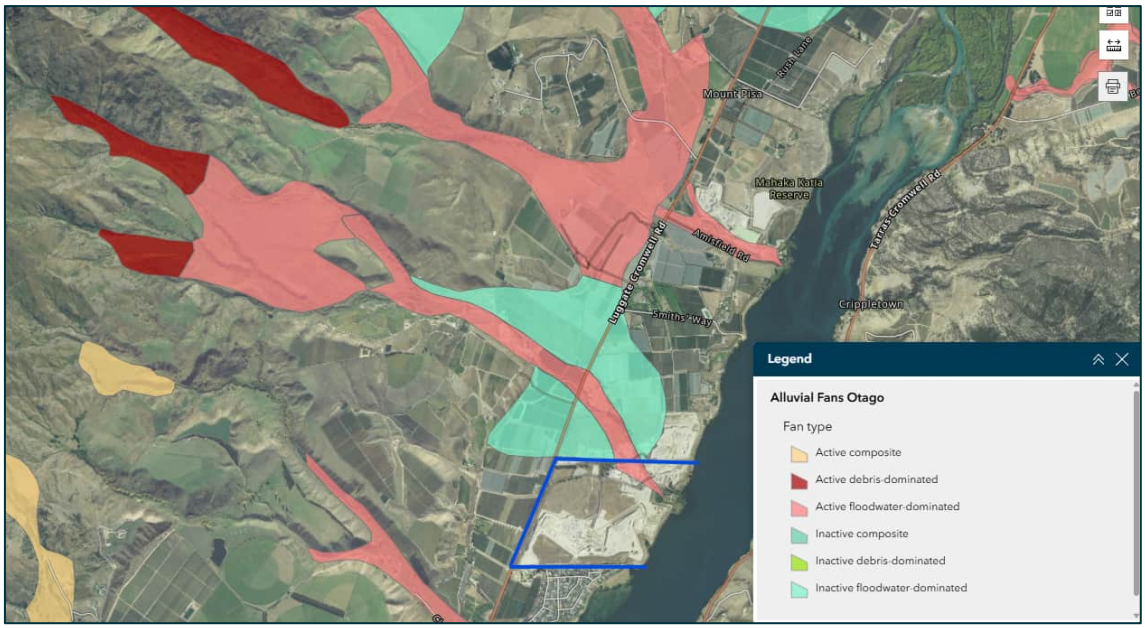
7.3.2. Required Finished Floor Levels

As per CODC Engineering Standards and NZS 4404:2004, habitable building floor levels are required to include a minimum freeboard of 0.5 m above the computed top water level for the 1% AEP (100-year) design stormwater event (including climate change allowance).

8. Alluvial Fan Hazards

The Otago Regional Council alluvial fan mapping has identified that a small portion of the development is overlaid by a 'active floodwater dominated' fan which extend from Mount Pisa to Lake Dunstan / Te Wairere (Figure 20). Further uphill (more than 5km from the development site) are smaller 'active debris dominated fans' which for the purpose of this report are not considered to potentially affect/inundate the development with debris.

The portion of the fan noted on the site, is within an existing drainage corridor. A high-level assessment was conducted to determine whether very extreme flood flows might have a negative impact on the development. For this, the 100-year ARI was bulked up three times (as this is floodwater dominated, no allowance for sediment/debris being carried from the hills was accounted for) and routed through the site using the previously constructed flood model. It was determined that even at these extreme flows (and with the reduction of the floodplain in the Bonisch site) the runoff is contained within the revised drainage corridor. Figure 21 shows the extents of the 100-year and the of the 3 x 100-year. Figure 22 and Figure 23 shows the upstream and downstream cross sections within the development site, respectively, where the terminal point of the alluvial fan is shown.


Mount Pisa
Mahaka Kaita Reserve
Cromwell Rd
Cromwell Rd
Smiths Way
Cromwell Rd
Cromwell Rd
Cromwell Rd

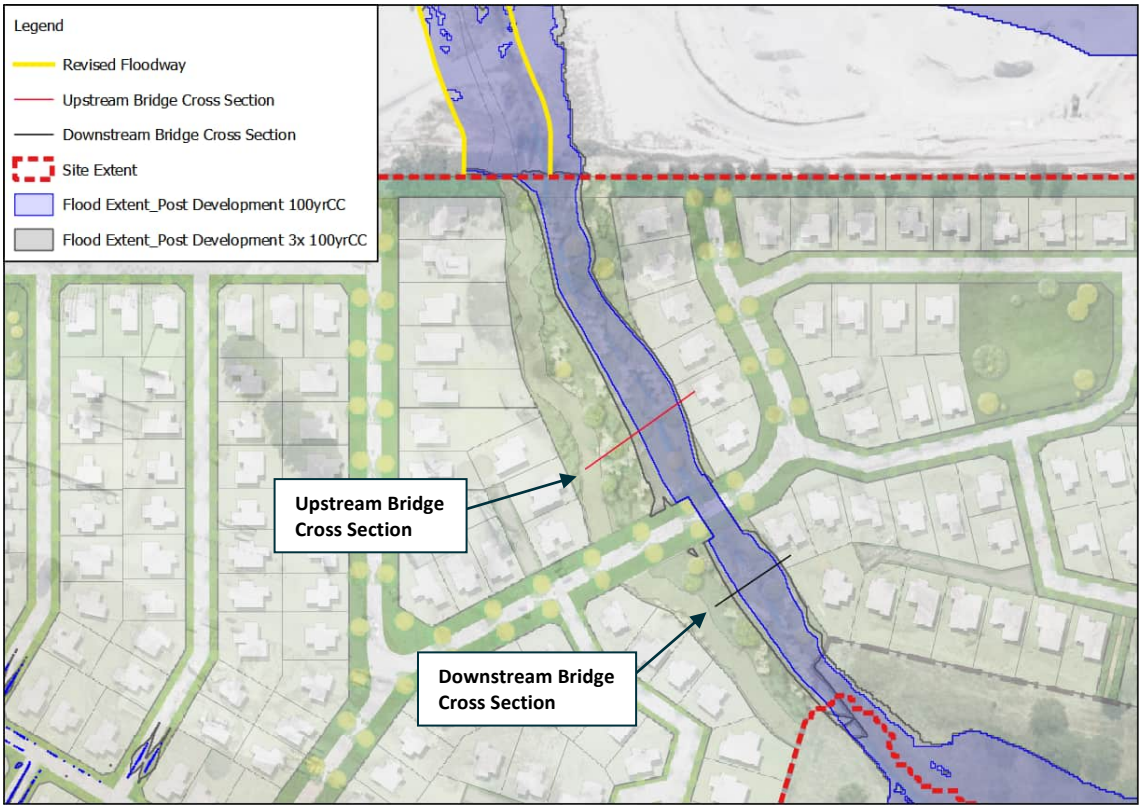


Figure 21: Extreme flood levels through drainage corridor

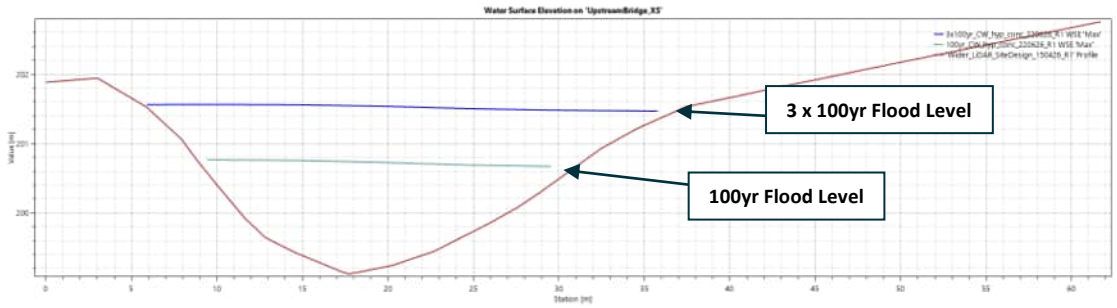


Figure 22: Upstream flood levels (1x100yr vs 3x100yr events)

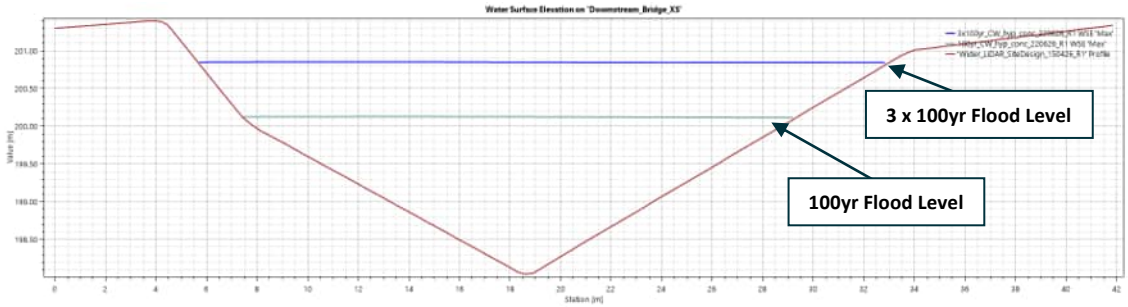


Figure 23: Downstream flood levels (1x100yr vs 3x100yr events)

9. National Policy Statement: Natural Hazards

The National Policy Statement for Natural Hazards 2025 (NPS-NH) was notified on 18 December 2025 and came into force on 15 January 2026. It is made under the Resource Management Act 1991 (RMA) and establishes national direction for managing natural hazard risk associated with subdivision, use, and development. Of direct relevance to this Stormwater Management Plan, the NPS-NH applies to flood hazard risk and requires that this risk be assessed and managed in a proportionate manner for all new subdivision, use, and development.

The NPS-NH establishes a risk matrix framework (Figure 24) that characterises flood hazard risk by combining the likelihood of a flood event with its potential consequences for life and property. Likelihood is assessed by reference to annual exceedance probability (AEP) and average recurrence interval (ARI), and consequence is assessed across five levels from Negligible to Catastrophic. Together, these determine whether the overall level of risk is Negligible, Low, Medium, High, or Very High. Where risk is assessed as Very High, development must be avoided. Where risk is assessed as Medium or High, it must be avoided or mitigated proportionate to the level of risk, having regard to the cost-effectiveness of mitigation measures. The NPS-NH also requires that the potential impacts of climate change to at least 100 years into the future be considered in any risk assessment, and that decisions be made on the basis of the best available information, even where that information is uncertain or incomplete.

The Parkburn site is subject to flood hazard risk from two primary sources:

a) Overland flow and fluvial flooding associated with the Park Burn, which flows through the northeastern corner of the site before discharging to Lake Dunstan / Te Wairere; and

b) Potential inundation associated with the alluvial fan hazard zone of the Park Burn, as identified by the Otago Regional Council. Each source has been assessed within the NPS-NH risk framework as set out below.

Consequence Level	Likelihood Level						
	Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

Figure 24: NPS-NH Risk Matrix Framework

9.1. Fluvial and Overland Flow Hazard

Flood hazards associated with Park Burn and overland flow paths across the site have been assessed using a two-dimensional HEC-RAS hydrodynamic model, as described in Section 8. The model was developed using LP2000 and NZVD16 survey data from Landpro Ltd, dated April 2026, with design rainfall derived from NIWA HIRDS V4. The RCP8.5 climate change scenario has been applied for the 100-year planning horizon, in accordance with CODC and ORC guidance.

The external flood modelling results, presented in Section 8.2, show that flood flows from the wider Mount Pisa catchment are contained within the existing drainage corridor for the 100-year ARI event, including climate change, and do not overtop into the proposed development areas. The post-development model, which includes the reduced floodplain within the neighbouring Bonisch site, confirms that the proposal does not cause adverse flooding effects on upstream properties.

The internal flood modelling results, presented in Section 8.3, show that flooding during the 5-year, 10-year, and 100-year ARI events, including climate change, is generally contained within the road corridors and central drainage corridor. The ARR hazard assessment for the 100-year ARI event indicates that the maximum flood hazard classification within the development area, including road corridors, is H1, which is generally safe for vehicles, people, and buildings. Higher hazard classifications are limited to drainage corridors and do not directly affect habitable building areas.

Based on the NPS-NH consequence and likelihood framework, the overall flood hazard risk across most of the development site is assessed as low to negligible. Minimum finished floor levels have been set 0.5 m above the computed 1% AEP flood level, including climate change, in accordance with CODC Engineering Standards and NZS 4404:2004.

The proposed stormwater management system, including the central conveyance channel, primary pipe network, secondary overland flow paths within road corridors, and upgraded culvert crossings, is designed to improve conveyance and maintain or reduce flood levels compared with the pre-development scenario. This is consistent with the NPS-NH requirement to avoid increasing flood risk on other land.

9.2. Alluvial Fan Hazard

ORC alluvial fan mapping identifies a small portion of the northeastern development area as being within an active, floodwater-dominated fan. This area coincides with the existing drainage corridor.

As described in Section 8, an extreme flow sensitivity assessment was undertaken using three times the 100-year ARI design discharge. The results show that flows remain contained within the revised drainage corridor and do not inundate the proposed development platforms.

The proposed layout avoids habitable buildings within the mapped active alluvial fan area. The corridor is instead used for infrastructure and open space, with channel improvements and upgraded culvert crossings providing a defined flow path to Lake Dunstan / Te Wairere.

9.3.Climate Change

The NPS-NH requires that climate change effects be considered to at least 100 years into the future as part of any flood hazard risk assessment. The flood modelling described in Section 8 incorporates climate change projections based on NIWA HIRDS V4 using the RCP8.5 high-emissions scenario projected to year 2100. This represents the upper range of plausible future rainfall intensification and has been applied to assess flood hazard risk for the full 100-year planning horizon, consistent with the NPS-NH requirement and CODC and ORC guidelines.

The minimum FFLs to be specified following completion of the detailed internal flood model will incorporate the climate change-adjusted 1% AEP flood level, providing resilience over the lifetime of the proposed development consistent with the NPS-NH.

9.4. NPS:NH Summary

The flood and alluvial fan hazard assessment demonstrates that the proposed Parkburn Development can be achieved in a manner consistent with the NPS-NH 2025. The key findings are summarised below:

- Flood hazard has been assessed using a two-dimensional HEC-RAS hydrodynamic model, with design rainfall derived from NIWA HIRDS V4 and RCP8.5 climate change projections applied to the 100-year planning horizon.
- The NPS-NH risk framework has been applied to the proposed residential and mixed-use activities. Flood hazard risk across the development platforms is assessed as low to negligible, with no very high risk areas identified within the proposed habitable development footprint.
- The ARR hazard assessment for the 100-year ARI event confirms that flood hazard within road corridors is generally classified as H1. Higher hazard categories are confined to drainage corridors.

- Minimum finished floor levels will be set 0.5 m above the 1% AEP flood level, including climate change, to manage residual risk for habitable buildings.
- The proposed stormwater infrastructure has been designed to maintain or reduce flood levels on upstream and downstream properties relative to the pre-development scenario.
- The alluvial fan hazard has been considered in the development layout. Habitable buildings are located outside the active fan corridor, and the extreme flow assessment confirms that flows remain contained within the revised drainage corridor.

On this basis, flood hazard risk has been assessed and managed in a proportionate manner appropriate to the scale, nature, and location of the proposed development. The proposal is therefore considered consistent with the relevant requirements of the NPS-NH 2025.

10. National Policy Statement – Freshwater Management

The National Policy Statement of Freshwater Management 2020 (NPS-FM) came into effect in September 2020 and provides local authorities with direction on how to manage freshwater under the Resource Management Act 1991. The NPSFM is a first step to improve freshwater management at a national level. The previous NPS-FM released in 2014, revised in 2017 and amended in 2025, sets out an objective and outlines policies for freshwater management.

The objective of the NPS is to ensure that natural and physical resources are managed in a way that priorities:

a) The health and well being of water bodies and freshwater ecosystems

b) The health needs of people (such as drinking water)

c) The ability of the people and communities to provide for their social, economic and cultural well-being, now and in the future

The policies include:

- Managing freshwater in a way that gives effect to Te Mana o te Wai
- Actively involving Tangata Whenua in freshwater management (including decision-making processes), and Maori freshwater values identified and provided for.
- Managing freshwater in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects of the receiving environments
- Managing freshwater as part of New Zealand's integrated response to climate change
- Managing freshwater to ensure health and well-being of water bodies and ecosystems is maintained/improved
- Protection of habitats of indigenous species
- Monitoring of conditions of water bodies and freshwater ecosystems systematically over time

In this project, effect is given to these policies via the design approaches adopted which include but not limited to the following:

- Consultation with mana whenua has been undertaken as part of the broader resource consent process. Matters relevant to freshwater values and Te Mana o te Wai have been considered through the Cultural Impact Assessment prepared in support of the application
- Working with the topography adjacent to the lake ensuring minimal impact
- The stormwater and flood modelling incorporates climate change projections using the RCP8.5 high-emissions scenario projected to year 2100, consistent with the NPS-FM requirement to manage freshwater as part of New Zealand's integrated response to climate change.
- Design of coves allowing access to the lake for the community

- The stormwater management strategy prioritises the health of Lake Dunstan/ Te Wairere as the primary receiving environment. Stormwater quality treatment is provided across all catchments prior to discharge.

On this basis, the proposed stormwater management strategy is considered consistent with the relevant policies and objectives of the National Policy Statement for Freshwater Management 2020.

11. Conclusion

The proposed stormwater management strategy for the Parkburn Development provides a practical, site-responsive, and risk-proportionate approach to managing stormwater across the site.

The strategy recognises the varying drainage conditions within the development area. Higher parts of the site will manage stormwater through soakage where ground conditions allow, while lower areas will be serviced by a reticulated stormwater network with appropriate treatment prior to discharge. This approach responds to the site levels, ground conditions, proposed land use, and receiving environment.

Stormwater quality will be managed through a combination of source control, vegetated swales, and a toolbox of at-source and network-based treatment devices. Appropriate treatment is proposed in accordance with current best practice to ensure stormwater discharges are suitably treated before discharge towards Lake Dunstan / Te Wairere. This will protect the water quality of the receiving environment and avoid degradation associated with the proposed development. Final device selection and sizing will be confirmed at detailed design stage in consultation with Central Otago District Council.

The water quality outcomes will also be secured through proposed conditions of consent, including specific treatment standards and pre-development and post-development water quality monitoring. These conditions will provide a clear framework for confirming treatment performance and ensuring the ongoing protection of Lake Dunstan / Te Wairere.

Flood modelling confirms that the proposed development can be managed without creating adverse flooding effects on neighbouring properties. Flood flows from the wider Mount Pisa catchment are contained within the central drainage corridor, and internal overland flow paths are generally directed through road corridors and designated drainage areas. Finished floor levels will be set above the modelled 1 % AEP flood level, including climate change, to manage residual flood risk to habitable buildings.

The alluvial fan assessment also confirms that habitable development is located outside the active fan corridor, with infrastructure and open space proposed in areas where this form of use is more appropriate. This provides a risk-proportionate response to the mapped natural hazard setting.

Overall, the proposed stormwater management strategy represents the Best Practicable Option for the Parkburn Development. It provides for stormwater collection, treatment, conveyance, and disposal in a manner that supports the proposed land use change, manages flood and natural hazard risk, protects people and infrastructure, and provides appropriate water quality treatment before discharge to Lake Dunstan / Te Wairere.

On this basis, the stormwater management approach is considered appropriate to support the substantive Fast-track Approvals Act application.

Appendix A – RFI Response Table

Comment Date	Review Comments	Designer Response	Response From	Response Date
14-Jul-26	Provide sediment transport capacity from SH6 culverts through proposed development site. Further assessment information including potential for blockage at the narrowings or asymmetries present in the indicated floodway, and potential bypassing impact if structures are blocked by sediment/debris during a major event.	The SMP modelling (Appendix C, Section 5.0) assumes all watercourses and culverts remain fully operational, with no allowance made for sediment build-up or blockage. The potential for debris and sediment from the upper catchment has been identified in the Bonisch correspondence (Appendix D) as an issue requiring further investigation and would likely be covered in that application. It is worth noting that the proposed development at the Bonisch site does not extend to SH6 and the flood corridor which starts downstream of SH6 and traversing through 1034 Luggate-Crowell Road (north of the Bonisch site) is not altered. The reason for referencing the Bonisch site in the Parkburn application was to confirm how their likely proposal will interface with Parkburn and how the reduced corridor (on the Bonisch site) will influence the downstream flow characteristics.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide evidence of Contact Energy Ltd dam operating range and spillway levels. Consider using a conservative understanding of the Clutha Dam operation to apply to design boundary conditions for flood modelling. LandPro Page 9 "*reported daily fluctuation of approx. 750 mm (with a normal operating range of 193.5 to 194.5 m AOD*." What is Clutha Dam emergency spillway overflow operation level and PMF level (for context).	The downstream boundary condition in the hydraulic model has been set at a constant water level of 196.5 mRL, based on the projected future Lake Dunstan level provided by Contact Energy Ltd (refer to Appendix C). This level is conservative, as it is higher than Contact Energy's normal operating range for Lake Dunstan, which is approximately 193.5 mRL to 194.5 mRL (as reported by Landpro). Adopting an elevated downstream boundary ensures that the hydraulic assessment considers a higher tailwater condition, providing a conservative estimate of upstream water levels and flood extents. The information provided by Contact Energy is included in Appendix C and will be revisited during the next phase of design, where the downstream boundary conditions will be reviewed alongside the detailed design of the lake-edge infrastructure and outlet structures.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Figure 4 - show flowpaths and subcatchment areas. Include labelled contours. Combine info from LandPro contours.	Figure 4 as it curretly appears in the SMP refers to overland flow paths based on the existing surface. The requested figure i.e., that based on post development finished surface, is provided in Figure 3 in Appendix C (Model Build Report). The figure shows, contours, post development overland flows and delineated subcatchment	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	Provide cross sections or long sections of proposed cut/fill depths required to build site floor levels. Provide a few typical conceptual earthwork cross sections to indicate proposed finished levels relative to north/south boundaries, SH6 levels and lake levels. This to support the bulkearthworks plan view model outputs (LandPro drawings 113.01 to 113.19 EMP, Appendix A)	Bulk earthworks concept information is presented in the LandPro bulk earthworks plan view model outputs (Drawings 113.01 to 113.19, EMP Appendix A). The SMP does not currently include cross sections or long sections showing proposed cut and fill depths relative to site levels, SH6, and the lake. Typical conceptual earthworks cross sections will be prepared once the lot layout and finished floor levels have been confirmed, as part of the next phase of the earthworks and civil design, alongside the Insight Engineering geotechnical assessment.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide proposed areas for other land zoning: community centre, education, commercial, etc. A list or table of conceptual areas. This information to show relative runoff coefficients for different development land use areas.	SMP Table 6 (Section 6.4.1) identifies Zone C (10.44 ha) as covering the commercial and mixed-use precincts, including the neighbourhood centre, preschool precinct, and lakeside commercial areas, with the remaining zones being predominantly residential. The SMP has been prepared using the adopted land use assumptions appropriate for this stage of the project noting that a 60% imperviouness was adopted and given that some catchments have lower imperviouness the overall result is not expected signficantly vary. A land use area table with corresponding runoff coefficients will be provided once the masterplan land use areas are confirmed, to support refinement of the hydrology model at detailed design.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide typical details of a Caudwell Pit and include into typical Lot detail to indicate intended use. State the level of service the Caudwell pit will provide (justify a case for less than 1%AEP). Provide more conceptual details of soakage disposal over Catchment 1. Provide a typical conceptual detail of soakage disposal infrastructure for a private house lot and for public road corridor. State the intended level of service of the soakage infrastructure and discuss assumptions with regards to normal engineering constraints of groundwater, elevation, spatial footprint. Confirm that freeboard to floor levels is feasible. Describe assumed operation and maintenance responsibility and feasibility. Describe secondary overland flowpaths through Catchment 1 that provide freeboard assurance to building platforms.	Section 6.3 confirms that traditional Caudwell pits, typically 6 m deep with 1 m of cover, have historically been used in Cromwell for soakage disposal. It also explains that adopting the 203 mRL FSL contour as the Catchment 1 boundary keeps soak pit bases at or above RL 196, where infiltration testing indicates soakage will perform adequately. Testing below RL 196 showed minimal infiltration. Section 6.3 also notes that site-specific infiltration testing will be required to confirm the final sizing of soak pits. The information requested, including typical Caudwell pit details and integration within a representative lot layout, the proposed level of service, conceptual soakage arrangements for private lots and the road corridor, groundwater, elevation and spatial constraints, confirmation of floor level freeboard, operation and maintenance responsibilities, and secondary overland flow paths within	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	With all water quality management strategies - clarify assumed responsibilities for operations and maintenance of toolbox devices. Provide evidence of Council engagement and acceptance of the proposed stormwater treatment approach and device responsibility.	SMP Table 5 (Stormwater Management Toolbox, Section 6.2) identifies the intended ownership and maintenance responsibilities for stormwater devices, with private devices to be maintained by individual lot owners or the body corporate, and public devices by Council. Sections 6.3.1, 6.4.1.2 and the Conclusion (Section 11) also confirm that the final selection, sizing and operation and maintenance requirements for individual devices will be determined during the subsequent design phase in consultation with CODC. Operation and maintenance responsibilities for individual devices, together with formal confirmation of the proposed treatment approach by CODC, will be documented as part of the subsequent design phase in consultation with Council.	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	Provide conceptual design long section drawings of channel connectivity and show levels/gradients and context with Lake levels (typical and extreme). Indicate the effects of the 0.74m lowering of the central conveyance channel. Show how buried pipes connect to 6 shallow depth vegetated swales, and connect to corridor conveyance.	Section 6.4.1.1 confirms that the central conveyance channel invert has been lowered by 0.74 m to allow the six vegetated swales (Swales 1 to 6, shown in Figure 7) to discharge into the channel. This hydraulic connectivity has been confirmed by Landpro. Indicative swale design parameters, including base width, side slopes, and effective length, are provided in Table 7 and Appendix B. As the Stormwater Management Plan (SMP) does not include long sections showing channel and pipe connectivity, longitudinal gradients, or invert levels relative to typical and extreme Lake Dunstan water levels. These details will be developed as part of the detailed drainage design. For the hydraulic modelling completed to date, a conservative downstream boundary level of 196.5 mRL has been adopted for all model scenarios. This level represents a worst-case tailwater condition and is above the normal operating range of Lake Dunstan, ensuring the assessment is conservative. Long section drawings, together with confirmation of pipe and channel connectivity, invert levels, and longitudinal grades, will be prepared during the subsequent detailed design phase once the pipe network layout and associated contributing catchments have been finalised. Based on the preliminary pipe network incorporated into the primary event hydraulic model, runoff is conveyed through the drainage network to the outlet structures located at the inlets of the vegetated swales, demonstrating that the proposed drainage concept provides hydraulic connectivity to the downstream discharge points.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide a rationale for designing the primary network to 5 year ARI level of service with respect to best practice and climate change risk at this site. Confirm the proposed residential zoning - is the zone considered "rural residential" as per NZS4404?. Consider a 10 year ARI level of service to NZS4404 for rural residential areas (ref NZS4404, Table 4.1).	Section 6.5.1 confirms that the preliminary primary stormwater network assessment is based on 10-year ARI events (note that the SMP also covers the 5-year ARI assessment). The development is proposed as urban residential and mixed-use under the FTAA application, rather than rural residential. At the detailed design stage the network will be extended to the rest of the development (except for soakage areas) and the assessment updated accordingly.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide hydraulic calculations and hydraulic grade line through culverts and bridge to demonstrate appropriate sizing. Confirm the level of service of the culverts is 1%AEP. Show modelling that includes the structures and the flood levels in a 1%AEP post-development scenario.	Section 6.5.2 confirms that both culverts (Culvert 1: 1.2 m high × 4 m wide, Culvert 2: 1.2 m high × 6 m wide) and bridge have been sized and modelled to convey the 100-year ARI event (1% AEP), including the applicable climate change allowance. The associated hydraulic modelling results, including flood extents through the central drainage corridor, are presented in Appendix C and Appendix B (Figure 16 / Drawing DR0003). The detailed hydraulic grade line calculations and structure-specific design, including invert levels, headloss coefficients and scour protection, will be completed as part of the subsequent design phase.	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	Confirm freeboard assumptions. Provide a typical cross section of the road corridor and building platforms indicating freeboard allowances. Show a flood map from modelling output indicating flood extents in a 1%AEP event assuming pipelines are neglected/blocked as a conservative case.	Section 7.3.2 confirms that a minimum freeboard of 0.5 m above the modelled 1% AEP (100-year ARI) flood level, including climate change, is required for habitable floor levels in accordance with the applicable design standards. The hydraulic model already adopts a conservative assumption for the 100-year ARI event, with pipes smaller than 600 mm diameter in the conceptual/preliminary network design excluded from the model (Appendix C, Section 2.3.3) and high capacity inlets incorporated to transfer overland flows into the network. The resulting flood extents are shown in Figure 17 and Appendix B (Drawing DR0003). Note that the purpose of the preliminary design is proof of concept that the development can be drained. A typical cross section illustrating the proposed road corridor and building platform freeboard allowances will be prepared as part of the subsequent design phase, once the road and lot levels have been confirmed.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Confirm what software was used to model the pipelines and state how flood mapping was prepared on the proposed earthworks surfaces. 1D or 2D model software, was rain applied to grid or at 'catchment' injection points?	Section 7.1.2 and Appendix C, Section 2.0 confirm that HEC-HMS was used for the hydrology and HEC-RAS (Version 7) for the combined 1D/2D hydraulic modelling. The hydraulic model couples the preliminary 1D pipe network with a 2D surface model based on the proposed post-earthworks design surface, using a 5 m x 5 m mesh with a 2 m × 2 m computational grid refinement along road and drainage corridors (Appendix C, Sections 2.3.2 and 2.3.3). Rainfall runoff was generated in HEC-HMS for each subcatchment, with the resulting hydrographs applied as inflow boundary conditions at discrete loading nodes within the 2D model (Appendix C, Sections 2.3.1 and 2.3.3). This assesment is deemed appropriate at this stage. Further refinement of the hydraulic model, including updates to the 1D drainage network and inflow locations where required, will be undertaken as part of the subsequent design phase.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	State how blockage risk is proposed to be managed at catchpits, pipes, culverts and bridge. Discuss secondary overland flowpaths system.	Blockage risk within the pipe network has been conservatively represented in the 100-year ARI model by excluding pipes smaller than 600 mm diameter, with the exception of catchpit leads, and incorporating high-capacity inlets to improve surface flow collection under these conditions (Appendix C, Section 2.3.3). The culverts and bridge have been modelled as fully operational, consistent with the stated modelling assumptions and limitations (Appendix C, Section 5.0). Blockage management measures, including any requirements for debris control, maintenance access, or structure-specific treatments, will be developed as part of the subsequent design phase. As part of the detailed design, allowances will be made to maximise the size of the pipes (as far as compliant cover is maintained) and inlets to ensure localised ponding zones are minimised. Roads will function as secondary overland flow paths conveying runoff to the lake.	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	Provide working that shows the critical time of concentration for the Parkburn at the northern boundary of the site. Use a range of 3 or 4 ToC methods and justify the critical duration storm event. Using the ARC TP108 time of concentration method along with 3 other methods. Compare peak design discharge with other hydrology methods for context (for example, the Regional Flood Frequency method subject to catchment size considerations) Provide design hydrographs at boundary line including allowance for future-developed upstream residential area, narrowed flood flow channel, SH6 culverts blocked/unblocked (which may change the location of some of the overland flows?)	Appendix C, Section 2.2.2 confirms that the time of concentration for the external catchment subcatchments (46 to 146 minutes) was calculated using the SCS method in accordance with Auckland Council's TP108, adopted in the absence of a Central Otago-specific methodology. A comparison with alternative time of concentration methods is provided in the Model Build memo Appendix C of the SMP with a representative catchment used to calculate the runoff for comparision. The methods show a great variation in the times of concentration with the TP108 method falling in the average range. A representative catchment was used to calculate the runoff for comparision. For the purpose of this SMP, we are assessing specific rainfall events (i.e., 5, 10 and 100-year for a 24-hour duration) and determining whether the proposal can adequately conveyed the runoff from these events (primary and secondary). This duration has been selected given that it is the basis for the TP108 methodology for hydrology which has been adopted for this project. Separate boundary hydrographs representing variations in future upstream development or blocked and unblocked SH6 culvert scenarios have not been developed, as this level of sensitivity testing is beyond the scope of the SMP. Any additional hydrological sensitivity testing, including comparisons of time of concentration methods and refinement of boundary hydrographs where required, will be undertaken as part of the subsequent design phase to support the final design of the drainage corridor.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	State the top elevation of the Parkburn catchment and show profile of the catchment	Appendix C, Section 2.1 confirms that the model extends from the upper Mount Pisa catchment to Lake Dunstan, covering approximately 11 km. While the model extent is described, the SMP does not currently identify the top-of-catchment elevation or include a longitudinal catchment profile. SMP to be updated to include the top-of-catchment elevation and a longitudinal catchment profile extracted from the existing LiDAR and terrain data used to develop the hydraulic model.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Figure 2 catchment wide delineation model. State the sub-catchment areas in km2 or hectares draining through the proposed site. Label the subcatchments, indicate catchment connectivity to Parkburn. Show that Catchments 1,2,3,7 connect for Parkburn. Show how other catchments 4,5,6,8 drain through the Site to the Lake.	SMP has been updated to show catchments with respective flow arrows	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide full NIWA HIRDS design rainfall table for the site for RCP8.5. Show the nested temporal profile.	Include - Appendix C, Table 1 (Section 2.2.1) presents the adopted 24-hr rainfall depths for the 5-, 10- and 100-year ARI events under RCP8.5 (61 mm, 72 mm and 114 mm respectively), with a 24-hr nested Type 2A temporal distribution peaking at midday adopted for the analysis.	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	Provide typical details drawing of proposed private residential lot size and building platform size. Demonstrate 60% impervious surface inside residential lots is appropriate, using assumption of typical Lot drawing, showing full area and roof footprint assumptions	Model build memo updated regarding this assumption.	Pranil Wadan / Boniface Kinnear	23-Jul-26
14-Jul-26	Provide discussion of conservative CN=81 runoff scenario for upper elevation subcatchments of Parkburn. Minimal vegetative cover (ref: TP108, Table 3.3). What effect on peak channel design discharge and corridor width. Is the corridor width conservatively sized? Provide discussion.	The corridor is not part of the Parkburn development and is instead within the Bonisch site. It has been included in the Parkburn hydraulic assessment solely to assess the hydraulic interface between the two developments. The corridor geometry adopted in the model reflects the width specified by Bonisch, as documented in the correspondence included in Appendix D. For the upper catchments, a Curve Number (CN) of 60 was adopted, representing moderately drained soil conditions. This is considered an appropriate and conservative assumption based on the available information, which indicates that the adjacent low-lying areas comprise a range of soil drainage characteristics, with well-drained soils being the predominant condition.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Show 1%AEP rainfall event HGL and assess freeboard to building levels. Catchment 2, Zones A-D. Provide a typical conceptual design long section drawings of pipeline infrastructure relative to typical and extreme Lake operation levels and Parkburn hydraulic grade line flood levels. Demonstrate that buried pipelines will be clear of Lake levels and indicate proposed finished ground levels in all zones. Provide pipe outlet velocities and outlet details including scour protection especially for outlets into the Parkburn stream where sediment transport and erosion/deposition may	The internal 100-year ARI (1% AEP) model results (Figure 17, Appendix B, Drawing DR0003) show the predicted flood extents and depths across the site, including the road corridors, from which hydraulic grade lines and floor level freeboard can be assessed. Confirmation of compliance with the minimum 0.5 m freeboard requirement (Section 7.3.2) will be completed once the proposed finished floor levels have been confirmed. These elements will be developed as part of the subsequent design phase, when the pipe network design is finalised and the associated hydraulic and structural details are confirmed.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Indicate how SH6 and perimeter lots will drain to the Lake. What is proposed in southwest corner of development against SH6, where there is ponding shown. Any impacts on NZTA drainage?	The preliminary pipe network (Figures 8 and 9) shows stormwater being conveyed generally towards the central drainage corridor and the discharge points to Lake Dunstan. The SMP does not include the detailed drainage design for the SH6 frontage or perimeter lots, including the drainage arrangement for the ponding area in the southwest corner of the site adjacent to SH6, or the interface with the existing NZTA/Waka Kotahi drainage network. These aspects will be developed as part of the subsequent design phase, including consultation with NZTA/Waka Kotahi to confirm the proposed interface with the state highway drainage infrastructure.	Pranil Wadan / Boniface Kinnear	21-Jul-26

14-Jul-26	referring to Appendix B flood model results: 1. provide long section hydraulic grade line profiles of Parkburn and central corridor drainage lines. 2. provide velocity information in Parkburn at main cross sections. Identify if scour is to be mitigated. 3. provide discharge hydrographs at upstream property boundary, bridge and oputlet to Lake. State the peak design discharges from the model. 4. Indicate effects of Lake level changes on drainage and freeboard during typical and extreme lake levels 5. Describe concept bridge: lanes, span, abutment types, deck and soffit elevation, indicative scour protection, freeboard assessment. 6. Provide erosion and scour assessment, gradient, hydraulic gradient, including bridge, including delta, including variations in lake level, debris loading and sediment transport, conservative hydrology assessment, conservative Lake level assessment, cross section drawing showing side	1. To be provided at detailed design 2. To be provided at detailed design 3. To be provided at detailed design 4. Designs already based on extreme lake level of 196.5mRL as per Item#2 comment above . 5. To be provided at detailed design where cross sections will be derived and relevant levels and scour protection matters detailed. *6. Request clarification why all these items are required*	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Flood maps: show contours and water surface elevations, show velocity information, show a combined flood map of Parkburn through development into Lake delta. Provide more model outputs for context and assessment by CODC / ORC.	SMP has been updated to include	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	Provide design flow velocity in the proposed resultant Parkburn cross section. More alluvial fan hazard assessment is needed to consider potential effects and mitigations. A fan exists and debris or sediment entrained flow is likely. Assessment of flood levels in a 3x100yr event should extend to building platforms and discuss available freeboard within the subdivision lower levels. The channel cross section Figure 23 is artificial looking with triangular section. Show the modified Parkburn channel gradient, design peak flow, design velocity, and available buffer room for channel to move to manage debris into the delta and Lake edge. Is the sediment transport capacity relatively uniform, or are there constrictions that could cause localised deposition, blockage, and avulsion (flow leaving the channel and finding other pathways)	Section 8 confirms that the 3×100-year ARI sensitivity assessment demonstrates the proposed central drainage corridor has sufficient capacity to safely contain an extreme flow event, with all proposed habitable buildings located outside the active alluvial fan corridor (Figures 21 to 23). This represents a conservative assessment of the proposed corridor and is considered appropriate for establishing the required corridor width and confirming the overall development layout at the SMP stage. The conceptual channel cross-section presented in Figure 23 is intended to illustrate the proposed corridor arrangement with the channel regraded accordinly - please note the scale on Figure 23 is exagerated and the preliminary design has a gentler grade. The detailed design of the drainage corridor will further refine the channel geometry and associated erosion protection measures. This may include additional assessment of flow velocities, sediment transport, channel stability, lateral channel migration, debris loading and avulsion risk, where required to support the final design. These assessments will inform the detailed design of the corridor but are not necessary to demonstrate the suitability of the proposed corridor at the current planning stage.	Pranil Wadan / Boniface Kinnear	21-Jul-26
14-Jul-26	EMP information reviewed with the SMP. No comments on the EMP.			

Appendix B - Stormwater Devices

WOODS
Engineers. Surveyors. Planners.

Indicative Raingarden Design

PROJECT NUMBER:	P24-487
ADDRESS:	Parkburn
BY:	SB
DATE:	4/06/2026

Required Volumes

Impervious Area (m^2)	500
Soil Infiltration Rate (mm/hr)	2
Evapotranspiration Rate (mm/day)	3

Rain Garden Design Parameters

Surface Width (m)	2.50
Surface Length (m)	10.00
Ponding Area (m^2)	25.00

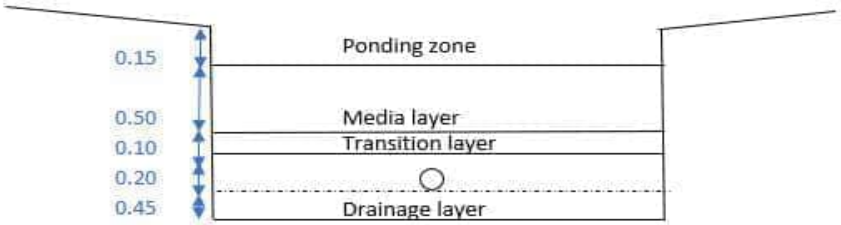
Ponding Depth (m)	0.15
Media Depth (m)	0.50
Transition layer Depth (m)	0.10
Aggregate Depth - above underdrain invert (m)	0.20
Aggregate Depth - below underdrain invert (m)	0.45
Infiltration Area Provided (m^2)	25.00

Media Void Space (%)	30%
Transition layer void ratio (%)	30%
Aggregate Void Space (%)	35%

Ponding Volume - Detention (m^3)	3.75
Media Volume - Detention (m^3)	3.75
Transition Volume - Detention (m^3)	0.75
Aggregate Volume Above Underdrain - Detention (m^3)	1.75
Aggregate Volume Below Underdrain (m3)	3.94

Total Depth (m)	1.40

* The diagram below is not not to scale



WOODS
Engineers. Surveyors. Planners.

Swale Sizing - (no check dams)

PROJECT NUMBER:	P24-487
ADDRESS:	Parkburn
BY:	SB
DATE:	7/04/2026
REVIEWED:	

Swale Design

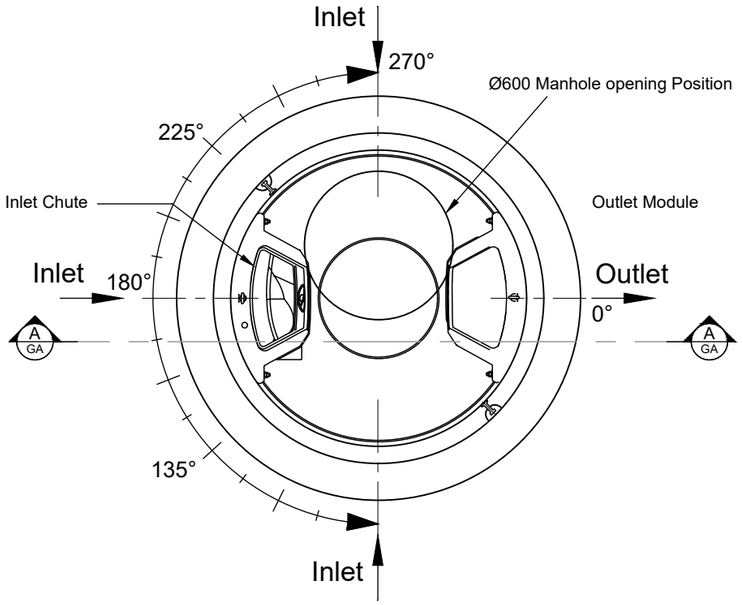
Water depth d(wq) (m)	0.3
Side slopes z (1V:zH)	5
Manning's roughness coefficient n	0.25
Channel slope i (m/m)	0.01
Base width b (m)	2
Total swale width (top width) (m)	5.00

Effective length (m)	80
Cross-sectional area of channel A (m2)	1.05
Hydraulic radius of channel R(hy) (m)	0.21
Flow velocity in the channel v (m/s)	0.14
Flow rate in the channel Q (m3/s)	0.1465

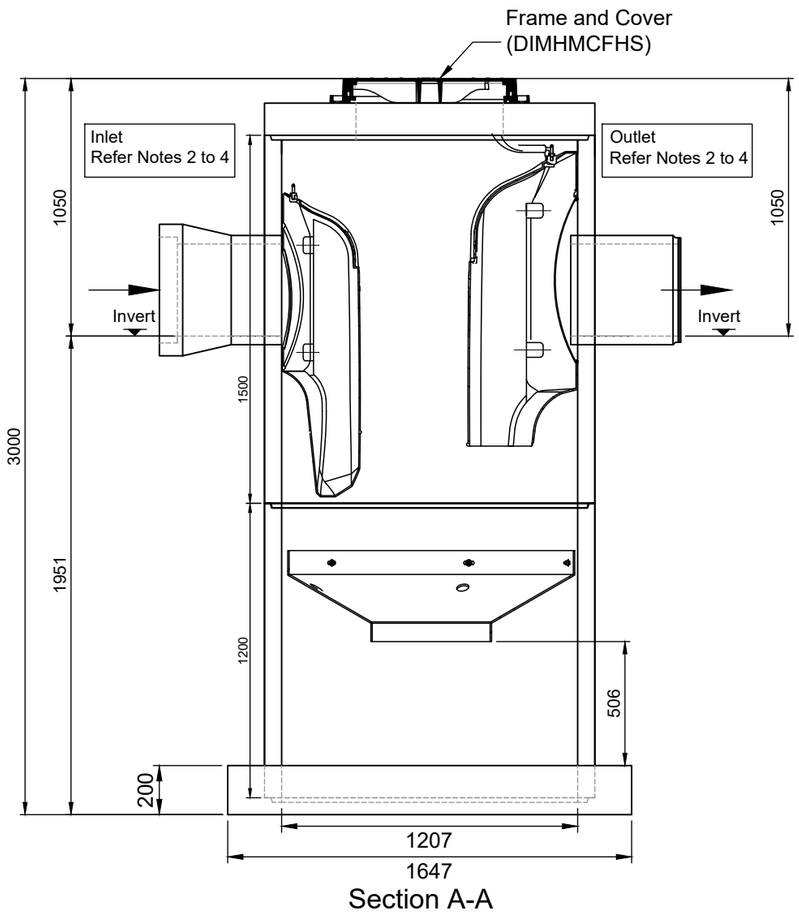
Total Hydraulic residence time HRT (min)	9.56
Required length (m)	**75**

Water Quality Runoff

Impervious percentage (%)	0.6
Pervious percetage (%)	0.4
Peak rainfall rate (mm/hr)	10
coefficient - impervious	0.95
coefficient - pervious	0.5
Water quality catchment area (ha)	**9.24**



Plan View



Section A-A

1. Pipes Diameter Range: Ø150mm to Ø375mm
2. *Inlet and Outlet openings are core drilled by Hynds at Factory
3. Contractor to provide and epoxy Inlet & Outlet Pipe Shorts to Manhole. Maximum allowable inlet/outlet pipe grade of 1:100.
4. *Minimum angle between inlet and outlet must be 90 degrees. This General Arrangement drawing represents a standard DDS supplied with single inlet.
5. For multiple inlets (maximum of 3), minimum angle between any connections must be 90 degrees. Additional inlet chutes to be priced separately. DDS with multiple inlets will be a made to order design.
6. Standard Manhole Lid designed to HD60 Vehicle Loads
7. For install in B2 Exposure Classification environment, consult with Hynds if C or U exposure classification is required

* Check Hynds Manhole Data sheets for guidance as to Maximum allowable openings and Minimum distance between pipes

Please Note:
Invert Dimensions maybe subject to minor changes.
Check with Hynds Stormwater Team prior to conformation of order to confirm details.

I AUTHORISE **HYNDS PIPE SYSTEMS LTD** TO PROCEED WITH THE MANUFACTURING OF THIS PIPE SPECIAL AS DETAILED
I ACKNOWLEDGE THAT ANY SPECIALS, ONCE MANUFACTURED, ARE DEEMED TO BE MY (CONTRACTOR'S) PROPERTY & ARE NON REFUNDABLE. STORAGE & HANDLING FEES WILL BE INCURRED FOR PRODUCTS THAT ARE NOT DELIVERED/COLLECTED WITHIN 1 MONTH OF THE DATE AGREED AT THE TIME OF ORDER. PRODUCT NOT DELIVERED/COLLECTED WITHIN 3 MONTHS OF THE DATE AGREED MAYBE DESTROYED AT MY EXPENSE.

NAME :- ..... SIGNATURE :- .....

DATE :- .....

NOTES:

South Island Option

MATERIALS	
VOL (m^3/unit) =	-
WT (ton/unit) =	-
CODE =	-

REVISIONS

REV #:	REVISION DESCRIPTION:	DATE:	DRAWN:
A	Issued For Approval	25 May 2023	GH
1	Issued For Construction	01 Feb 2024	GH
2	Fixing Locations Amended	15 July 24	GH
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PO Box 58142, Botany, Auckland, 2163
Tel: 09-274 0316
Fax: 09-272 7485
email: technicalservices@hynds.co.nz

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM

PROJECT DESCRIPTION:
Hynds Pipe Systems
Stormwater
Downstream Defenter Select
South Island

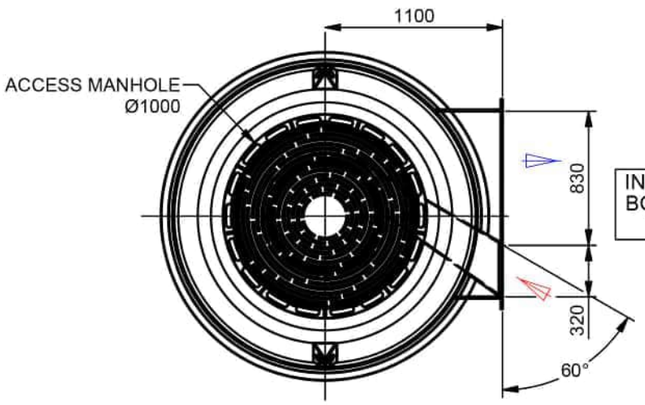
SERVICE DETAIL:
Downstream Defender Select 1200
Concrete Advance Vortex (CAV)
Spun Manhole Ø1200
General Arrangement

REFERENCE/QUOTE NUMBER:	-	
DRAWN: GH SIGNATURE:	DESIGN: GH/BH SIGNATURE:	CHECKED: BH SIGNATURE:
SCALE: 1:25 PAPER SIZE: A3	Note: Do not scale drawing if in doubt **ASK!!!**	DATE: 29-Jan-25
DRAWING NUMBER: T8530 SI	SHEET NUMBER: SI of --	REVISION NUMBER: 2

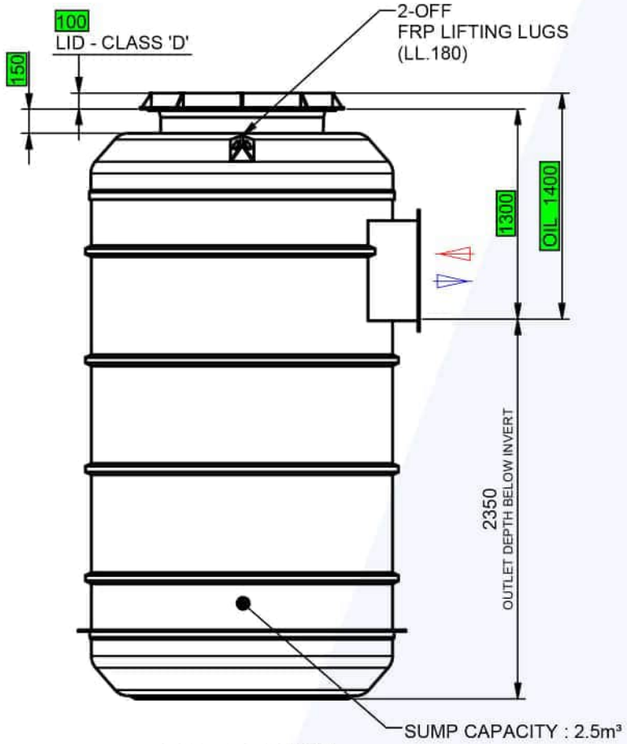
LEFT SIDE INFLOW

MODEL NO.: OVOR.100.18.L
TITLE: MAIN ASSEMBLY
TFR: 100 LPS
MAX. FLOW: PROJECT SPECIFIC DESIGN

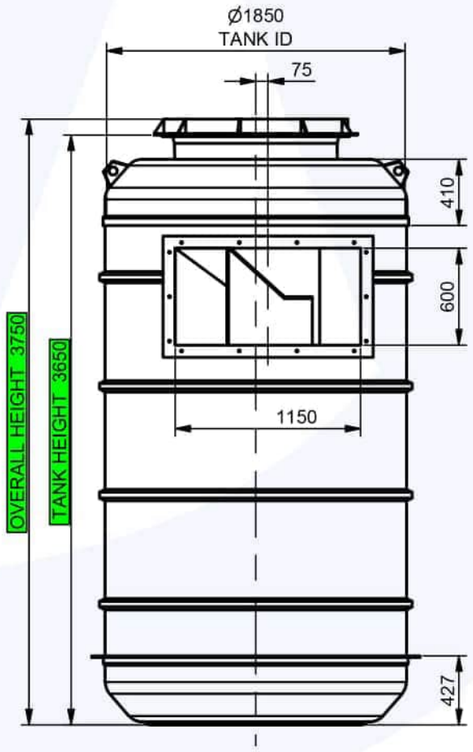
Dimensions that can be modified.



PLAN VIEW

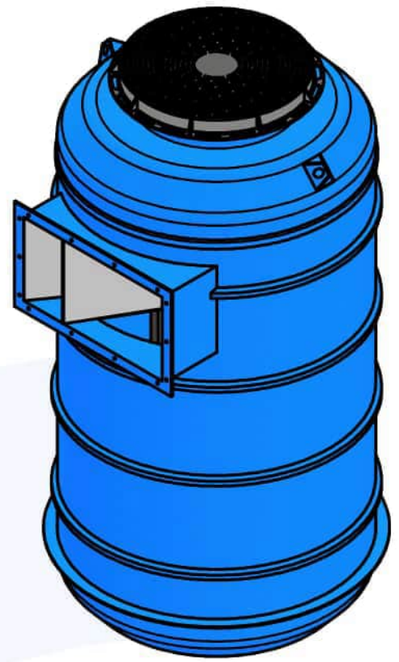


ELEVATION VIEW



BOX OPENING VIEW

Atlan STORMWATER
MASTER DRAWING
NO SUBSTITUTIONS OR MODIFICATIONS



ISOMETRIC VIEW

Atlan Vortceptor				
Site Level Confirmation				
Vortceptor Flow	Off-Line ☑	In-Line ☐		
Flow Configuration	Left ☑	Right ☐		
finished surface level (FSL)	RL.			
Access Cover Thickness		mm		
Inlet Pipe Size	Ø			
Inlet Invert Level	RL.			
Outlet Pipe size	Ø			
Outlet Invert Level	RL.			
Company				
Name :				
Date :				

TOLERANCE: All Dimensions to Closest 10 mm & +/- 30 mm

ALL INTERCONNECTING PIPEWORK, PITS AND ASSOCIATED DRAINAGE BY OTHERS

REV	DATE	BY	DESCRIPTION	CHK
1	18/05/2026	R.R.	INITIAL RELEASE	

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Check		Date
Verified		Date
Approved		Date
Request No.		

Atlan STORMWATER

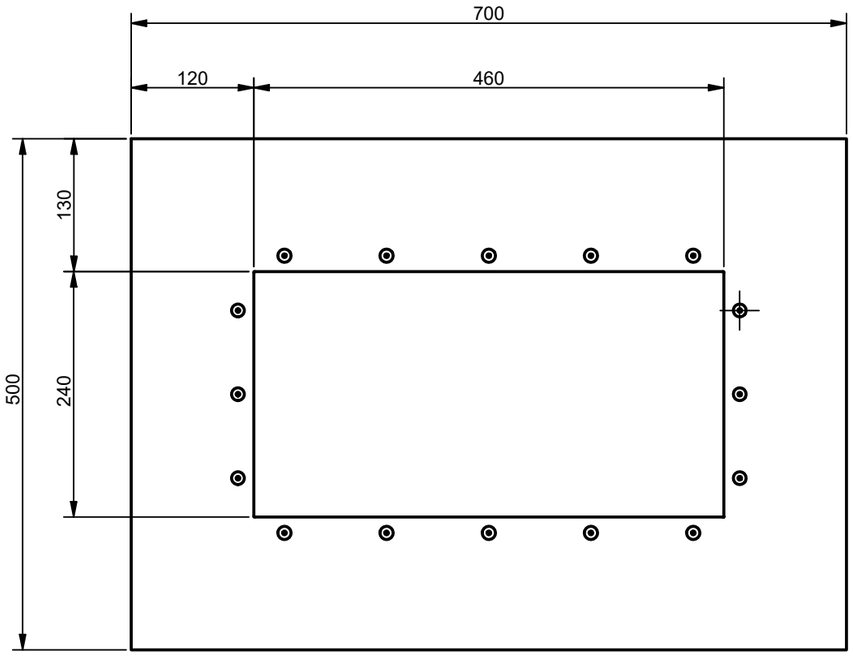
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TITLE
ATLAN VORTCEPTOR - OFFLINE
OVOR.100.18.L
GENERAL ARRANGEMENT

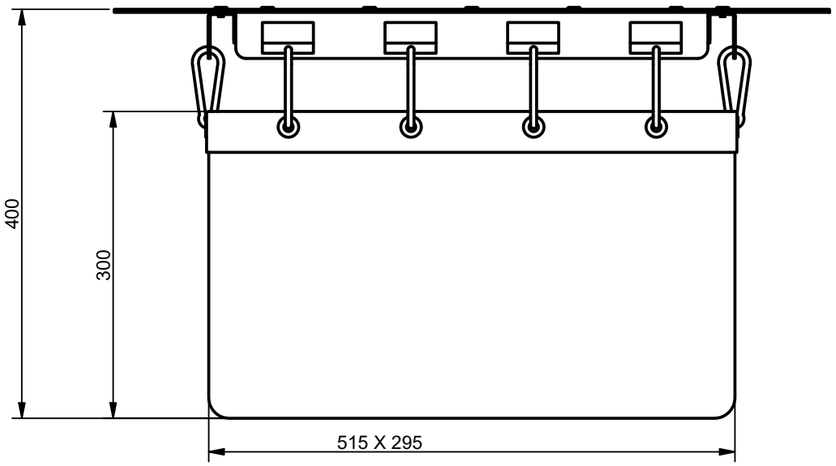
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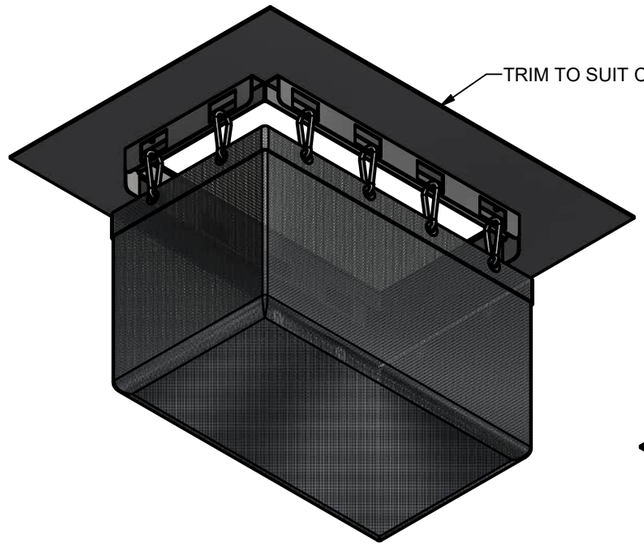
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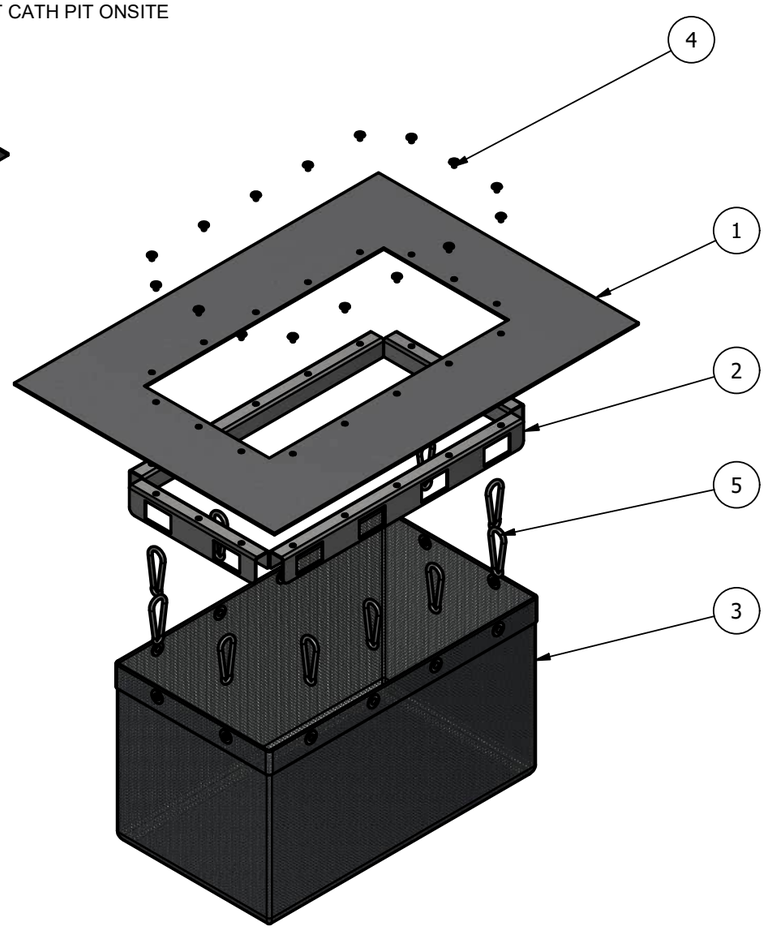
PLAN VIEW



ELEVATION VIEW



ISOMETRIC VIEW
BOTTOM VIEW



ISOMETRIC VIEW
EXPLOSION

ISSUE FOR APPROVAL
NOT FOR CONSTRUCTION

TOLERANCE: All Dimensions to Closest 10 mm & +/- 30 mm

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1		M.M	INITILT RELEASE	

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Check		Date
Verified		Date
Approved		Date

Request No.

ATLAN STORMWATER

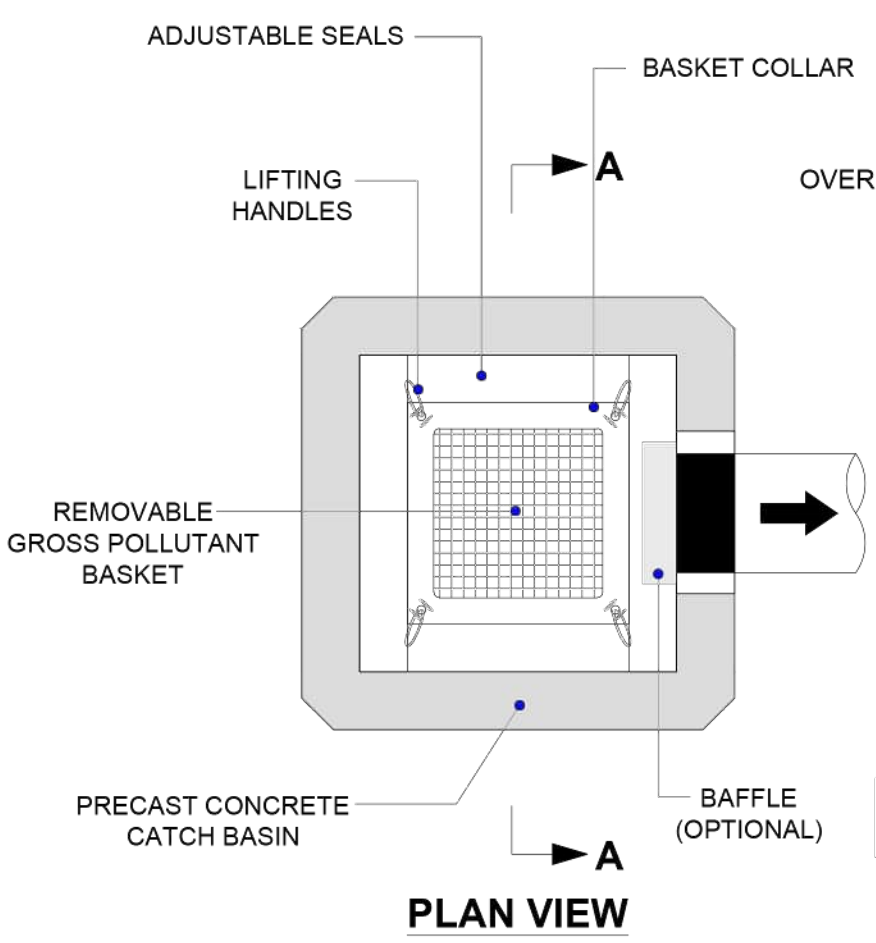
PROJECT :

TITLE
ATLAN STOMSACK
SSS.4060.C1
BLACK POLY SIZE : 700 X 500
GENERAL ARRANGEMENT

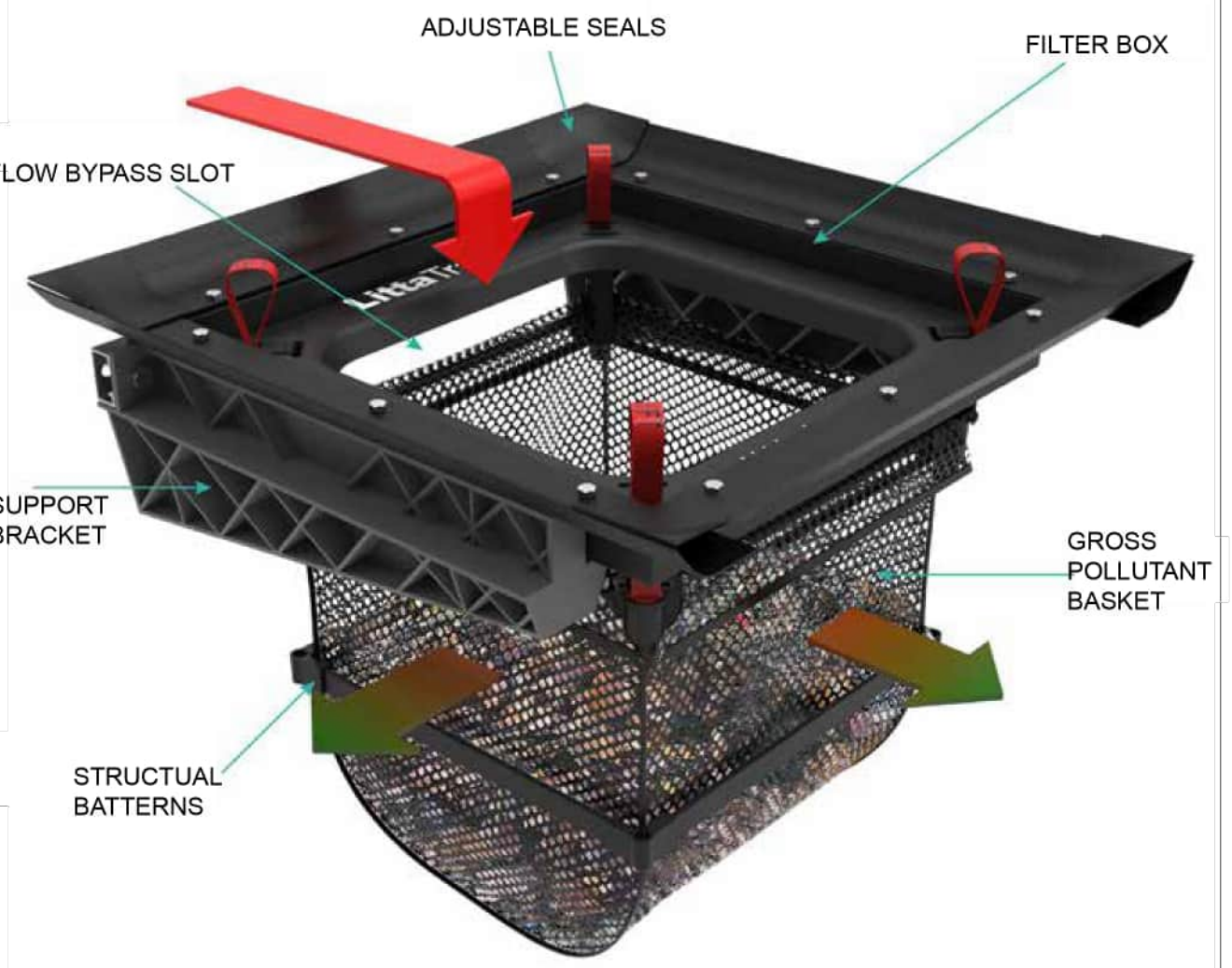
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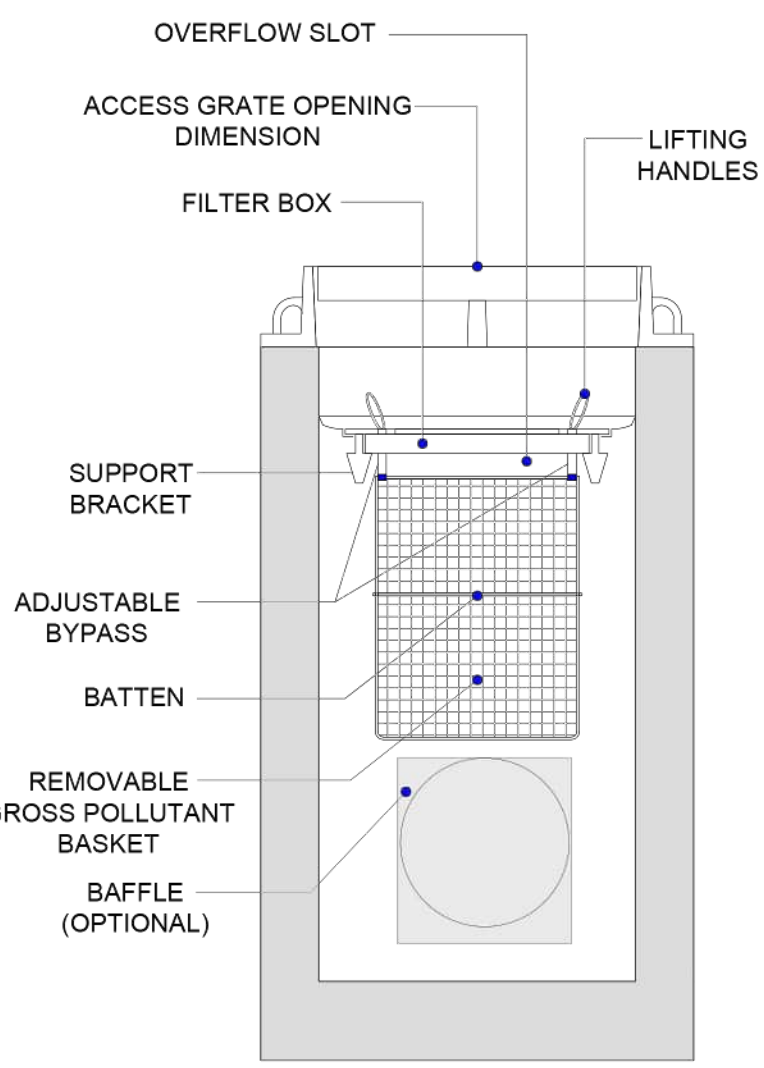
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PLAN VIEW



LITTATRAP™ COMPONENTS



SECTION A-A

MODEL AND SIZE SPECIFICATION

Catch pit size (mm)	LittaTrap™ model	Bracket width (mm)	Filter box size (mm)		Seal kit size (mm)		Basket size** (mm)		
			Length	Width	Length	Width	Length	Width	Depth
450x450	LT4545	435	377	377	492	492	225	225	400
600x400	LT6040	570	522	302	647	427	370	150	400
675x450	LT6745	648	587	367	722	542	435	223	400
600x600	LT6040*	570	522	302	677	677	370	150	400
800x500	LT6745*	648	587	367	842	572	435	223	400

Notes:
* Requires seal kit extension.
**Basket Collar is 80 mm greater in length and width than the basket.

FLOW AND STORAGE SPECIFICATION

Catch pit size (mm)	LittaTrap™ model	Screen area (cm^2)	Capture volume (L)	Design flow rate (L/s)[1]	Maximum treatable flow rate (L/s)[2]	Bypass flow rate (L/s)[3]
450x450	LT4545	3 880	17	21	42	55
600x400	LT6040	4 100	19	26	53	63
675x450	LT6745	5 900	34	33	67	80
600x600	LT6040*	4 100	19	26	53	63
800x500	LT6745*	5 900	34	33	67	80

Notes:
[1] design flow rate for gross pollutant trap taken at 75% maximum capture volume.
[2] maximum treatable flow rate taken at 75% maximum capture volume.
[3] factor set bypass based on bypass orifice dimensions.
* Requires seal kit extension.

The Enviropod® LittaTrap™ may be protected by one of the following Canadian, USA or International patent numbers and has other patents pending :
2,810,974, 13/824,376, 15/459,964, 2011302712, 588049

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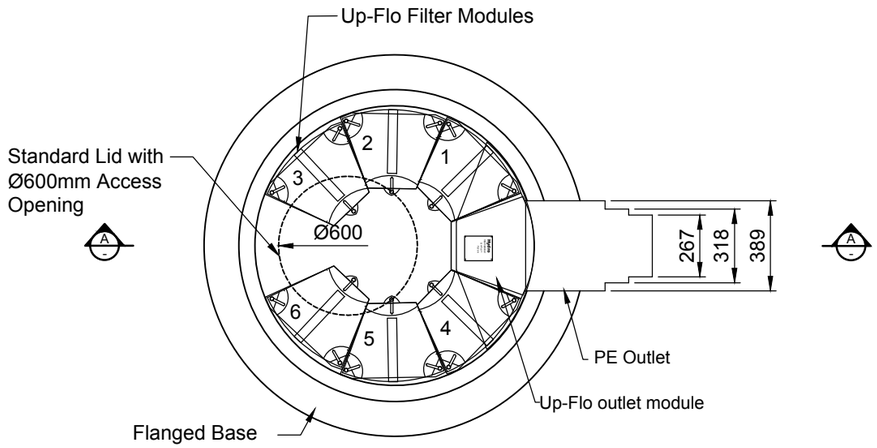
LITTATRAP™ SPECIFICATION DRAWING

REV #	DATE	REVISION DESCRIPTION	BY
A	12.01.21	DRAFT	M.M.
B	21.01.21	MAX PITS ADDED	D.T.
C	26.01.22	BASKET COLLAR NOTE ADDED	B.V.

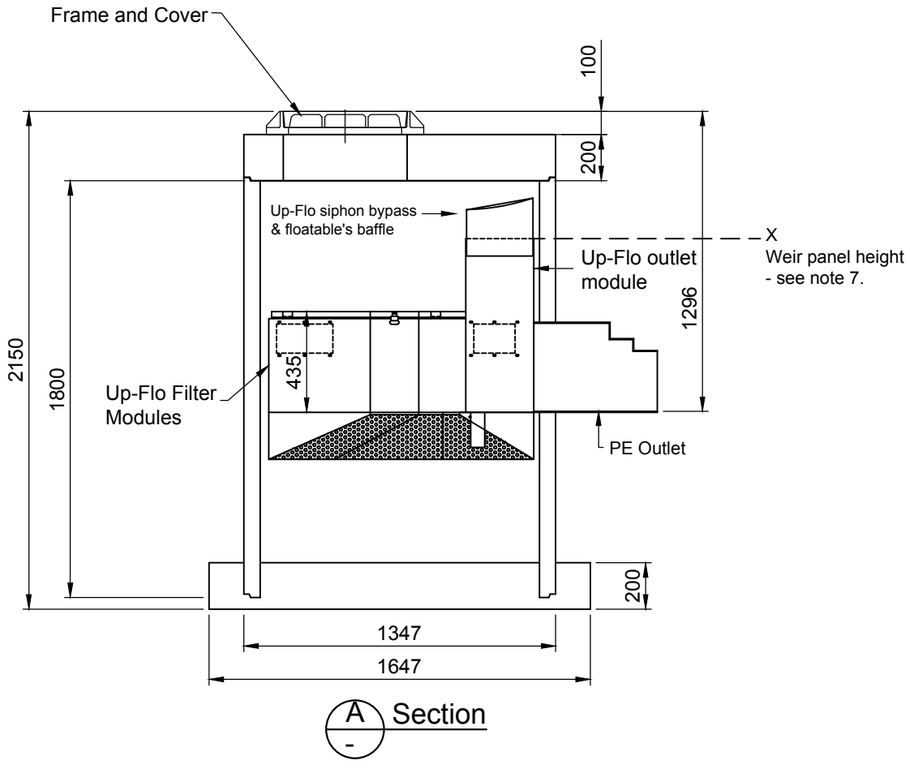
SHEET NUMBER 1 OF 1

www.stormwater360.co.nz | sales@stormwater360.co.nz | 0800 STORMWATER

DRAWN : M.M. | CHECKED : M.H. | DATE : 21.01.21 | SCALE : NTS | REV : A

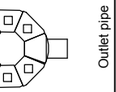


Plan



A - Section

ITEM	DESCRIPTION - MATERIAL	CODE	UNIT WEIGHT (T)	
1	Ø1200mm FB Up-Flo Filter			
	with 1 module	UP-FLO.1KIT	2.390	
	with 2 modules	UP-FLO.2KIT	2.402	
	with 3 modules	UP-FLO.3KIT	2.415	
	with 4 modules	UP-FLO.4KIT	2.427	
	with 5 modules	UP-FLO.5KIT	2.439	
	with 6 modules	UP-FLO.6KIT	2.451	LOCATION INDICATOR
	STANDARD SUPPLIED OUTLET Ø300mm (O/D 315mm)			
2	Lid			
			0.613	☑
3	Streetware			
	Ductile Iron Cover & Frame Ø600mm		0.058	☑



* PLEASE TICK THE NUMBER OF MODULES REQUIRED. IF THE LOCATION OF THE MODULES IS IMPORTANT, PLEASE USE THE ABOVE LOCATION INDICATOR TO SELECT YOUR PREFERENCE.

NOTE:

1. The Up-Flo Filter can contain 1 to 6 modules. The invert level of optional inlet/s can be a minimum of 240mm above the invert level of the outlet pipe. Inlet pipework is installed by the contractor on site.
2. The standard PE outlet pipe provides the following optional outside diameters: 389mm / 318mm / 267mm. The contractor simply trims the outlet back to the size required.
3. Some dimensions could change to accommodate a site constraint situation. Please contact Hynds for technical assistance.
4. The orientation and elevation of the inlet pipe can be adjusted to suit site requirements. Refer to the site plan for orientation.
5. If the outlet invert depth to the ground level is >1296mm, the contractor will need to provide an appropriate riser to suit the on-site requirements.
6. The unit includes an 1200Ø x 1800mmH flanged based manhole chamber and a 200mm thick heavy duty concrete lid. A 600Ø ductile iron cover & frame is Hynds standard supply throughout NZ.
7. If Up-Flo is installed in an offline configuration and is connecting to a weir chamber - please note that the weir panel height within the weir chamber must match the height of the UpFlo outlet shaft, level " X " as shown on drawing.
   Height between invert of outlet stub to "X" is approximately 750mm

I AUTHORISE **HYNDS PIPES SYSTEMS LTD** TO PROCEED WITH THE MANUFACTURING OF THIS PRODUCT SPECIAL AS DETAILED ABOVE.
I ACKNOWLEDGE THAT ANY SPECIALS, ONCE MANUFACTURED, ARE DEEMED TO BE MY (CUSTOMERS) PROPERTY & ARE NON REFUNDABLE. PLEASE NOTE COSTS ARISING FROM CHANGES REQUESTED AFTER SIGNING THIS DRAWING WILL BE BORNE BY THE CUSTOMER.

NAME :- ..... SIGNATURE :- .....

DATE :- .....

NOTES:

1. Concrete : ƒ'c = 40MPa
2. Reo : ƒy = Grade 500E
3. Reo Cover : 30mm Min
4. Min Lap Length : 40 x Bar Dia
5. Dimensional tolerances:Table 1-NZS3109:1997
6. Do not re-bend reinforcing steel
7. Traffic loading to HN-HO-72 Transit New Zealand load criteria
8. Consult Engineer where exposure classification C or U is required (Saltwater Tidal/Splash Zone or other aggressive environment).

MATERIALS

VOL (m³/unit) =
WT (ton/unit) = See Table
CODE =

REVISIONS

REV #:	REVISION DESCRIPTION:	DATE:	DRAWN:
1	Details Updated	17 Nov 2015	HJ
2	Finalise drawing for issuing	20 Nov 2015	HJ
3	Txt Update GA ready to load into HUB	04 Dec 2015	DA
4	Update invert on notes	10 May 2016	HJ
5	Update outlet to US version and notes	15 Jun 2016	HJ
6	Update notes and mark up for weir panel height	4 May 2018	KI
7	CAD Stamp updated	23/7/2018	KI

PO Box 58142, Botany, Auckland, 2163
Tel: 09-274 0316
Fax: 09-272 7485
email: technicalservices@hynds.co.nz

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ISO 9001 CERTIFIED MANAGEMENT SYSTEM

PROJECT DESCRIPTION:
Hynds Environmental

Up-Flo Filter

SERVICE DETAIL:
Ø1200 x 1800mm High Flanged Base
Up-Flo Filter - 1 to 6 Modules

General Arrangement

REFERENCE/QUOTE NUMBER:	T2965-1	
DRAWN: DA SIGNATURE:	DESIGN: SIGNATURE:	CHECKED: HJ SIGNATURE:
SCALE: As Shown PAPER SIZE: A3	Note: Do not scale drawing if in doubt **ASK!!!**	DATE: 16 Sep 2015
DRAWING NUMBER: E1000		REVISION NUMBER: 8

STORMFILTER™

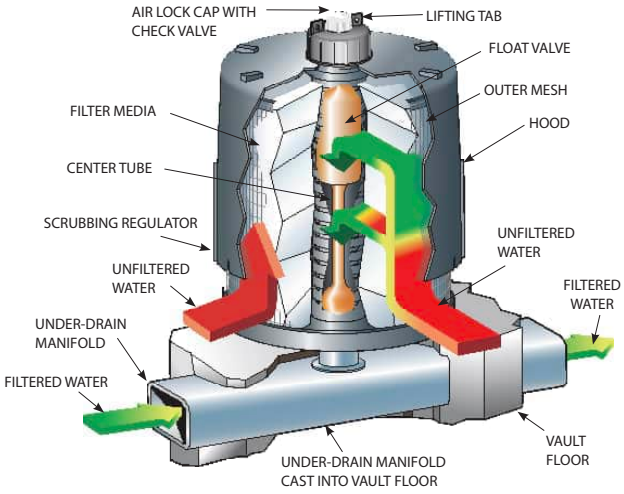
High efficiency / low maintenance stormwater filter.

SIPHON-ACTUATED FILTRATION The stormwater management StormFilter™ cleans stormwater through a patented passive filtration system, effectively removing pollutants to meet the most stringent regulatory requirements. Highly reliable, easy to install and maintain, and proven performance over time, StormFilter™ products are recognised as a versatile BMP for removing a variety of pollutants, such as sediments, oil and grease, metals, organics, and nutrients. These systems come in variable configurations to match local conditions and come with prolonged maintenance periods to ensure long-term performance and reduce operating costs.

HOW DOES IT WORK?

During a storm, runoff passes through the filtration media and starts filling the cartridge center tube. Air below the hood is purged through a one-way check valve as the water rises. When water reaches the top of the float, buoyant forces pull the float free and allow filtered water to drain.
After the storm, the water level in the structure starts falling. A hanging water column remains under the cartridge hood until the water level reaches the scrubbing regulators. Air then rushes through the regulators releasing water and creating air bubbles that agitate the surface of the filter media, causing accumulated sediment to drop to the vault floor. This patented surface-cleaning mechanism helps restore the filter's permeability between storm events.

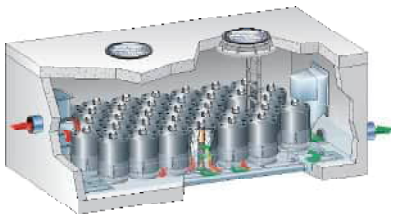
STORMFILTER™ CARTRIDGE



PROVEN PERFORMANCE

- First independently verified filter by Washington Department of Ecology, New Jersey Department of Environmental Protection and USEPA's Environmental Technology Verification program
- Approved and accepted by most regulatory bodies across New Zealand
- Over 16,800 x StormFilter's™ cartridges installed throughout New Zealand
- Continual innovation Design refined and perfected over two decades of research and experience

STORMFILTER™ VAULT



STORMFILTER BENEFITS

UNDERGROUND SYSTEMS MAXIMISE PROFITABILITY

- Save land space allowing denser developments reducing sprawl
- Add parking spaces and increase building size, increasing profitability
- Compact design reduces construction and installation costs by limiting excavation

RELIABLE LONGEVITY & LOWER MAINTENANCE COSTS

- Self cleaning hood prevents surface blinding, ensures use of all media and prolongs cartridge life
- 1-3 year maintenance cycles
- 20 years maintenance experience
- Minimal or no standing water. Lower disposal costs

CONTACT DETAILS

Stormwater360

FREEPHONE:
0800 STORMWATER
(0800 786769)

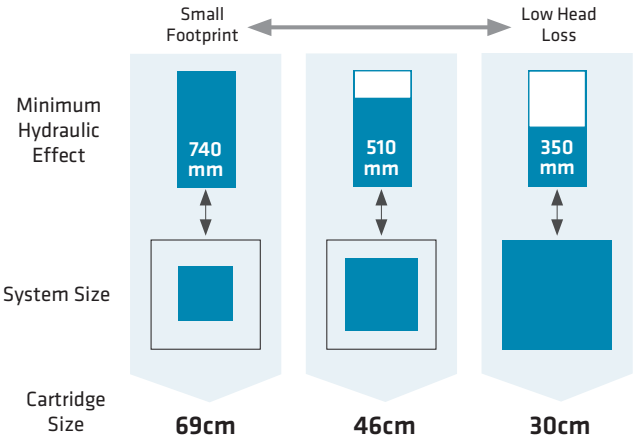
www.stormwater360.co.nz

Stormwater360®
BETWEEN SKY AND SEA

Nothing in this brochure should be construed as an expressed warranty or an implied warranty of merchantability or fitness for any particular purpose.
See the Stormwater360 standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

SUPERIOR HYDRAULICS

Multiple cartridge heights gives design solutions for site restraints.

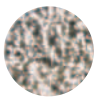


Other hydraulic benefits

- Hydraulic effect as low as 350mm head loss
- Zero surcharge of inlet pipe unlike upward flowing filters
- Can be designed for tail water e.g tidal conditions
- Online and offline configurations can limit hydraulic effects

MEDIA CHOICES

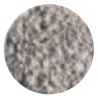
Our filtration products can be customised using different filter media to target site-specific pollutants. A combination of media is often recommended to maximise pollutant removal effectiveness.



Perlite is naturally occurring puffed volcanic ash. Effective for removing TSS, oil and grease.



ZPG™ is a multi-purpose media option approved for highly trafficked sites or sites with high metal loadings. ZPG is a mixture of Zeolite, Perlite and GAC (granular activated carbon). ZPG is ideal for removing soluble metals, TSS, oils and grease, organics and ammonium.



Zeolite is a naturally occurring mineral used to remove soluble metals, ammonium and some organics.



GAC (Granular Activated Carbon) has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

CONFIGURATION

Stormfilter's can be configured in any drainage structure. Please contact SW360 for a customised design.



PRECAST VAULT

- Treats medium sized sites
- Simple installation – arrives on-site fully assembled
- Plug and play solution

PRECAST MANHOLE

- Provides a low drop, point-of-entry configuration
- Uses drop from the curb inlet to the conveyance pipe to drive the passive filtration cartridges
- No crane required (Hi-AB lifting for most sizes)
- 1050-2400mm diameter sizes available





HIGH FLOW

- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Several configurations available, including: Panel Vault, Box Culvert, or Cast-In-Place

PEAK DIVERSION



- Combines off-line bypass and StormFilter™ pollutant removal into one structure
- Internal weir allows high peak flows with low hydraulic head losses
- Approved and accepted as offline configuration by councils around NZ
- Eliminates cost of additional structures to bypass peak flows
- Reduces the overall footprint of the treatment system

Stormwater360®
BETWEEN SKY AND SEA

StormFilter Project Details

Project Name	Parkburn	Project Number	
Project Address	Cromwell	Local Council	Other
Location	Cromwell	Author	Boniface Kinnear

Catchment Details

Reference	Catchment Type	Runoff Coefficients (C)	Area, m^2 (A)	Product, m^2 (CxA)
	Roof	0.9	3000	2700
	Hardstand/Road	0.85	3000	2550
	Pervious	0.25	4000	1000
Totals	-	0.63	10000	6250

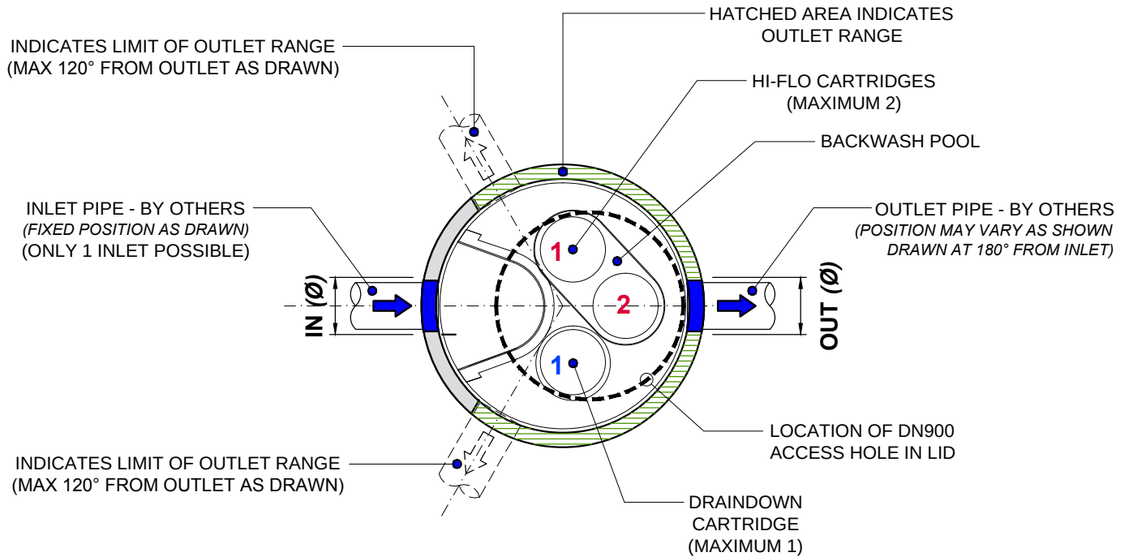
Rainfall Intensity (iwq): 10 mm/hr

*Note: The chosen rainfall intensity value is to treat 90% of annual rainfall (10mm/hr for Auckland region as per Auckland Council. 5mm/hr for Christchurch region as per Christchurch City Council, and 10mm/hr for other councils). If unsure, please contact Stormwater360

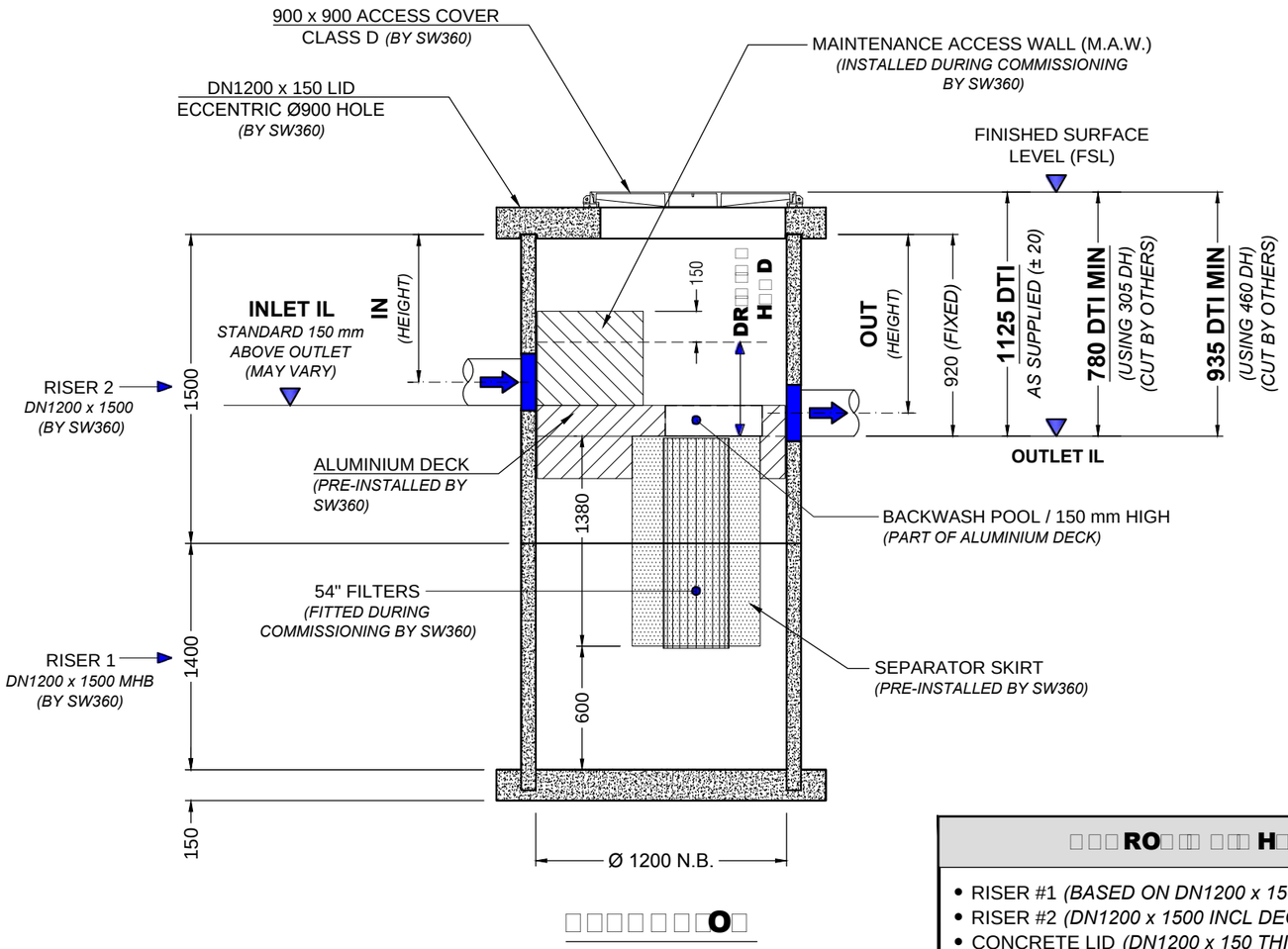
Output

Required treatable flow rate (Qwq)	17.36 L/s	Calculated using Rational method Qwq = C x iwq x A (L/s)
StormFilter model required	Contact Stormwater360	Please refer to drawing for footprint and size
No. of cart required (nCart)	13	Calculated - Qwq/Qcart (Rounded up to whole number)
Cartridge size/height	69cm	Recommended hydraulic effect is 770mm, for lower hydraulic effect option please contact Stormwater360
Media	Perlite	Other media options are available, please contact Stormwater360
Design treatment flow rate per cartridge (Qcart)	1.42 L/s	
Design StormFilter treatment flow (QSF)	18.46 L/s	Calculated - Qcart x nCart
Is QSF > Qwq?	Yes	

For any questions or further details please contact sales@stormwater360.co.nz



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□O□ □□ OM□□□□□ D□ Y□ □□□ OM□ R□□□ O□ □R□□□OR

COMPANY :		P.O. NUMBER :	
SITE ADDRESS :			
SITE CONTACT & PHONE :			
PREFERRED DELIVERY DATE *(TBC SW360)* :			
FILTER REFERENCE *(IF APPLICABLE)* :		LID LEVEL *(INPUT REQUIRED)* :	
INLET PIPE DATA *(DN225 RCRRJ-MAX)* : *(DN300 PVC-MAX)*	IL :	DIA :	MATERIAL :
OUTLET PIPE DATA *(DN225 RCRRJ-MAX)* : *(DN300 PVC-MAX)*	IL :	DIA :	MATERIAL :
OUTLET PIPE ORIENTATION : *(CIRCLE 180° OR INPUT REQUIREMENT)*	AS DRAWN : *180° FROM INLET*	CLOCKWISE FROM INLET : *(60° MIN)*	ANTICLOCKWISE FROM INLET : *(60° MIN)*
COMPLETED BY :	SIGNED :		DATE :

□O□ □□ OM□□□□□ D□ Y□□ □□□

DR□□ □□ □ □H□ □ D□DH□ *(CIRCLE REQUIREMENT OR INPUT CUSTOM VALUE)* :	305 mm	460 mm	CUSTOM DRIVING HEAD : *(INPUT DETAILS IF REQUIRED)*
DEPTH TO INVERT (DTI) CHECK : *(CALCULATE AND RECORD)* :	INLET / OUTLET IL CHECK : *(CALCULATE AND RECORD)* :		No. OF FILTERS :
ACCESS COVER : 900 x 900 WEBFORGE / CLASS D : *(SUPPLIED UNLESS STATED OTHERWISE)*		DETAILS OF OTHER : *(IF REQUIRED)*	
COMPLETED BY :		SIGNED :	DATE :

□ O□□□□□

1. CONCRETE MANHOLE RISER UNITS FITTED WITH SWIFTLIFT ANCHOR POINTS (QTY 2). DO NOT EXCEED 60 DEGREE LIFT ANGLE. CONCRETE LID FITTED WITH SWIFTLIFT ANCHOR POINTS (QTY 4).
2. UNIT SUPPLIED WITH BOTH INLET AND OUTLET CORE DRILLED.
3. SEALING / GROUTING OF MANHOLE COMPONENTS AND PIPES BY CONTRACTOR. ENSURING LOCAL CODES AND REGULATIONS ARE COMPLIED WITH.
4. ANY RISERS REQUIRED TO INCREASE THE DEPTH TO INVERT (DTI) FROM THAT AS DRAWN TO BE SUPPLIED BY THE CONTRACTOR.
5. FOR A DTI EXCEEDING 5m PLEASE CONTACT **0800STORMWATER**.
6. BACKFILL, BEDDING AND BUOYANCY DESIGN BY ENGINEER OF RECORD.
7. CONCRETE MANHOLE RISERS ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH AS/NZS 4058 : 2007
8. CONCRETE MANHOLE BASES ARE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH NZS 3101 : 2006 AND NZS 3109 : 1997
9. CONCRETE LID DESIGNED AND MANUFACTURED TO HN-HO-72.
10. FILTERS AND MAINTENANCE ACCESS WALL (MAW) TO BE INSTALLED DURING COMMISSIONING BY STORMWATER360.
11. COMMISSIONING TO OCCUR ONLY WHEN CONSTRUCTION IS COMPLETE, AND SITE IS CLEAN.
12. CONTRACTOR TO ENSURE MANHOLE IS CLEAN FROM SITE RUN-OFF PRIOR TO COMMISSIONING.
13. CONTACT **0800STORMWATER** FOR COMMISSIONING OR ANY REQUIREMENTS OUTSIDE THIS DRAWING.

D□ □□ □OR□ ROD□ □□□ O□ □O□ □Y□□ OM□□□□□ D□ Y□□ □□□□

OUT *(Ø)* *OUTLET CORE Ø*		*MAX Ø 350*	**OUT** *(HEIGHT)* *= 920 mm - 0.5 PIPE ID*		**IN** *(Ø)* *OUTLET CORE Ø*	*MAX Ø 350*	**IN** *(HEIGHT)* **= OUT** *(HEIGHT)* *- Δ INVERT*
INLET TO OUTLET DISTANCE : *WRAP MEASUREMENT FROM C/L INLET TO C/L OUTLET*	= (ANGLE) x (3.14 x RISER *OD*) / 360						
COMPLETED BY :			SIGNED :				DATE :

□□□RO□□ □□□ H□□

- RISER #1 *(BASED ON DN1200 x 1500)* : 1900 Kg
- RISER #2 *(DN1200 x 1500 INCL DECK)* : 1150 Kg
- CONCRETE LID *(DN1200 x 150 THICK)* : 520 Kg

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0800 STORMWATER
sales@stormwater360.co.nz
www.stormwater360.co.nz

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JELLYFISH® FILTER
STORMWATER MEMBRANE FILTER
DN1200 / 54" FILTERS 2 + 1 / OFFLINE / TRAFFICABLE
GENERAL ARRANGEMENT

SCALE : N.T.S. | DRG No : JF-MH-54-1200-T-OFF-20 | REV : 1 | DATE : 25.05.19

JOB NO :		REV	REVISION DETAIL	DATE
PROJECT :		0	APPROVED	25.05.19
		1	FORMULA REV	12.08.19
DRN :	R.P.	25.05.19			
CKD :	G.S.	25.05.19			

JellyFish Project Details

Project Name	Parkburn	Project Number	
Project Address	Parkburn	Local Council	Other
Location	Cromwell	Author	Boniface Kinnear

Catchment Details

Reference	Catchment Type	Runoff Coefficients (C)	Area, m2 (A)	Product, m2 (CxA)
	Hardstand/Road	0.85	4000	3400
	Pervious	0.25	1000	250
Totals	-	0.73	5000	3650

Rainfall Intensity (iwq): 10 mm/hr

*Note: The chosen rainfall intensity value is to treat 90% of annual rainfall (10mm/hr for Auckland region as per Auckland Council. 5mm/hr for Christchurch region as per Christchurch City Council, and 10mm/hr for other councils). If unsure, please contact Stormwater360

Output

Required treatable flow rate (Qwq)	10.14 L/s	Calculated using Rational method Qwq = C x iwq x A (L/s)
Jellyfish model required	JF1200-2-1 (54")	Please refer to drawing for footprint and size
No. of cart required (nCart)	3	Calculated - Qwq/Qcart (Rounded up to whole number)
Cartridge size/height	1.4m	For smaller cartridge, please contact sales@stormwater360.co.nz
Designed Head Loss	460mm	For lower hydraulic effect, please contact sales@stormwater360.co.nz
Design Jellyfish max treatment flow (Qcart)	12.5 L/s	Calculated using nCart x Qcart
Is QSF > Qwq?	Yes	

For any questions or further details please contact sales@stormwater360.co.nz

Appendix C – Model Build Memo

Memorandum

Fulton Hogan Land Development Tim James, Development Manager	Woods Simran Bassan – Engineer
	W-REF: P25-561 22 July 2026 Reviewer: Boniface Kinnear – Principal Engineer Revision 2

1.0 Introduction

Wood and Partners Consultants Ltd ('Woods') has been engaged by Fulton Hogan Land Development to undertake flood modelling for the proposed development at 922 Luggate-Cromwell Road, Cromwell Central Otago (the Site). The flood modelling has been undertaken in support of a substantive application to the Environmental Protection Authority (EPA) under the Fast-Track Approvals Act 2024 (FTAA).

This memo summarises the flood modelling undertaken for the Site, including the modelling methodology, assumptions, and key findings. It is intended to be read in conjunction with the Stormwater Management Plan (SMP) prepared by Woods, which provides the broader stormwater design context and an interpretation of the key findings. A site location plan is included in Figure 1.

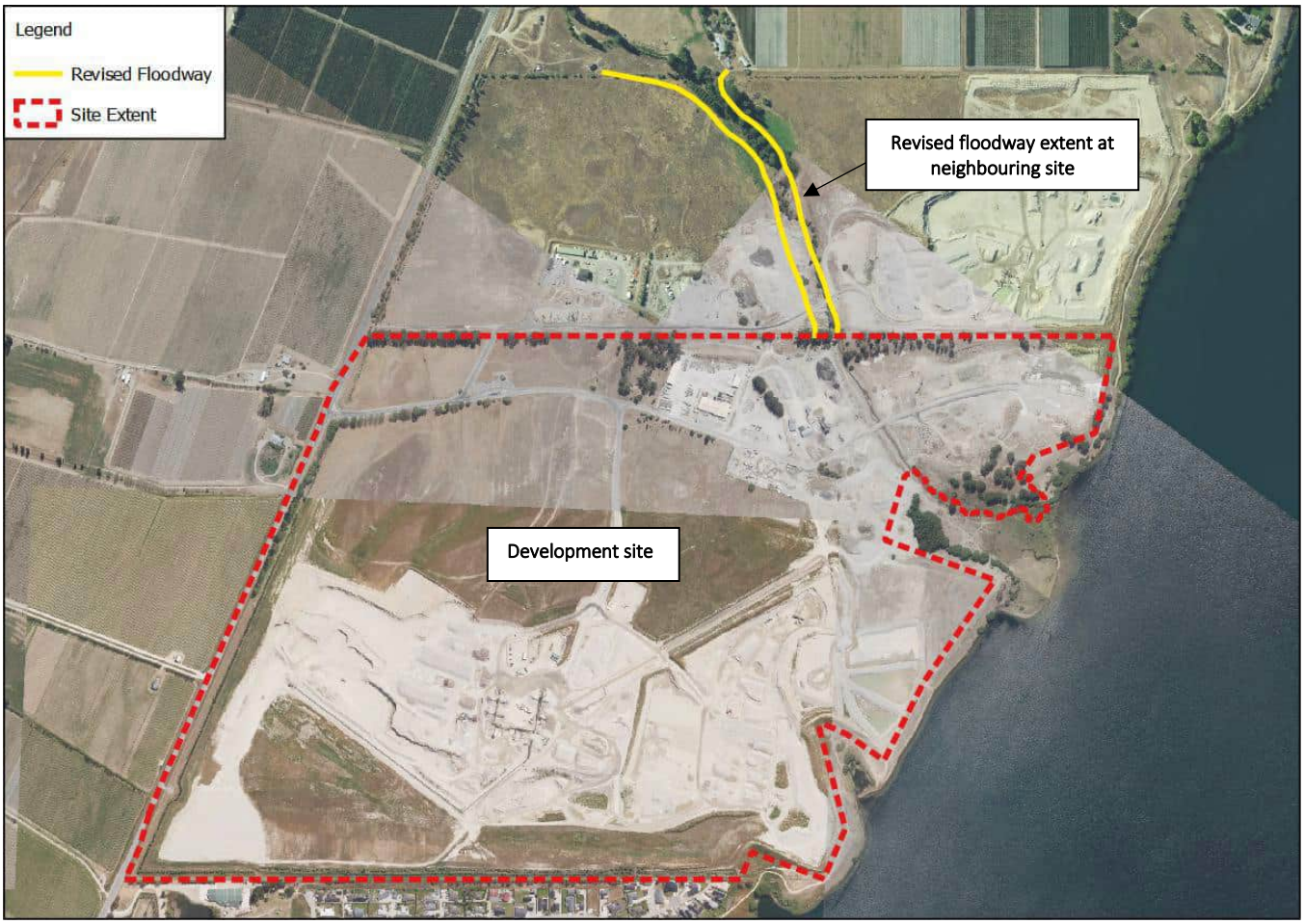


Figure 1: Site Location

2.0 Flood Modelling

A series of flood models have been developed to assess the potential impacts of the proposed. The modelling has been completed using U.S. Army Corps of Engineers' Hydrologic Engineering Center – River Analysis System (HEC-RAS) and Hydrologic Modeling System (HEC-HMS). The modelling parameters and assumptions are consistent with best practice and recognise New Zealand Standards 4404:2010.

Three flood models have been developed: a catchment model, an alluvial fan model, and an internal site model. The catchment model assesses runoff contributions from the external catchment to the development site, with its outputs used as boundary inputs to the internal site model.

The second model adopts the same modelling parameters as the catchment model and assesses alluvial fan hazard across the portion of the development overlain by an active, floodwater-dominated fan extending from Mount Pisa to Lake Dunstan. Further details of this model are included in Section 2.4.

The internal/site model is more detailed to allow for analysis of flows within the site. For this exercise, a cutdown site model was created. Hydrographs were extracted from the wider catchment model for use as external/upstream boundary conditions for the cutdown model.

Details for these models are discussed within the subsequent sections of this report.

2.1 Terrain Data

Existing and design model surfaces were provided by Landpro Ltd, extending from the top of the catchment on Mount Pisa to Lake Dunstan (approximately 11 km). The site topography has been established using LP2000 and NZVD2016 vertical datum survey data prepared by Landpro Ltd, projected in NZTM2000 coordinates.

The property to the north is subject to a separate redevelopment that includes a reduction of the existing floodway entering the development site. Although these works do not form part of the proposed development, their influence on flood behaviour at the site has been accounted for in this assessment. Accordingly, the post-development model incorporates modifications to the northern property's landform to reflect the revised floodway configuration at the site boundary.

2.1.1 Catchment Delineation and Model Extents

Two model extents have been developed: (1) catchment-wide and (2) internal. The catchment-wide extent is used by both the catchment model and the alluvial fan model (with some modifications), while the internal extent is used in the cut-down site model. Catchment analyses were undertaken using QGIS and SAGA tools to delineate contributing catchments from surfaces provided by Landpro. The resulting catchment extents are shown in Figure 2 and Figure 3.

The delineated subcatchments were also used to derive times of concentration and calculate design hydrographs in HEC-HMS, which were subsequently applied as inputs to the hydraulic models and are discussed further in later sections of this report.

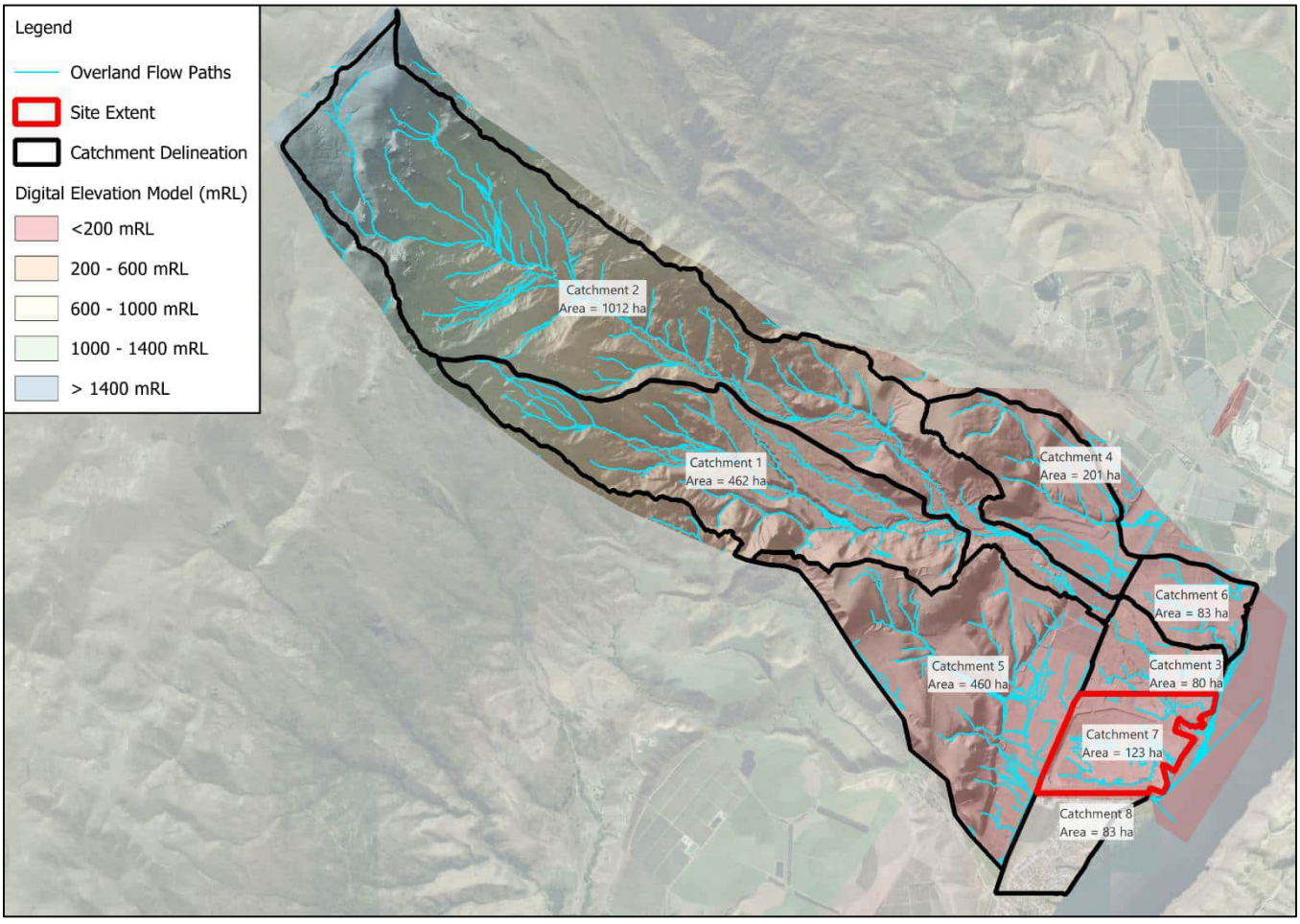


Figure 2: Catchment wide model delineation

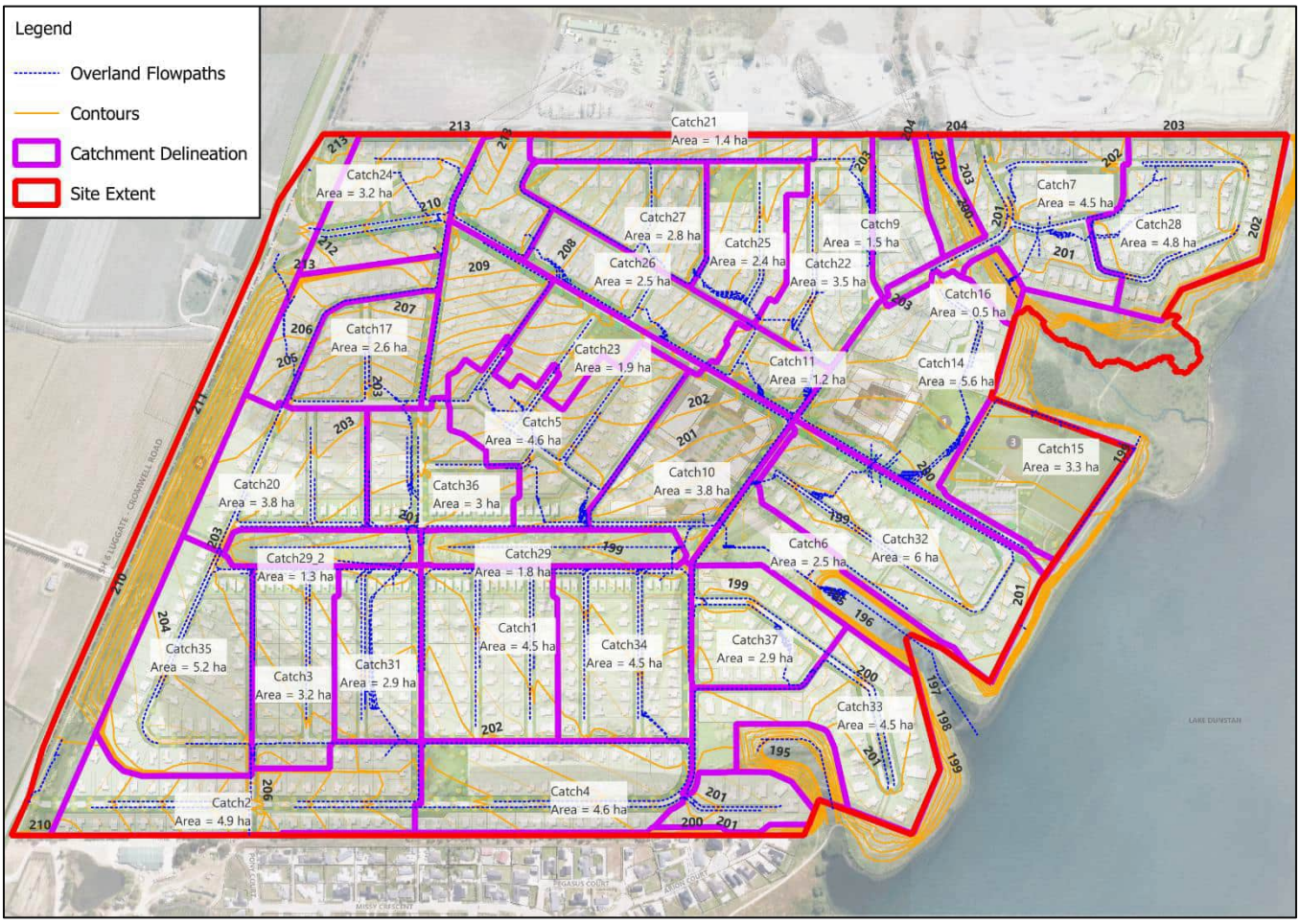


Figure 3: Internal model delineation

2.2 Hydrological Model

The following sections detailed the hydrologic model parameters.

2.2.1 Rainfall Data

A 24-hr nested rainfall event using the Type 2A temporal distribution, peaking at midday, has been adopted for this analysis. This approach is consistent with standard hydrological modelling practice in New Zealand.

The 24-hr rainfall depths have been obtained from HIRDS by NIWA and are summarised in Table 1. To allow for the effects of future climate change, the RCP8.5 scenario has been adopted with climate change projections for the period of 2081-2100.

Table 1: Rainfall Data

Annual Recurrence Interval (ARI)	Duration	Rainfall Depth RCP 8.5
5-year	24-hr	61 mm
10-year	24-hr	72 mm
100-year	24-hr	114 mm

2.2.2 Time of concentration

The time of concentration (ToC) for the modelled subcatchments was calculated following the SCS methodology detailed in Auckland Council's Guidelines for Stormwater Runoff Modelling in the Auckland Region (TP108, 1999). This document was adopted in the absence of a regionally specific methodology applicable to the Central Otago context. The calculation is based on the longest flow path within each subcatchment. A comparison of alternative calculation methods was undertaken and is provided in Appendix A. A representative catchment used to calculate the runoff. The methods show a great variation in the times of concentration with the TP108 method falling in the average range. The adopted ToC values are summarised in Table 2 below.

Table 2: Time of Concentration

Model Extent	Time of Concentration
External catchment (catchment model)	46 min to 146 min
Internal model extent	10 min (minimum applied)

2.2.3 Land use

Within the modelled extents, impervious area assumptions were based on the master plan and existing site coverage, as seen in Figure 4. Within the site extent, the model assumes full build-out of the proposed design, where lots are assumed to be 60% impervious based on a typical lot layout, included in Appendix B, and roads and other hard-stand surfaces are assumed to be 100% impervious. External catchments draining to the site are represented under existing conditions and are assumed to constitute near 100% pervious area.



Figure 4: Proposed Masterplan

2.2.4 Initial Abstraction

Initial abstraction represents losses from storage, vegetation interception, evaporation, and infiltration that occur before runoff begins. Initial abstraction ratios were estimated in accordance with the SCS method. Impervious areas were assigned an initial abstraction of 0 mm, and pervious areas were assigned 5 mm.

2.2.5 Curve Number

Curve numbers for the various subcatchments were selected based on soil type and land use in accordance with the SCS method, detailed in USDA TR-55. The site has historically been used for quarrying activity and comprises predominantly well-drained soils. In the absence of complete site-specific soil investigation data, conservative assumptions have been adopted in the classification of hydrological soil groups.

Pervious areas within the upper catchments were assigned a CN of 60, consistent with Hydrological Soil Group B, reflecting the well-drained nature of the external catchment soils. Within the site extent, pervious areas were assigned a CN of 74, consistent with Hydrological Soil Group C, to reflect the anticipated reduction in infiltration capacity under post-development conditions.

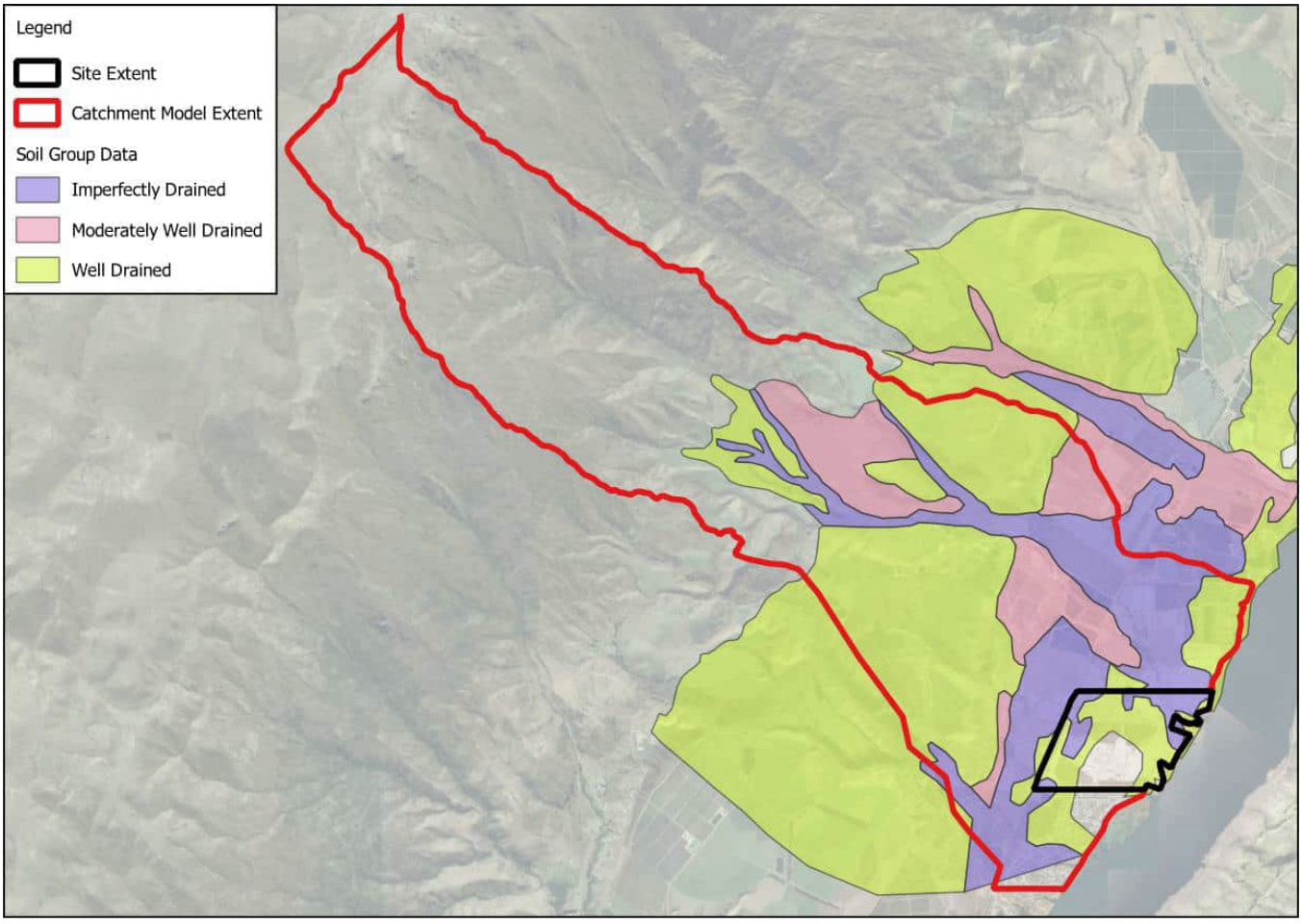


Figure 5: Soil Group Data

2.2.6 2D roughness

Manning's 'n' values have been used to represent the 2D roughness of different areas. Various Manning's coefficients were applied for the different land covers within the catchment, as seen in Figure 6. The manning's values applied are as follows:

a. Public roads – 0.02
b. Open Space – 0.05
c. Lots – 0.1
d. Open Water / Hydro – 0.1



Figure 6: 2d Mannings Roughness

2.3 Hydraulic Model

The following sections detail the hydraulic model parameters. It is noted that hydrographs generated by the HEC-HMS model were used as inputs to the hydraulic model.

2.3.1 Boundary Conditions

The HEC-HMS hydrographs derived from the catchment model were applied as inflow boundary conditions to the hydraulic models. Peak flow outputs from the HEC-HMS models for various subcatchments are provided in Appendix C. Where required, the catchment model also provides inflow boundary conditions directly to the internal site model as seen in Figure 7 and Figure 8.

A constant downstream boundary condition of 196.5 m RL has been applied, representing the future lake level based on reporting undertaken for Contact Energy, the asset owner. This correspondence is attached in Appendix D.

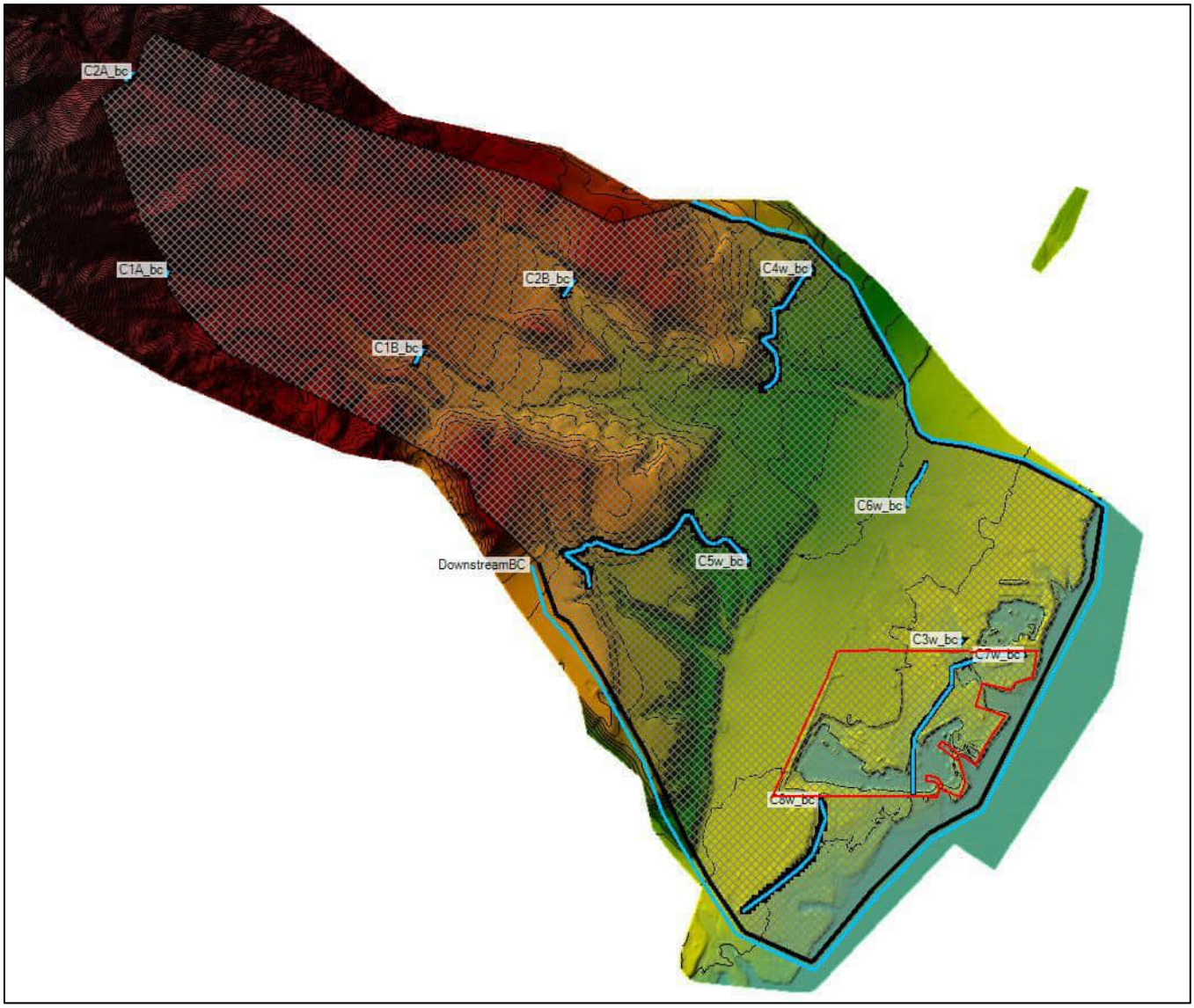


Figure 7: Catchment model boundary conditions



Figure 8: Internal model boundary conditions

2.3.2 2D Model Grid

The catchment model domain was characterised by grids of varying sizes, from 5 m × 5 m within the development area to 25 m × 25 m in the wider catchment. Breaklines were applied along stream corridors, channels, and stop banks, with smaller grid sizes applied in these areas for improved model representation.

The internal model grid was further refined to 2 m × 2 m to better capture flooding behaviour within the site. This mesh resolution is considered suitable to generate flow paths and floodplains through the modelled extent. The model also incorporates the preliminary pipe network to ensure potential ponding zones are adequately captured.

2.3.3 1D network

In the catchment wide model, the pipe network was not included as this model was developed to assess runoff contributions from the external catchment and to provide the basis for the alluvial fan assessment only. The pipe network was included in the internal/site model, as this model was intended to allow for more detailed analysis of flows within the site

The primary piped network within residential areas has been designed to the 5-year ARI in accordance with Central Otago District Council (CODC) guidelines. Figure 9 presents the preliminary pipe network layout, including pipe diameters, illustrating the proposed approach to primary flow management.

It should be noted that, for the 100-year ARI scenario, pipes smaller than 600 mm in diameter (except for catchpit leads) were excluded from the model to simulate partial blockage conditions. High-capacity inlet structures were incorporated to improve surface runoff collection and conveyance under these conditions.

The overall stormwater conveyance strategy includes two rectangular culverts within the central drainage corridor (Figure 9): Culvert 1 (1.2 m H × 4.0 m W) and Culvert 2 (1.2 m H × 6.0 m W). A bridge is also proposed across the floodway to provide connectivity between the north-western portion of the development and the remainder of the site (for modelling purposes this was left as an open channel).



Figure 9: Preliminary stormwater pipe network

2.3.4 Entry and Exit Losses

The head losses applied at the nodes have been adopted from the Auckland Council Modelling Specifications (2011) and are summarized in Table 3.

Table 3: Summary of head losses

Node type	Parameter
Upstream Manhole	Km = 0.2
Downstream Manhole	Km = 0.4
Culvert Inlet	Km = 0.5
Culvert Outlet	Km = 1.0

2.4 Alluvial Fan Model

The Otago Regional Council alluvial fan mapping has identified that a small portion of the development is overlaid by a 'active floodwater dominated' fan which extend from Mount Pisa to Lake Dunstan (Figure 10). Further uphill, more than 5 km from the development site, are smaller active debris-dominated fans which, for the purpose of this assessment, are not considered to pose a debris inundation risk to the development.

The portion of the fan identified within the site falls within an existing drainage corridor. A high-level assessment was conducted to determine whether extreme flood flows could adversely affect the development. For this purpose, the 100-year ARI event was scaled by a factor of three and routed through the site using the existing Catchment flood model. Given the floodwater-dominated classification of the fan, no allowance for sediment or debris loading was applied.

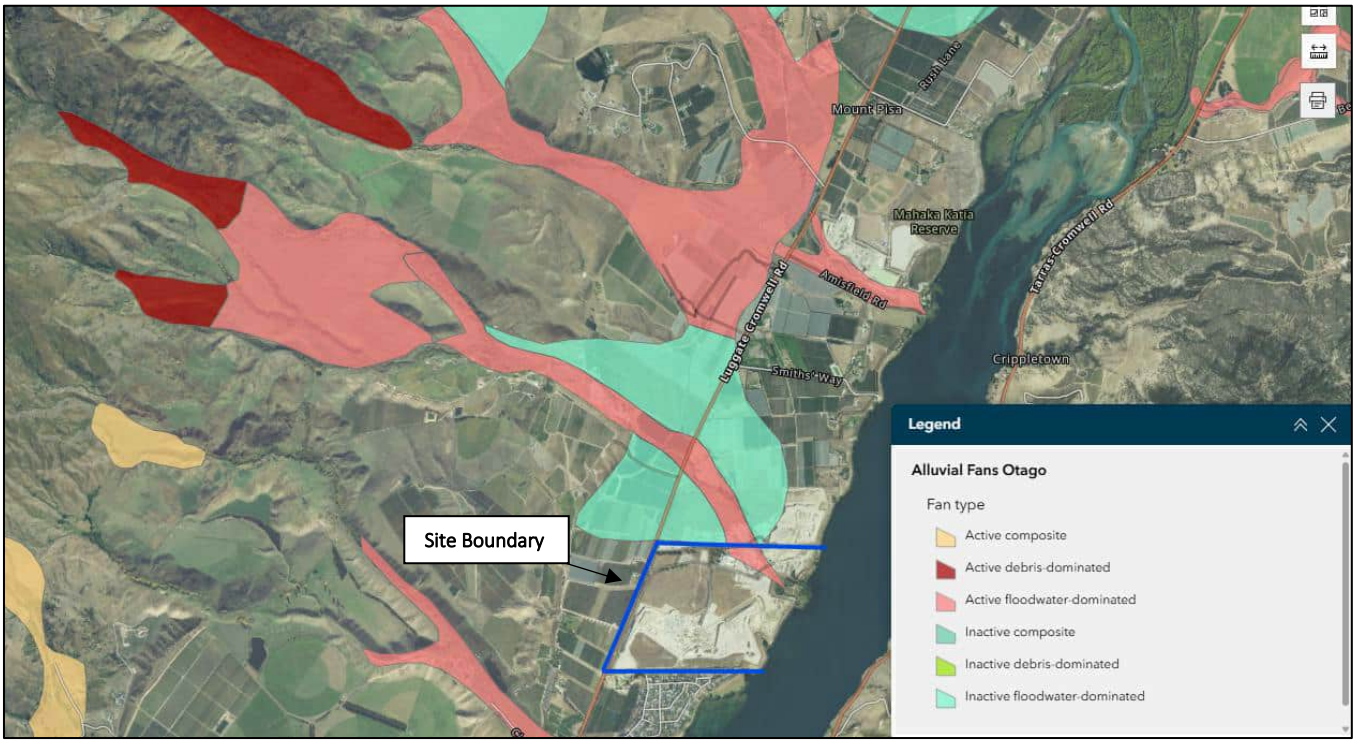


Figure 10: ORC Alluvial Fans Mapping

2.5 Flood modelling scenarios

A series of scenarios have been simulated across the three flood models to assess both pre- and post-development flood behaviour. The modelled scenarios are summarised in Table 4 below.

Table 4: Modelled scenarios

Model Extent	Scenario	Event	Land Use	Terrain	Purpose
Catchment	Pre-development	5, 10, 100-year	Existing conditions; external catchments assumed 100% pervious	Existing surfaces provided by Landpro	Establish baseline flood behaviour and quantify external flow contributions to the site
Catchment	Post-development	5, 10, 100-year	Full build-out; lots 60% impervious, roads and hard-stand 100% impervious; external catchments 100% pervious	Existing surfaces with northern property landform modified to reflect the reduced floodway	Assess the influence of the proposed development and neighbouring redevelopment on flood behaviour; provide boundary conditions to the internal model
Internal Site	Post-development	5, 10, 100-year	Full build-out; lots 60% impervious, roads and hard-stand 100% impervious	Design surfaces incorporating the preliminary pipe network and proposed culverts	Assess localised flood behaviour within the site and inform stormwater design optioneering
Catchment	Alluvial Fan	100-year × 3	Existing conditions	Existing surfaces with northern property landform modified to reflect the reduced floodway	Assess the potential for extreme alluvial fan flows to adversely affect the development

3.0 Flood Modelling Results

This section presents the results of the flood modelling scenarios summarised in Table 4. Results are discussed across the three models - the catchment model, the internal site model, and the alluvial fan model - for the pre- and post-development scenarios. This report should be read in conjunction with the Stormwater Management Plan (SMP), which provides a summary of the key findings.

A full set of flood model results is included in Appendix E.

3.1 Catchment Model Flood Results

Pre- and post-development catchment models were developed for the catchment-wide extent. As discussed in Section 2.1, the post-development model incorporates modifications to the northern property's landform to reflect the proposed reduction of the floodway as part of the separate neighbouring redevelopment. The pre- and post-development 100-year ARI results are shown in Figure 11 and Figure 12 respectively. A comparison of the flood extents upstream of northern property boundary are shown in Figure 13.

It should be noted that for the post development model, the catchment wide model does not incorporate the proposed pipe network within the site. Therefore, flood levels within the site have been assessed using the internal model as discussed in section 3.2.

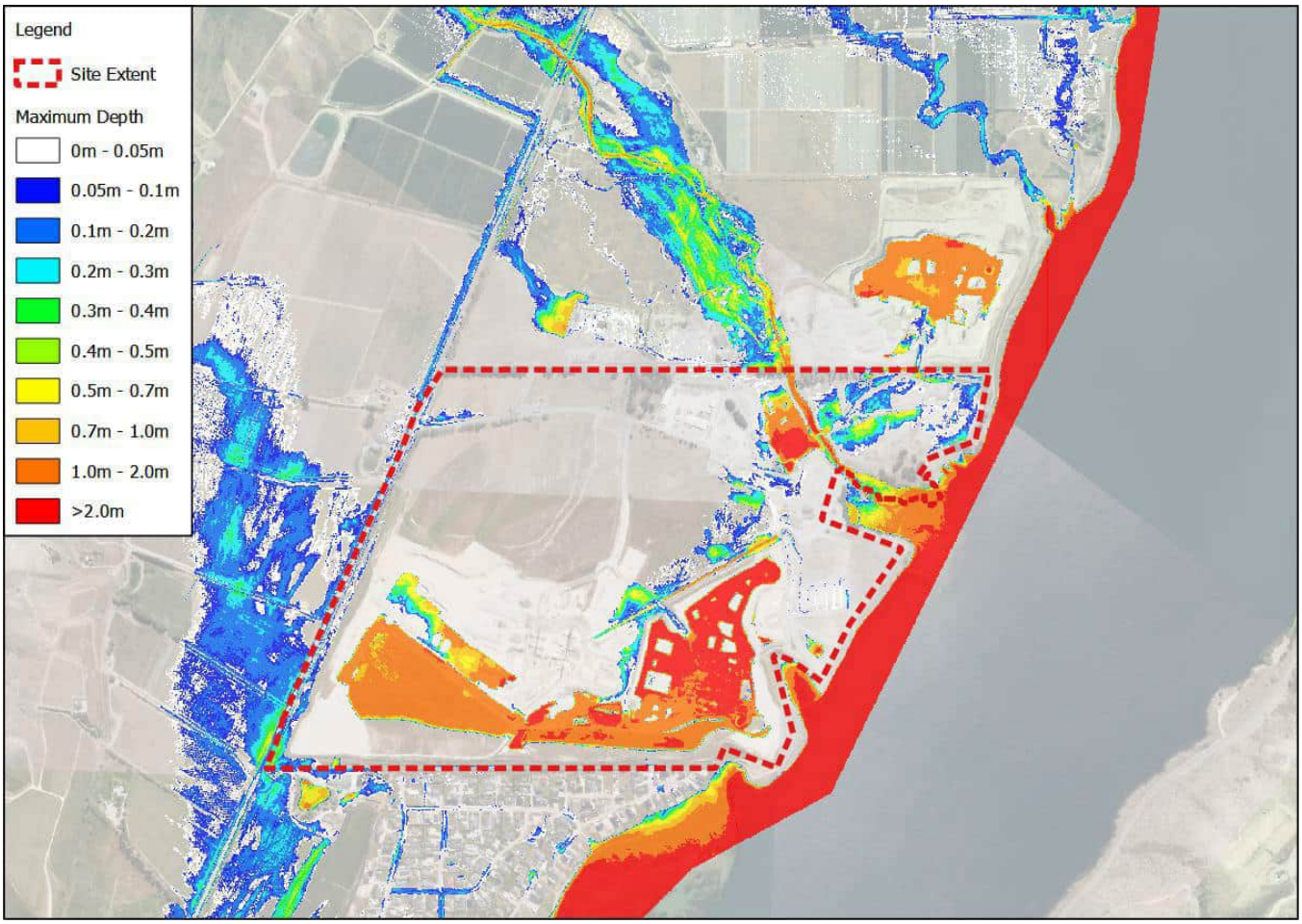


Figure 11: Predevelopment 100-year ARI RCP8.5

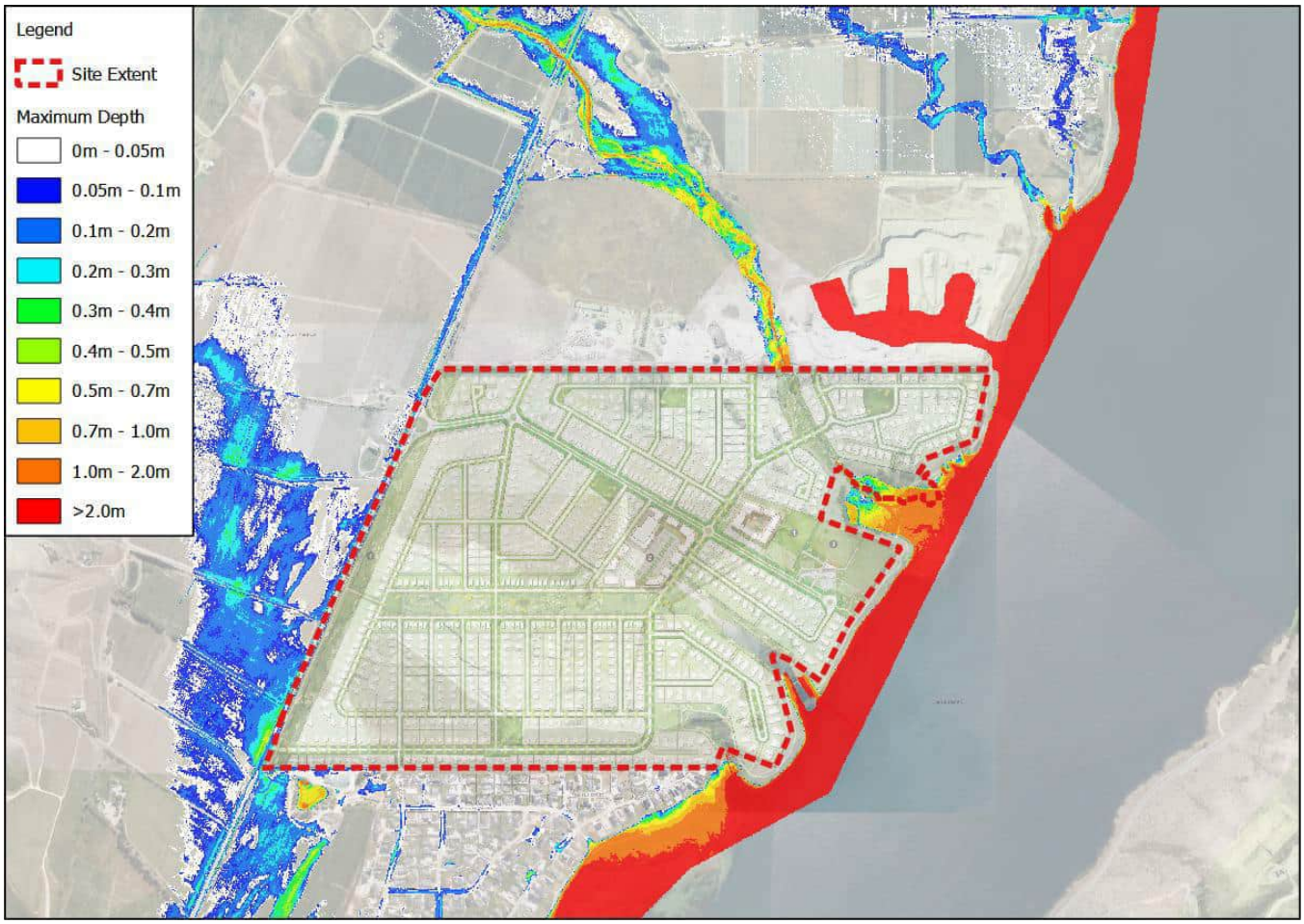


Figure 12: Post development 100-year ARI RCP8.5

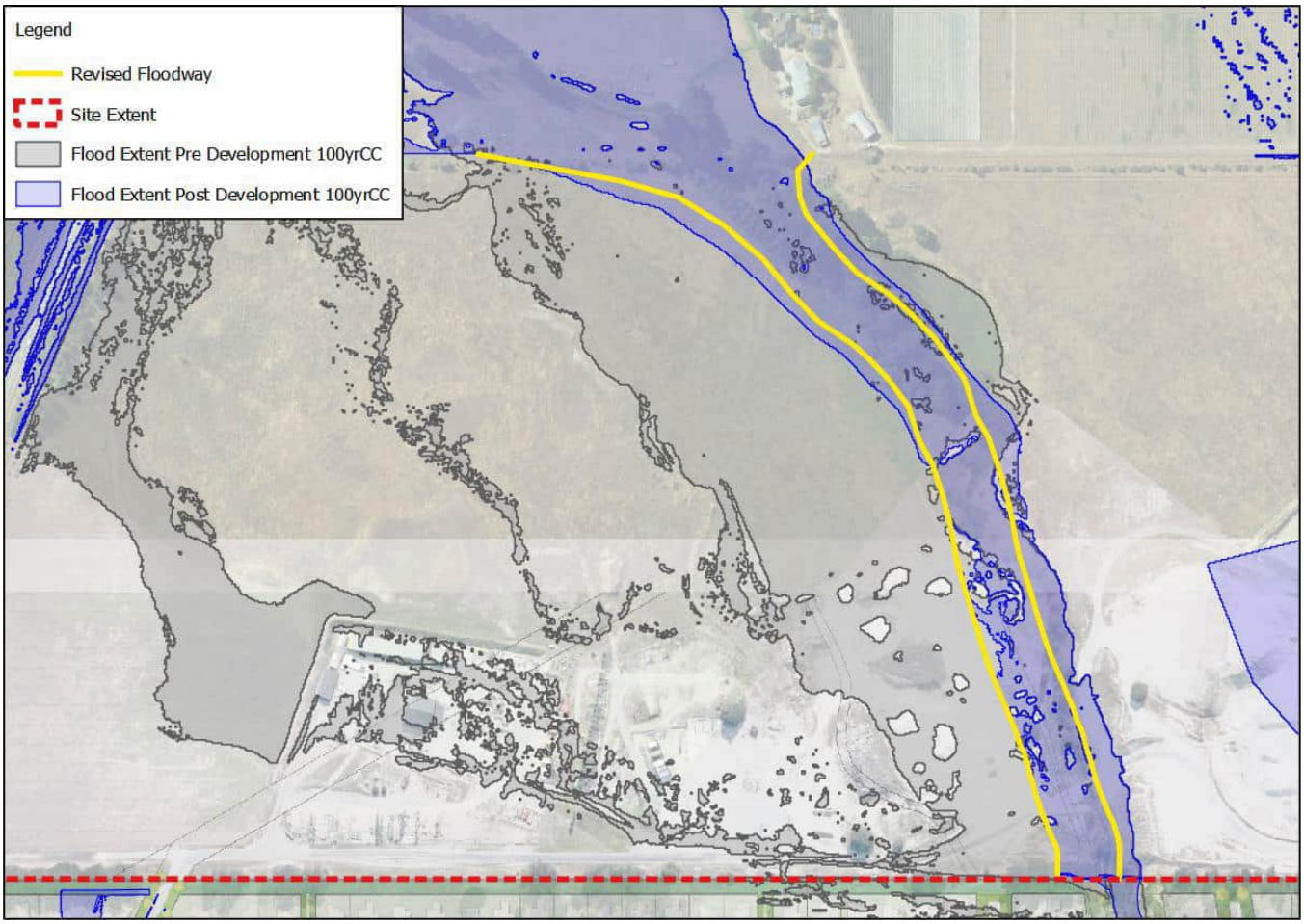


Figure 13: Flooding upstream of northern property (Bonisch Site)

3.2 Internal Model Flood Results

A refined site model was developed to assess flooding behaviour within the development for the 5-year, 10-year, and 100-year ARI events. The results are shown in Figure 14, Figure 14 and Figure 15 respectively.



Figure 14: 5-year ARI internal flooding



Figure 15: 10-year ARI internal flooding

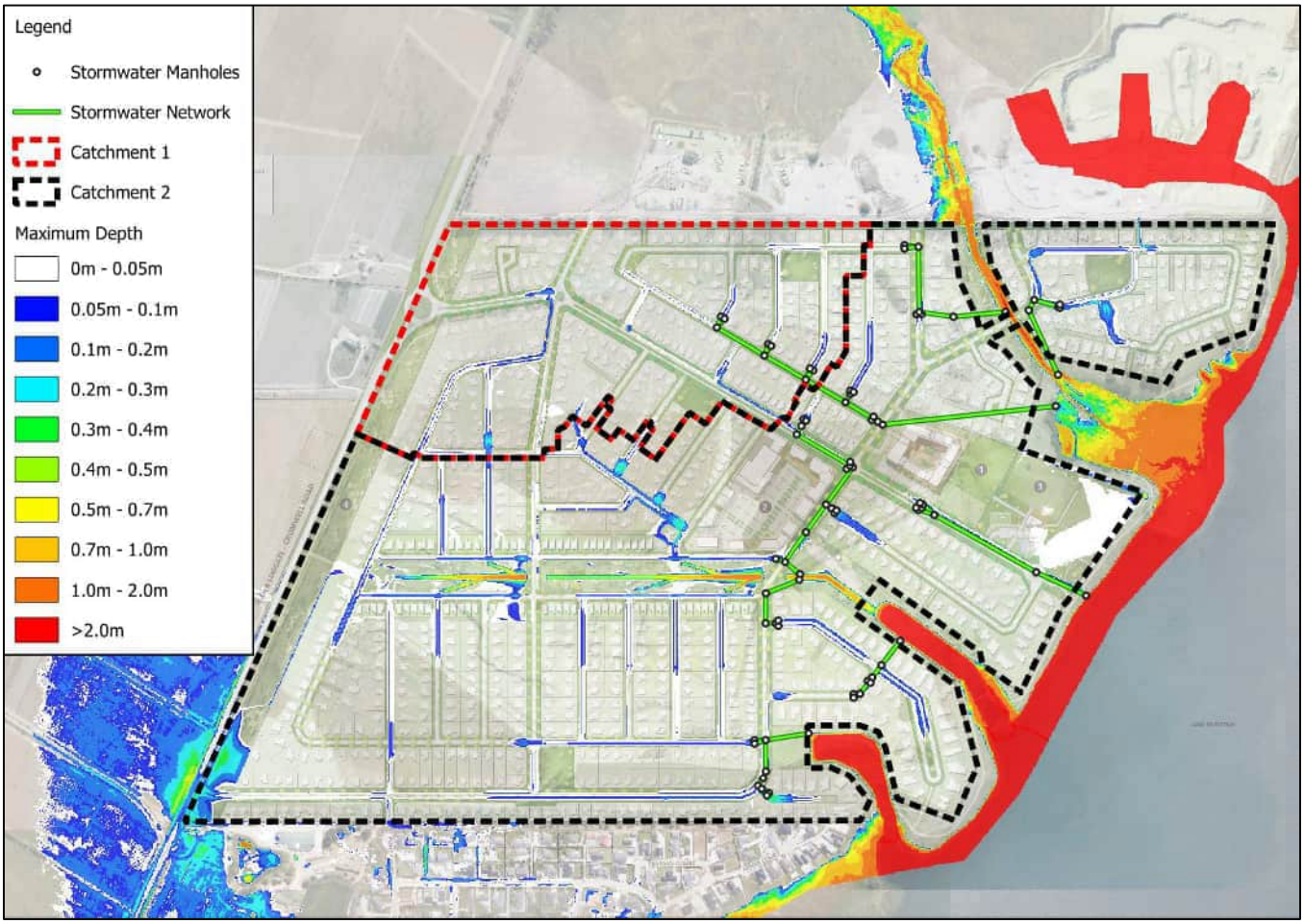


Figure 16: 100-year ARI internal flooding

3.3 Alluvial Hazard Model Results

The alluvial fan model was used to assess whether extreme flood flows from the active, floodwater-dominated fan could adversely affect the development. As described in Section 2.4, the 100-year ARI event was scaled by a factor of three to represent a conservative extreme flow scenario.

Figure 17 shows the modelled flood extents for both the 100-year ARI and the scaled 100-year ARI × 3 scenario through the drainage corridor. Figure 18 and Figure 19 shows the upstream and downstream cross sections within the development site, respectively, where the terminal point of the alluvial fan is shown.

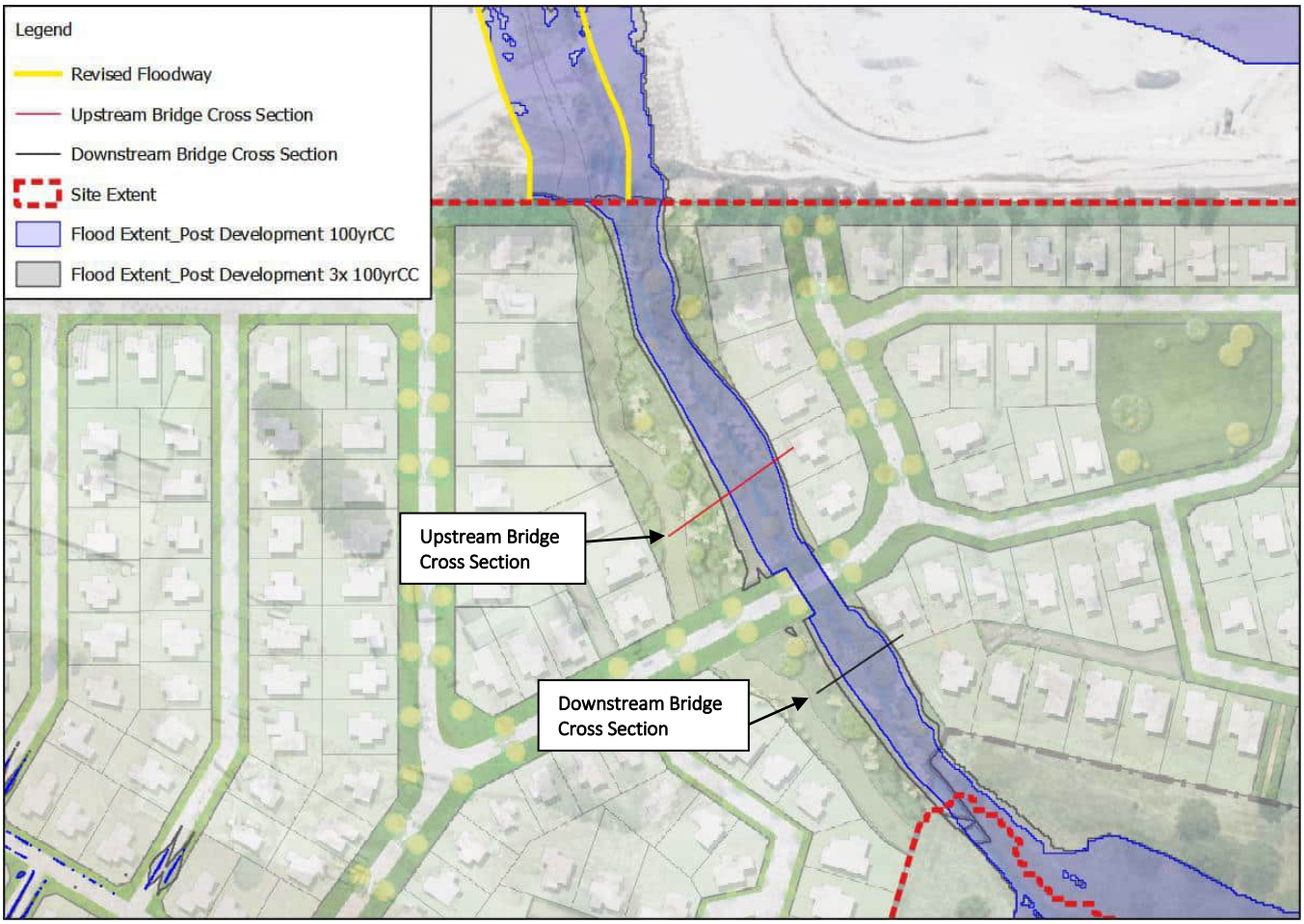


Figure 17: Extreme flood levels through drainage corridor

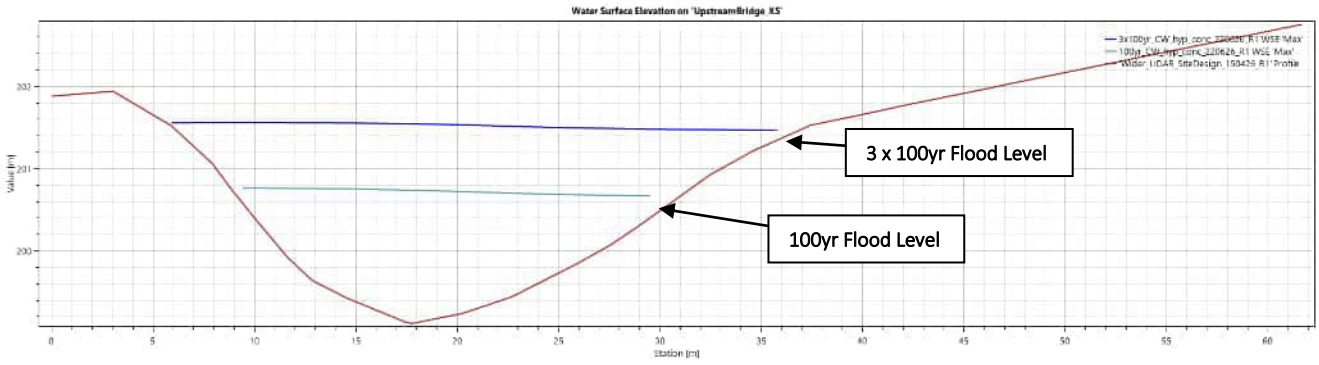


Figure 18: Upstream flood levels (1x100yr vs 3x100yr events)

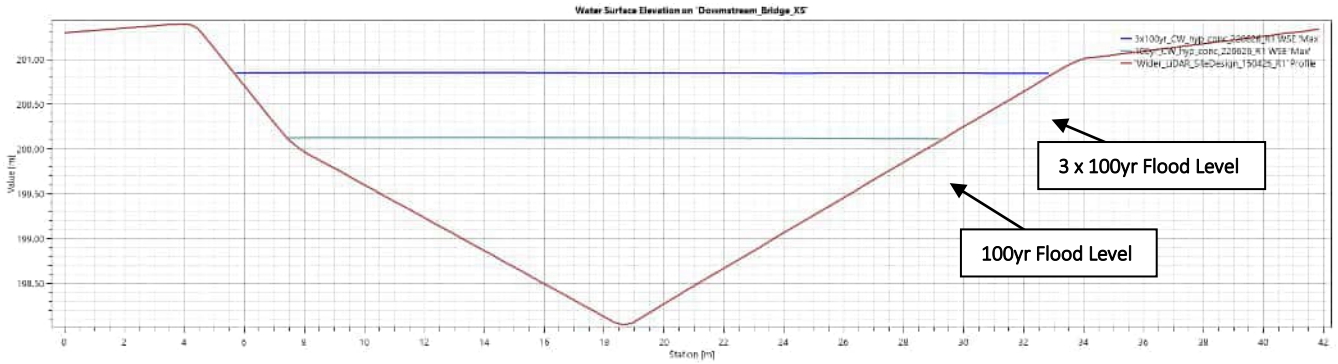


Figure 19: Downstream flood levels (1x100yr vs 3x100yr events)

4.0 Flood Hazard Assessment

The flood risk to people is associated with the likelihood of coming into contact with fast flowing deep flood waters. The Australian Rainfall-Runoff 2019 manual (ARR) methodology is considered best practice in Australia and New Zealand to assess this risk.

A quantitative hazard assessment was undertaken for the 100-year ARI event in accordance with the ARR methodology, assuming the stormwater network is fully operative. The results are shown in Figure 20.

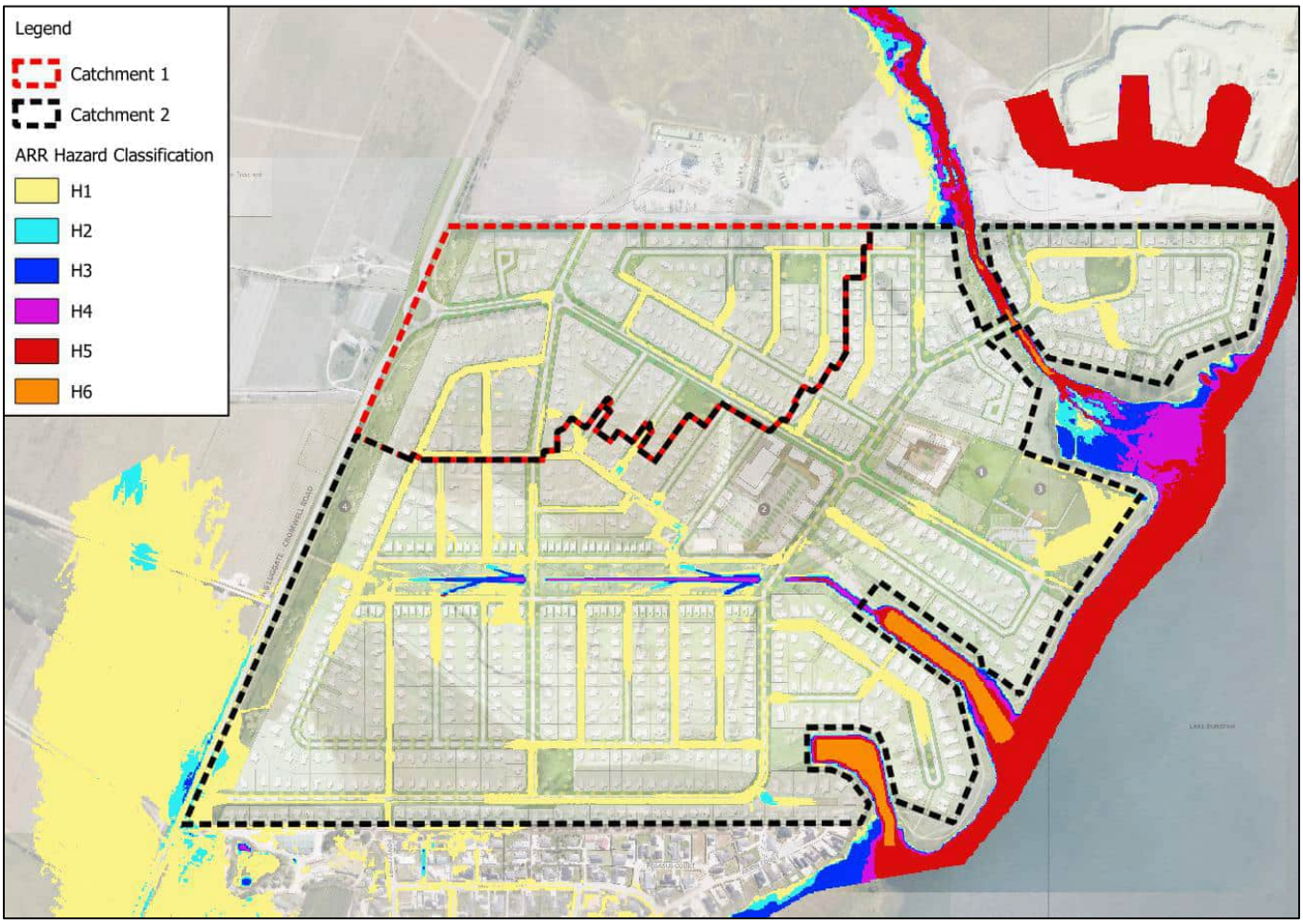


Figure 20: 100-year ARI ARR Hazards

5.0 Modelling Limitations & Assumptions

The flood modelling undertaken represents the flood risk within the modelled extent and are subject to assumptions and limitations outlined below:

- The design storms have been derived in accordance with the applicable regional rainfall methodology. The adopted rainfall model carries inherent uncertainty, and flow results should be understood as estimates within a reported confidence range rather than precise predictions.
- The runoff flows calculated by the hydrological model are loaded in the hydraulic model at specified nodes inside the two-dimensional model extents (structured mesh). Inside the two-dimensional model extents, water can flow in all directions from the loading node. The extents of the flow paths may vary according to the location of the loading node, the elevation of the two-dimensional grid cells (from LiDAR data) and other model assumptions. The location of the loading determines the origin of the overland flow path.
- No sedimentation or blockage has been allowed for in any watercourses or culverts. i.e., it is assumed that all culverts and watercourses are fully operational.
- The potential for change in asset condition over time is not represented.
- This model has been prepared to provide guidance on flood levels and depths within the modelled catchment area for the modelled scenario. The modelling process relies on a range of assumptions and

simplifications and is subject to errors and inaccuracies. The compounding effects of the uncertainties in the rainfall model, the uncertainties in the contour model and the uncertainties in hydraulic parameters such as roughness could result in the water level varying from the mapped levels.

- Topographic data used in the model has been sourced from a combination of survey methods, each carrying their own vertical accuracy tolerances. These tolerances introduce additional uncertainty into modelled flood extents, particularly in areas of low relief or where the flood boundary is sensitive to small changes in ground elevation. Additional error is introduced through the application of geodetic height models to the underlying survey data.
- The results of this modelling should be interpreted in the context of these limitations and used as a guide to inform design and planning decisions rather than as definitive predictions of flood behaviour.

6.0 Conclusion

Flood modelling has been undertaken for the proposed residential development at 922 Luggate-Cromwell Road, Cromwell, in support of a substantive EPA application under the Fast-Track Approvals Act 2024. Three flood models were developed and simulated across the 5-year, 10-year, and 100-year ARI events, incorporating the RCP8.5 climate change scenario for the period 2081-2100.

It is intended that this report be read in conjunction with the Stormwater Management Plan (SMP) prepared by Woods, which provides the broader stormwater design context and an interpretation of the key findings.

Appendix A

ToC Comparison

TP 108 Worksheet

WORKSHEET 1: RUNOFF PARAMETERS AND TIME OF CONCENTRATION - OLFP

Catchment Details

Total Area (ha)	Atotal =	1012.09		
Pervious Area (ha)	Aper =	1001.97		
Impervious Area (ha)	Aimp =	10.12		
Channelisation factor	C =	1	0.6 piped stormwater system.	0.8 engineered grassed channels.
Catchment Length (km)	L =	11.88		
Catchment Slope (m/m)	Sc =	0.087		
Catchment Height (m)	H=	1539.39		

ASSUMPTIONS (IF ANY)

			Area (ha)	CN x Area
Drainage	CN	Ratio	1002	
Well drained	56	0.9	901.8	50500.8
Moderately drained	72	0.05	50.1	3607.2
Poorly drained	80	0.05	50.1	4008
		Weighted pervious CN =		58

RUNOFF CURVE NUMBER (CN) AND INITIAL ABSTRACTION (Ia)

Soil Name & Classification	Cover Desctiption (cover type, treatment and hydrological condition)	Curve number	Area (ha)	Product CN x Area
Group C	Pervious	58	1001.97	58114.43748
Group C	Impervious	98	10.12	991.85212
		Total	**1012.09**	**59106.2896**

CN (weighted) = total product / total area = 59106.29 / 1012.09 = **58.4**

Ia (weighted) = 5 x pervious area / total area = 5009.865 / 1012.09 = **4.95**



Figure 1 South Island contour maps of q*

TIME OF CONCENTRATION

Runoff Factor = CN / (200 - CN) = 0.412429

TP108 Method

Tc = 0.14CL^0.66 (CN/200-CN)^-0.55 * Sc^-0.30 = **2.429** hrs = **145.744** mins

Ramser-Kirpich Equation

Tc = 0.0195L^0.77 *Sc^-0.385 = **1.143** hrs = **68.584** mins

Bransby-Williams Equation

Tc = (0.953*L^1.2)/(A^0.1*H^0.2) = **3.395** hrs = **203.728** mins

WORKSHEET 2 : GRAPHICAL PEAK FLOW RATE

1. Catchment Area (km2) = 10.121

2. Storage, S = 25.4 x [(1000/CN) - 10] = 180.932

			Storm #1	Storm #2	Storm #3
3. Annual Recurrence Interval (ARI)					100
4. 24 hour rainfall depth, P24 (mm)					111
5. Compute C* =	P24 - 2Ia / P24 - 2Ia + 2S	(mm)			0.22
6. specific flow rate q*					0.02
7. Peak flow rate, q_p = q*AP_{24} (m^3/sec)					22.47
8. Runoff depth, Q_{24} =	$(P_{24} - Ia)^2$ / $(P_{24} - Ia) + S$	(mm)			39.19
9. Runoff Volume, V_{24} = 1000 x Q_{24}A (m^3)					396632

WORKSHEET 3 : REIGONAL FLOOD ESTIMATION

10. Catchment Area (km2)		=	10.121	km2
11. Specific Discharge (m3/s)	q* (refer Figure 1)	=	0.5	
	q100 (refer Figure 2)	=	3	
12. Plotted mean Annual Flood, Q* (m3/s)	**Q*** = q*A^0.8	=	3.185	m3/s
13. Peak flow rate, Q100 (m3/s)	Q100=q100***Q***	=	9.556	m3/s

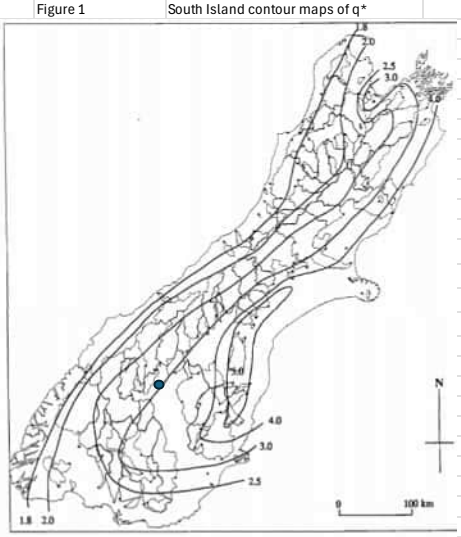


Figure 2 South Island contour maps of q100

Appendix B

Typical Lot Layout

LOT TESTING

LOT NUMBER: 295

LOT AREA: 625m^2

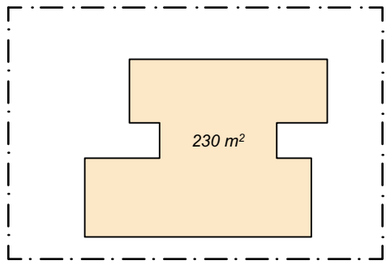
FLOOR AREA: 227m^2

RESIDENTIAL STANDARDS ASSESSMENT

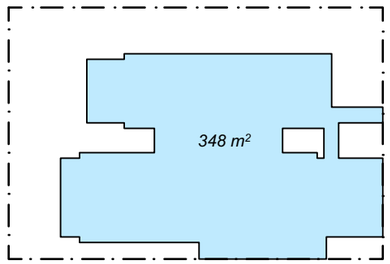
STANDARDS	REQUIREMENT	PROPOSED	COMPLIANCE
BUILDING HEIGHT	Maximum 7.5m	6.1m	☑
BULK AND LOCATION	Front Yards: 4.5m Side and Rear Yards: 3.0m & 1.8m	4.5m front + 1.8m side + 6.3m rear	☑
BUILDING COVERAGE	Maximum 40%	230m^2 (37%)	☑
IMPERVIOUS AREA	Maximum 60%	348m^2 (56%)	☑



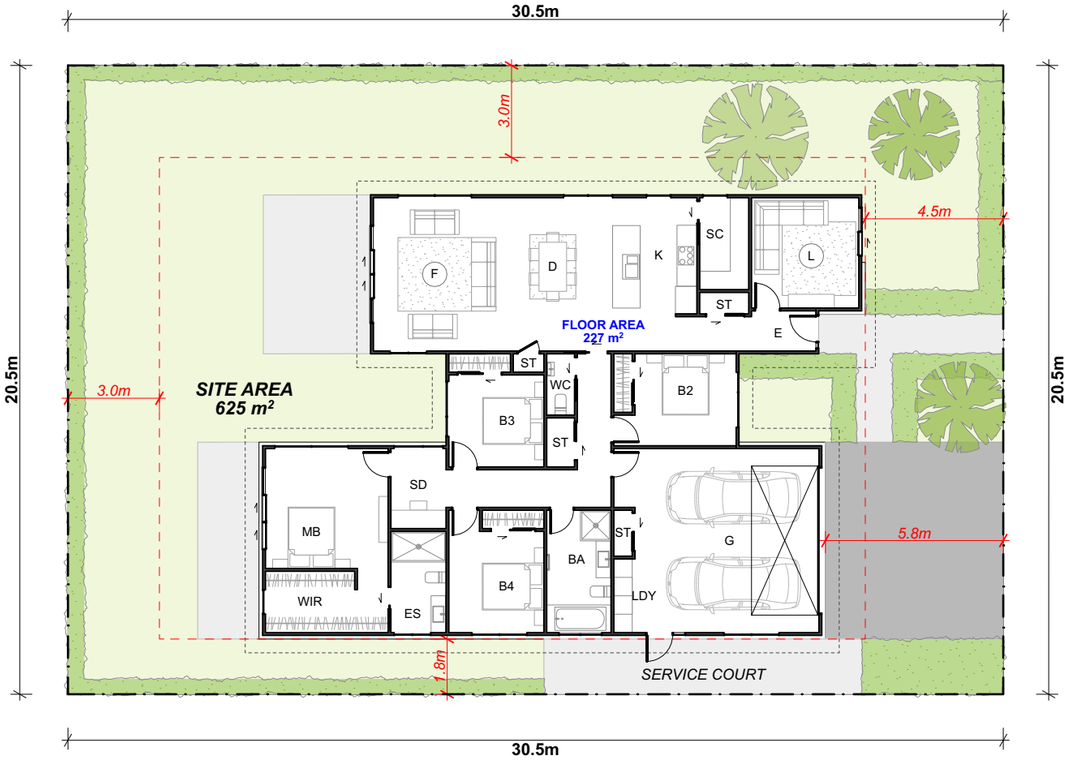
1 - SITE LOCATION



2 - BUILDING COVERAGE
1:500



3 - IMPERVIOUS AREA
1:500



4 - INDICATIVE BUILDING LAYOUT
1:200

N

PARKBURN

Fulton Hogan LAND DEVELOPMENT LTD.

Appendix C

HEC-HMS Outputs

Wider Catchment

Global Summary Results for Run "5yrRCP8.5_catchment"

Project: P24-642 - Luggate Crom Simulation Run: 5yrRCP8.5_catchment

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 17:47:34
Basin Model: Parkburn
Meteorologic Model: 5yrRCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catch2A	7.59694	7.62157	1 January 2000, 12:50	103.9907
Catch1B	2.80843	3.13018	1 January 2000, 12:40	38.6973
Catch2B	2.52400	2.55236	1 January 2000, 12:50	34.5668
Catch1A	1.81599	2.40375	1 January 2000, 12:20	25.2566
CATCH_5	3.17940	4.23229	1 January 2000, 12:50	55.0995
CATCH_4	2.00670	2.85595	1 January 2000, 12:40	34.8850
CATCH_7	1.08300	3.77419	1 January 2000, 12:50	52.8814
CATCH_8	0.83200	2.35936	1 January 2000, 12:50	32.8210
CATCH_6	0.82520	1.54963	1 January 2000, 12:30	16.4985
CATCH_3	0.80000	2.66965	1 January 2000, 12:30	28.5179

5-year ARI

Global Summary Results for Run "10yrRCP8.5_catchment"

Project: P24-642 - Luggate Crom Simulation Run: 10yrRCP8.5_catchment

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 17:46:09
Basin Model: Parkburn
Meteorologic Model: 10yrRCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catch2A	7.59694	10.54235	1 January 2000, 12:50	142.3806
Catch1B	2.80843	4.32946	1 January 2000, 12:40	52.9719
Catch2B	2.52400	3.52972	1 January 2000, 12:50	47.3270
Catch1A	1.81599	3.33164	1 January 2000, 12:20	34.5631
CATCH_5	3.17940	5.70164	1 January 2000, 12:50	73.6969
CATCH_4	2.00670	3.85138	1 January 2000, 12:40	46.6562
CATCH_7	1.08300	4.55150	1 January 2000, 12:50	64.0127
CATCH_8	0.83200	2.91751	1 January 2000, 12:50	40.5806
CATCH_6	0.82520	2.07904	1 January 2000, 12:30	21.9435
CATCH_3	0.80000	3.33483	1 January 2000, 12:30	35.5878

10-year ARI

Global Summary Results for Run "WiderCatch100yr"

Project: P24-642 - Luggate Crom Simulation Run: WiderCatch100yr

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 10:16:26
Basin Model: Parkburn
Meteorologic Model: 100yr RCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Catch2A	7.59694	22.96802	1 January 2000, 12:50	302.9844
Catch1B	2.80843	9.43101	1 January 2000, 12:40	112.6665
Catch2B	2.52400	7.68606	1 January 2000, 12:50	100.7076
Catch1A	1.81599	7.29311	1 January 2000, 12:20	73.4597
CATCH_5	3.17940	11.79533	1 January 2000, 12:40	149.2318
CATCH_4	2.00670	7.95543	1 January 2000, 12:40	94.4574
CATCH_7	1.08300	7.27995	1 January 2000, 12:50	103.2235
CATCH_8	0.83200	4.94497	1 January 2000, 12:50	68.7243
CATCH_6	0.82520	4.21440	1 January 2000, 12:30	43.6352
CATCH_3	0.80000	5.79551	1 January 2000, 12:30	61.6413

100-year ARI

Site Catchment

Global Summary Results for Run "Detailed Catchment 5yr RCP"

Project: P24-642 - Luggate Crom Simulation Run: Detailed Catchment 5yr RCP

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 17:38:30

Basin Model: Detailed Catchment
Meteorologic Model: 5yrRCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
C1	0.04542	0.30607	1 January 2000, 12:00	1.9216
C10	0.03811	0.25684	1 January 2000, 12:00	1.6125
C11	0.01162	0.07829	1 January 2000, 12:00	0.4916
C12	0.01188	0.04101	1 January 2000, 12:00	0.2560
C13	0.01282	0.08638	1 January 2000, 12:00	0.5423
C14	0.05617	0.37851	1 January 2000, 12:00	2.3764
C15	0.03320	0.22373	1 January 2000, 12:00	1.4047
C16	0.00471	0.01626	1 January 2000, 12:00	0.1015
C17	0.02565	0.17285	1 January 2000, 12:00	1.0852
C18	0.02275	0.15331	1 January 2000, 12:00	0.9625
C19	0.01788	0.12050	1 January 2000, 12:00	0.7566
C2	0.04858	0.32738	1 January 2000, 12:00	2.0555
C20	0.03792	0.25553	1 January 2000, 12:00	1.6043
C21	0.01400	0.09434	1 January 2000, 12:00	0.5923
C22	0.03460	0.23316	1 January 2000, 12:00	1.4639
C23	0.01946	0.13116	1 January 2000, 12:00	0.8235
C24	0.03181	0.21438	1 January 2000, 12:00	1.3460
C25	0.02437	0.16421	1 January 2000, 12:00	1.0310
C26	0.02547	0.17163	1 January 2000, 12:00	1.0775
C27	0.02811	0.18945	1 January 2000, 12:00	1.1895
C28	0.04753	0.32031	1 January 2000, 12:00	2.0110
C29	0.01789	0.06176	1 January 2000, 12:00	0.3855
C29_2	0.01317	0.04546	1 January 2000, 12:00	0.2838
C3	0.03180	0.21430	1 January 2000, 12:00	1.3454
C30	0.01492	0.10053	1 January 2000, 12:00	0.6312
C31	0.02893	0.19497	1 January 2000, 12:00	1.2241
C32	0.05992	0.40378	1 January 2000, 12:00	2.5351
C33	0.04545	0.30628	1 January 2000, 12:00	1.9230
C34	0.04512	0.30405	1 January 2000, 12:00	1.9089
C35	0.05193	0.34996	1 January 2000, 12:00	2.1972
C36	0.02967	0.19993	1 January 2000, 12:00	1.2552
C37	0.02875	0.19374	1 January 2000, 12:00	1.2164
C4	0.04575	0.30830	1 January 2000, 12:00	1.9356
C5	0.04640	0.31268	1 January 2000, 12:00	1.9631
C6	0.02503	0.16868	1 January 2000, 12:00	1.0591
C7	0.04538	0.30582	1 January 2000, 12:00	1.9201
C8	0.00850	0.02934	1 January 2000, 12:00	0.1831
C9	0.01510	0.10176	1 January 2000, 12:00	0.6389

5-year ARI

Global Summary Results for Run "Deatiled Catchment 10yr RCP"

Project: P24-642 - Luggate Crom Simulation Run: Deatiled Catchment 10yr RCP

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 17:41:02

Basin Model: Detailed Catchment
Meteorologic Model: 10yrRCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
C1	0.04542	0.37457	1 January 2000, 12:00	2.3562
C10	0.03811	0.31432	1 January 2000, 12:00	1.9772
C11	0.01162	0.09582	1 January 2000, 12:00	0.6027
C12	0.01188	0.05549	1 January 2000, 12:00	0.3421
C13	0.01282	0.10572	1 January 2000, 12:00	0.6650
C14	0.05617	0.46323	1 January 2000, 12:00	2.9138
C15	0.03320	0.27380	1 January 2000, 12:00	1.7223
C16	0.00471	0.02200	1 January 2000, 12:00	0.1356
C17	0.02565	0.21154	1 January 2000, 12:00	1.3306
C18	0.02275	0.18762	1 January 2000, 12:00	1.1802
C19	0.01788	0.14747	1 January 2000, 12:00	0.9276
C2	0.04858	0.40065	1 January 2000, 12:00	2.5202
C20	0.03792	0.31272	1 January 2000, 12:00	1.9671
C21	0.01400	0.11546	1 January 2000, 12:00	0.7263
C22	0.03460	0.28535	1 January 2000, 12:00	1.7949
C23	0.01946	0.16051	1 January 2000, 12:00	1.0097
C24	0.03181	0.26236	1 January 2000, 12:00	1.6503
C25	0.02437	0.20097	1 January 2000, 12:00	1.2642
C26	0.02547	0.21004	1 January 2000, 12:00	1.3212
C27	0.02811	0.23185	1 January 2000, 12:00	1.4584
C28	0.04753	0.39199	1 January 2000, 12:00	2.4658
C29	0.01789	0.08357	1 January 2000, 12:00	0.5152
C29_2	0.01317	0.06152	1 January 2000, 12:00	0.3793
C3	0.03180	0.26226	1 January 2000, 12:00	1.6497
C30	0.01492	0.12303	1 January 2000, 12:00	0.7739
C31	0.02893	0.23860	1 January 2000, 12:00	1.5009
C32	0.05992	0.49415	1 January 2000, 12:00	3.1084
C33	0.04545	0.37483	1 January 2000, 12:00	2.3578
C34	0.04512	0.37210	1 January 2000, 12:00	2.3406
C35	0.05193	0.42828	1 January 2000, 12:00	2.6940
C36	0.02967	0.24468	1 January 2000, 12:00	1.5391
C37	0.02875	0.23710	1 January 2000, 12:00	1.4914
C4	0.04575	0.37730	1 January 2000, 12:00	2.3733
C5	0.04640	0.38266	1 January 2000, 12:00	2.4071
C6	0.02503	0.20644	1 January 2000, 12:00	1.2985
C7	0.04538	0.37426	1 January 2000, 12:00	2.3542
C8	0.00850	0.03971	1 January 2000, 12:00	0.2448
C9	0.01510	0.12453	1 January 2000, 12:00	0.7833

10-year ARI

Global Summary Results for Run "Detailed Catchment 100yr RCP"

Project: P24-642 - Luggate Crom Simulation Run: Detailed Catchment 100yr RCP

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 22Jun2026, 17:42:27

Basin Model: Detailed Catchment
Meteorologic Model: 100yr RCP8.5
Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Alphabetic

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
C1	0.04542	0.62199	1 January 2000, 12:00	3.9226
C10	0.03811	0.52192	1 January 2000, 12:00	3.2915
C11	0.01162	0.15912	1 January 2000, 12:00	1.0035
C12	0.01188	0.11309	1 January 2000, 12:00	0.6808
C13	0.01282	0.17555	1 January 2000, 12:00	1.1071
C14	0.05617	0.76921	1 January 2000, 12:00	4.8510
C15	0.03320	0.45466	1 January 2000, 12:00	2.8673
C16	0.00471	0.04483	1 January 2000, 12:00	0.2699
C17	0.02565	0.35126	1 January 2000, 12:00	2.2152
C18	0.02275	0.31155	1 January 2000, 12:00	1.9648
C19	0.01788	0.24487	1 January 2000, 12:00	1.5443
C2	0.04858	0.66529	1 January 2000, 12:00	4.1957
C20	0.03792	0.51928	1 January 2000, 12:00	3.2748
C21	0.01400	0.19172	1 January 2000, 12:00	1.2091
C22	0.03460	0.47383	1 January 2000, 12:00	2.9882
C23	0.01946	0.26652	1 January 2000, 12:00	1.6808
C24	0.03181	0.43565	1 January 2000, 12:00	2.7474
C25	0.02437	0.33372	1 January 2000, 12:00	2.1046
C26	0.02547	0.34878	1 January 2000, 12:00	2.1996
C27	0.02811	0.38498	1 January 2000, 12:00	2.4279
C28	0.04753	0.65091	1 January 2000, 12:00	4.1050
C29	0.01789	0.17030	1 January 2000, 12:00	1.0252
C29_2	0.01317	0.12537	1 January 2000, 12:00	0.7547
C3	0.03180	0.43548	1 January 2000, 12:00	2.7464
C30	0.01492	0.20431	1 January 2000, 12:00	1.2885
C31	0.02893	0.39620	1 January 2000, 12:00	2.4986
C32	0.05992	0.82056	1 January 2000, 12:00	5.1749
C33	0.04545	0.62241	1 January 2000, 12:00	3.9253
C34	0.04512	0.61788	1 January 2000, 12:00	3.8967
C35	0.05193	0.71117	1 January 2000, 12:00	4.4850
C36	0.02967	0.40630	1 January 2000, 12:00	2.5623
C37	0.02875	0.39372	1 January 2000, 12:00	2.4830
C4	0.04575	0.62652	1 January 2000, 12:00	3.9512
C5	0.04640	0.63542	1 January 2000, 12:00	4.0073
C6	0.02503	0.34279	1 January 2000, 12:00	2.1618
C7	0.04538	0.62147	1 January 2000, 12:00	3.9193
C8	0.00850	0.08091	1 January 2000, 12:00	0.4871
C9	0.01510	0.20679	1 January 2000, 12:00	1.3041

100-year ARI

Appendix D

Contact Energy Correspondence

Central Otago News Print

LAKE DUNSTAN
DEVELOPMENT GUIDE

Electricity Corporation
of New Zealand Limited
ELECTRICORP PRODUCTION

April 1990

WATER LEVELS IN LAKE DUNSTAN

(Levels in metres above mean sea level)

	Time from lake filling								
	Immediate			30 years			100 years		
Flow condition:	1	2	3	1	2	3	1	2	3
Water level at:									
Clyde Dam	194.5	195.0	195.1	194.5	195.0	195.1	194.5	195.0	195.1
Pisa Mooring Reach	194.5	195.1	195.3	194.5	195.2	195.4	194.8	196.2	196.8
Clarkes Rd Reach	194.5	195.1	195.3	194.5	195.2	195.4	194.8	196.2	196.8
Lowburn Inlet	194.5	195.1	195.3	194.5	195.2	195.4	194.8	196.2	196.8
Brewery Creek	194.5	195.1	195.3	194.5	195.2	195.3	194.8	196.0	196.5

Flow Condition Columns:

1. Levels with flow for maximum generation at Clyde (1200 cumecs)
2. Levels with a 100 year flood (2600 cu.metres/sec)
3. Levels with a 500 year flood (3200 cu.metres/sec)

Figure 1.

5: Criteria

Generally both on-water and shoreline activities and facilities will need to be designed and sited to take account of the above considerations. All proposals received will be assessed in terms of their response to these features.

(a) Location of Facilities

Electricorp's main concern about the location of facilities will be in relation to the dam and intake structures, in order that a reasonable margin of safety can be maintained.

The proposed location of structures/facilities/activities should be acceptable to the various other agencies having jurisdiction or likely to have future jurisdiction over the designated area. The proposals will be referred to these agencies for comment.

(b) Access

Any development proposal should include an agreement to allow Electricorp to gain access to any area of the reservoir or foreshore to carry out maintenance and other activities related to Electricorp's activities.

(c) Potential for Flooding

There is potential for flooding of the reservoir beyond its maximum operating level of 194.5m above mean sea level to approximately a lake level of 196m. This level is calculated for a one in 500 year flood and to allow for sedimentation effects after 30 years operation of the reservoir. This level is not intended to cover every eventuality or every flood event. Any building which is likely to be extensively damaged by floods should be designed and constructed with a floor level at least 300mm above this. Height limits on other structures will be determined by the nature of the structure — for example jetties will be allowed close to maximum operating level. No habitable structures will be permitted within the designated area.

Further, where a development proposal includes changes to shoreline configuration such that the lake surface is enlarged beyond the designated area, Electricorp will not purchase more land for inundation etc. Agreements will need to be reached concerning these potential floodable areas beyond the project area. Any structures located therein should be designed and constructed to the same standard as above.

(d) Water Level Fluctuation and Wave Movement

The design and siting of facilities and activities needs to take account of water level fluctuations and wave movement.

(e) Potential for Erosion

The action of both floods and lake level fluctuations will modify the profile of the shoreline. Certain areas are known to be "sacrificial" in that they will gradually erode to form a stable shoreline and development will not be approved in these areas.

(f) Siltation and Water Quality

Electricorp Production has only a requirement to monitor and not maintain water quality in the lake. Nevertheless potential adverse impacts from a development on sedimentation and water quality must be a consideration. Siltation can cause a reduction in the volume of the lake therefore reducing the operating range of the reservoir, and adversely affect lake aesthetics, aquatic plant growth and recreational uses. Deterioration in water quality due to events such as fuel spillage from boats, waste and sewage disposal has similar impact. Therefore in assessing proposals consideration will be given to the potential for siltation of the lake, effects on water quality and the potential for lake weed infestation.

(g) Geotechnical Considerations

A significant part of the reservoir margin is bounded by disturbed schist or mass movement areas some of which are being stabilised by Electricorp for reservoir safety purposes. The design of any proposed facilities in areas at risk from mass movement should therefore be based on detailed geotechnical assessment of slope stability of the immediate site and its effect on the surrounding area and cannot be allowed to compromise Electricorp's preventative works.

NOTE

In providing these guidelines Electricorp wishes to ensure that all applicants are aware of the conditions that it predicts are likely to prevail based on the information available to it in September 1989. Applicants are advised that predictions of future occurrences cannot be made with absolute certainty and that they will accept some risk in proceeding with development before conditions of the lake and surrounding areas have established.

Appendix E

Flood Model Results



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
-	-	-	-	DRAWN	SB
-	-	-	-	CHECKED	BK
				APPROVED	BK

8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

WOODS.CO.NZ

WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Depth 5-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0001	

Legend

- Catchment 1
- Catchment 2

Maximum Depth

- 0m - 0.05m
- 0.05m - 0.1m
- 0.1m - 0.2m
- 0.2m - 0.3m
- 0.3m - 0.4m
- 0.4m - 0.5m
- 0.5m - 0.7m
- 0.7m - 1.0m
- 1.0m - 2.0m
- >2.0m

REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
-	-	-	-	DRAWN	SB
-	-	-	-	CHECKED	BK
				APPROVED	BK

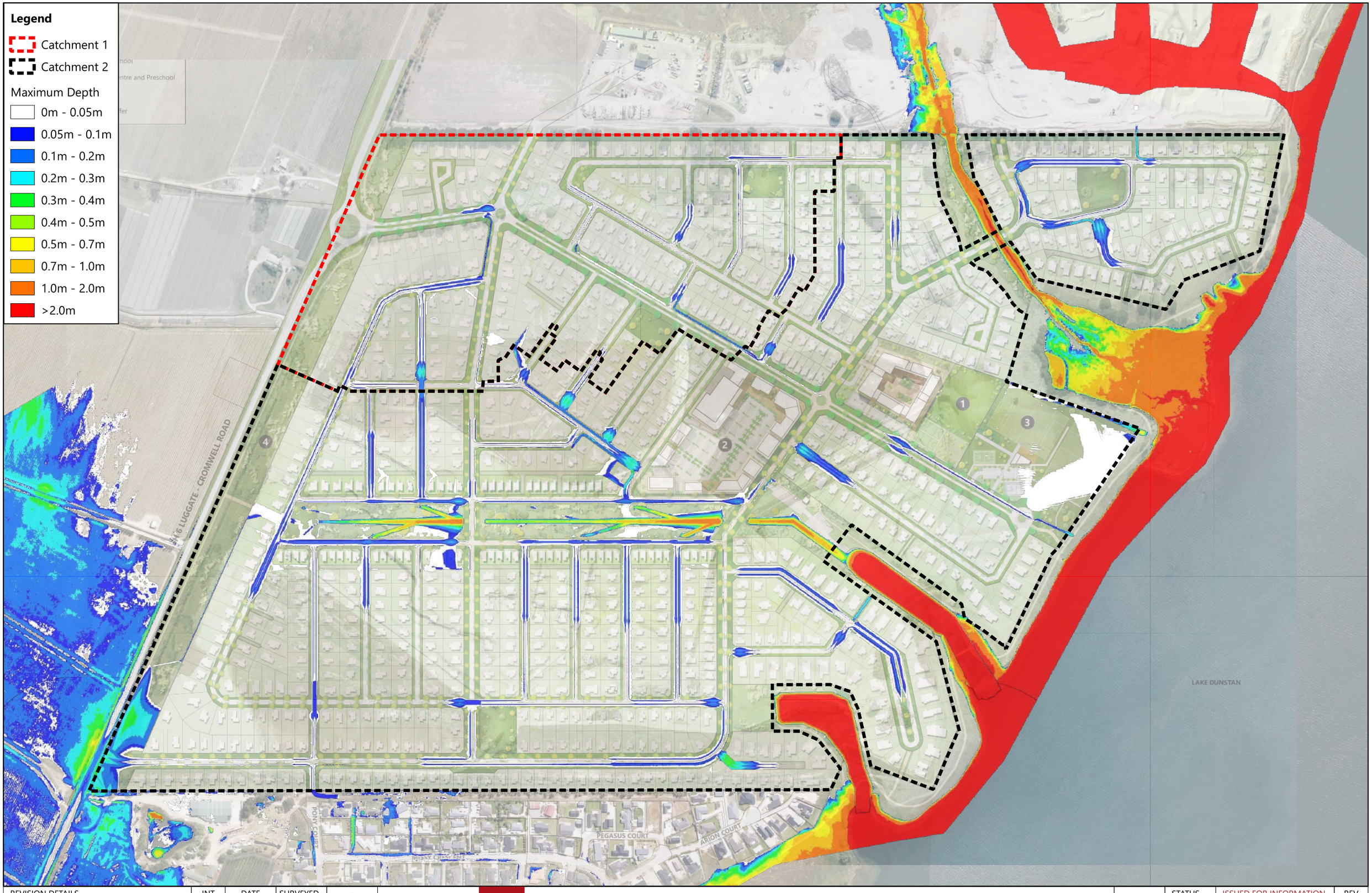
8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

WOODS
Est.1970

WOODS.CO.NZ

P24-487 Parkburn
Internal Model Post-development
Flood Depth 10-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0002	

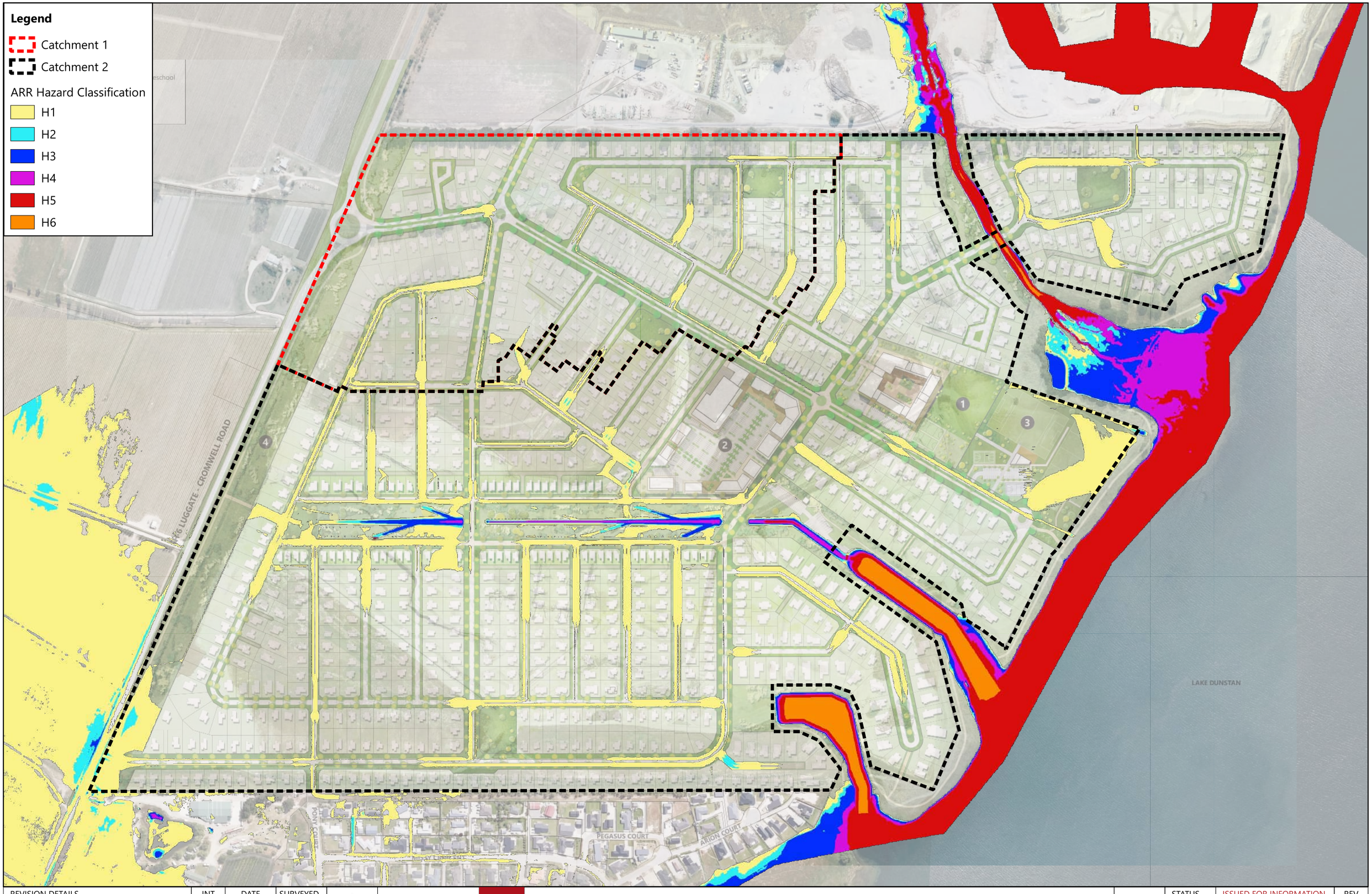


REVISION DETAILS		INT	DATE	SURVEYED	-	8 NUGENT STREET, GRAFTON, AUCKLAND 1023
1.0	For Information	-	22/07/2026	DESIGNED	-	
-	-	-	-	DRAWN	SB	
-	-	-	-	CHECKED	BK	
				APPROVED	BK	WOODS.CO.NZ

WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Depth 100-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0003	



REVISION DETAILS		INT	DATE	SURVEYED	-	8 NUGENT STREET, GRAFTON, AUCKLAND 1023
1.0	For Information	-	22/07/2026	DESIGNED	-	
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-	-	-	-	CHECKED	BK	
				APPROVED	BK	WOODS.CO.NZ

P24-487 Parkburn
Internal Model Post-development
Flood Hazard 100-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0004	



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
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-	-	-	-	CHECKED	BK
				APPROVED	BK

8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

WOODS.CO.NZ

WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Level 5-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0005	

Legend

- Catchment 1
- Catchment 2

Maximum Level

- < 196 mRL
- 196 - 200 mRL
- 200 - 204 mRL
- 204 - 208 mRL
- > 208 mRL

REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
-	-	-	-	DRAWN	SB
-	-	-	-	CHECKED	BK
				APPROVED	BK

8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

WOODS.CO.NZ

WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Level 10-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0006	



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
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-	-	-	-	CHECKED	BK
				APPROVED	BK

8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

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Est.1970

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P24-487 Parkburn
Internal Model Post-development
Flood Level 100-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0007	



REVISION DETAILS		INT	DATE	SURVEYED	-	8 NUGENT STREET, GRAFTON, AUCKLAND 1023
1.0	For Information	-	22/07/2026	DESIGNED	-	
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-	-	-	-	CHECKED	BK	
				APPROVED	BK	WOODS.CO.NZ

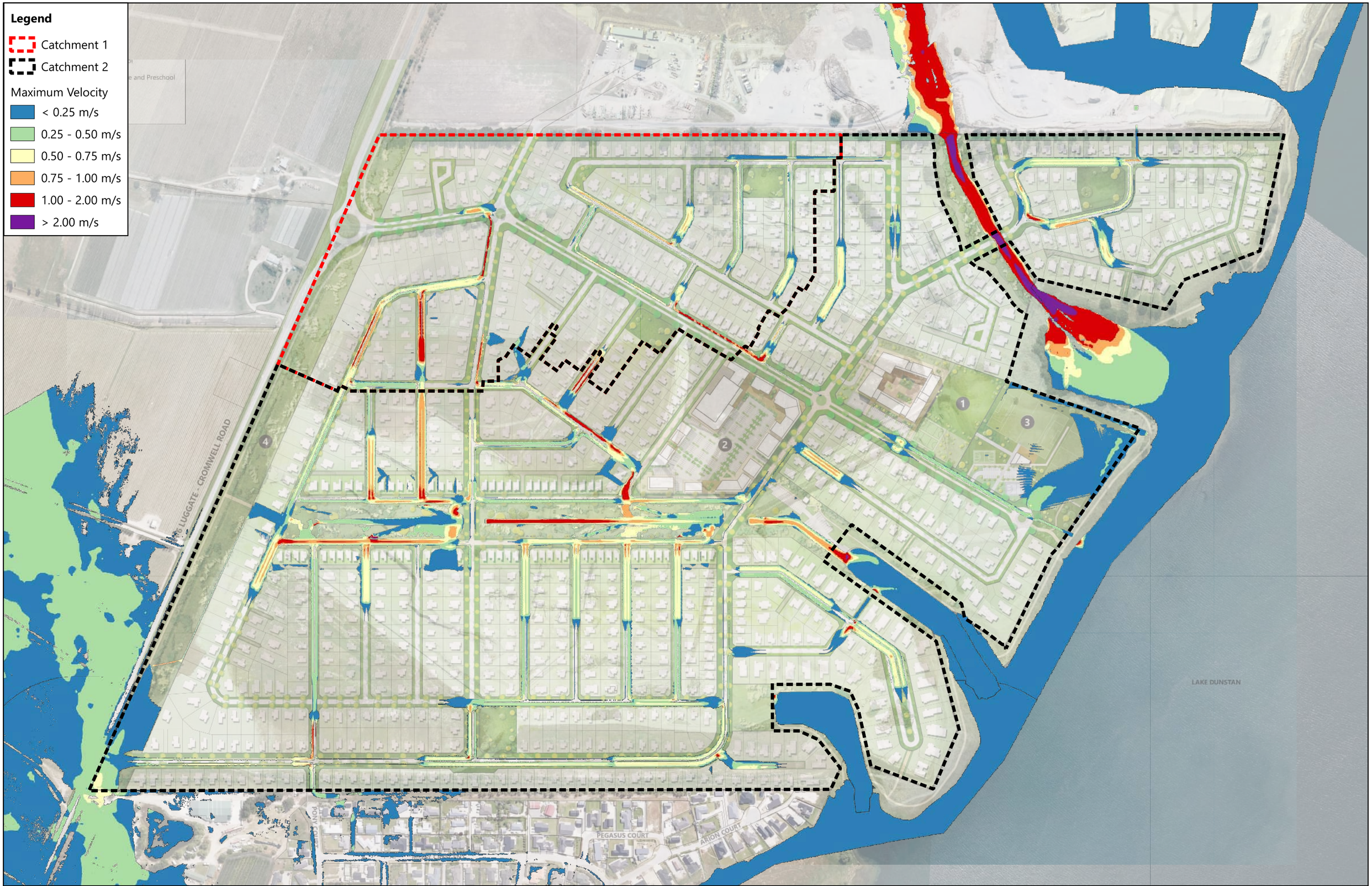
WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Velocity 5-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0008	



REVISION DETAILS		INT	DATE	SURVEYED	-	8 NUGENT STREET, GRAFTON, AUCKLAND 1023	WOODS Est.1970	P24-487 Parkburn Internal Model Post-development Flood Velocity 10-year ARI RCP 8.5		STATUS	ISSUED FOR INFORMATION	REV
1.0	For Information	-	22/07/2026	DESIGNED	-					SCALE	1:5000 @ A3	1.0
-	-	-	-	DRAWN	SB					COUNCIL	CENTRAL OTAGO	
-	-	-	-	CHECKED	BK					SHEET	P24-487 DR0009	
				APPROVED	BK	WOODS.CO.NZ						



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	22/07/2026	DESIGNED	-
-	-	-	-	DRAWN	SB
-	-	-	-	CHECKED	BK
				APPROVED	BK

8 NUGENT STREET,
GRAFTON,
AUCKLAND 1023

WOODS.CO.NZ

WOODS Est.1970

P24-487 Parkburn
Internal Model Post-development
Flood Velocity 100-year ARI RCP 8.5

STATUS	ISSUED FOR INFORMATION	REV
SCALE	1:5000 @ A3	1.0
COUNCIL	CENTRAL OTAGO	
SHEET	P24-487 DR0010	

Appendix D – Correspondence with Bonisch

Boniface Kinnear

From: Pranil Wadan
Sent: Wednesday, 26 February 2025 8:54 am
To: Boniface Kinnear
Subject: Fw: Parkburn Preliminary SW model results

WOODS
Est.1970

Pranil Wadan | BE Civil, CPEng, IntPE(NZ), CMEngNZ
General Manager - Water Infrastructure and Planning
Water Infrastructure and Planning
[redacted]
[redacted]

Warkworth | **Auckland** | Hamilton | Tauranga | Napier | Christchurch | Queenstown

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From: Tim James [redacted]
Sent: Tuesday, February 25, 2025 11:25:25 AM
To: Pranil Wadan [redacted]; Nathan Archer [redacted]
Subject: Fwd: FW: Parkburn Preliminary SW model results

---------- Forwarded message ---------
From: **Boyd Wilson** [redacted]
Date: Mon, Feb 24, 2025 at 5:39 PM
Subject: FW: Parkburn Preliminary SW model results
To: Tim James [redacted]
Cc: Scott O'Donnell [redacted]

Hi Tim

To follow is the summary of the stormwater modelling undertaken for the Parkburn sites.

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The volumes of water traversing the sites is significant, but the protection/engineering of the existing flow paths will ensure the surrounding houses are clear of the hazard.

We need to discuss several things:

1. Earthworks and predicted levels at the common boundaries
2. Access and approach to NZTA
3. Sewer and Water connections and possible developers' agreement with CODC
4. Planning process and approach

When would it suit to catch-up regarding the above?

Regards

Boyd

Boyd Wilson
MANAGING DIRECTOR

bonisch

[redacted] EXT 204

[redacted]

0800 802 546

Level 4, 25 Esk Street , Invercargill

Connect with us bonisch.nz

LAND DEVELOPMENT SURVEYING PLANNING CIVIL ENGINEERING

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From: Simon Collie [redacted]
Sent: Monday, 24 February 2025 4:49 pm
To: Boyd Wilson [redacted]
Cc: Kieron Thorpe [redacted]
Subject: Fw: Parkburn Preliminary SW model results

Hi Boyd,

Kieron has undertaken a preliminary analysis of the flooding extents of Park Burn within 922A Luggate-Cromwell Rd, Mt Pisa.

High level summary is:

- Upstream catchment is approx. 15km2, with flows through the site at approx. 15m3/s in a 1%AEP event.
- There is a 200m wide floodplain through the site where flow spreads as it passes through in design events
- This should be able to be addressed through constructed channelisation through the site. At this stage we recommend a 40m corridor is allowed for in the site plan for a main channel, spillway and associated amenity elements. This should be able to be aligned to the current legal corridor, but some flexibility in this may be useful.
- Where flow exits the site it is re-channelised by an existing bund within the southern property
- The next key thing to understand for the site and stormwater design is looking into debris flow from the upper catchment, to ensure any channel design through the site deals with this risk.

Regarding your email around the exit point of flow and minimum floor level for an asphalt plant on the common boundary, it is too early to be able to provide definitive direction as this would be tied to earthworks volume balances etc. If it was temporary, you could select an appropriate level with reference to the bunding along the northern boundary and the flood plain extent shown in earlier images. We can look into this further if more information can be provided.

Below is Kieron's full summary:

Inundation Protection Standards

The **NZ Building Act** requires two levels of property protection:

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- The 10% AEP (1 in 10yr ARI) event shall be managed in a way that avoids the likelihood of damage or nuisance to other property.
- The 2% AEP (1 in 50yr ARI) shall not enter buildings.

The Central Otago Land Development and Subdivision Engineering Code of Practice is currently transitioning to basing itself on **NZS4044:2010 Land Development and Subdivision Engineering**, which stipulates:

- Primary stormwater systems in residential and rural residential areas shall be designed to cope with the 10% AEP / 10yrARI event
- Secondary flowpaths shall be designed to cope with the 1% AEP / 100yrARI event
- Habitable dwellings shall be set at a minimum freeboard of 0.5m above the 1% AEP / 100yrARI event

With regard to the **Central Otago District Plan** we understand the area is subject to Plan Change 19, rezoning new land for residential use, and that this is currently under appeal. We are unaware of any existing or potential change from the general requirements of the Act or the Code of Practice with respect to flood protection.

At this early stage we recommend **adopting for design purposes** the following:

- *The critical duration (peak flow) 100yr ARI event shall be contained within the reserve set aside for the Park Burn, without entering private property.*
- *For the above event, minor inundation of road corridors, e.g. at the crossings of the Park Burn, shall be acceptable if limited to within the H1 hazard level as defined by the Australian Institure for Disaster Resilience, Guideline 7-3, Figure 6, below.*
    - *In short, depths shall not exceed 0.3m unless velocity exceeds 1m/s, beyond which, up to v=2m/s, depths shall be progressively limited to 150mm. Depths beyond 0.3m and velocities beyond 2m/s shall not be permitted.*

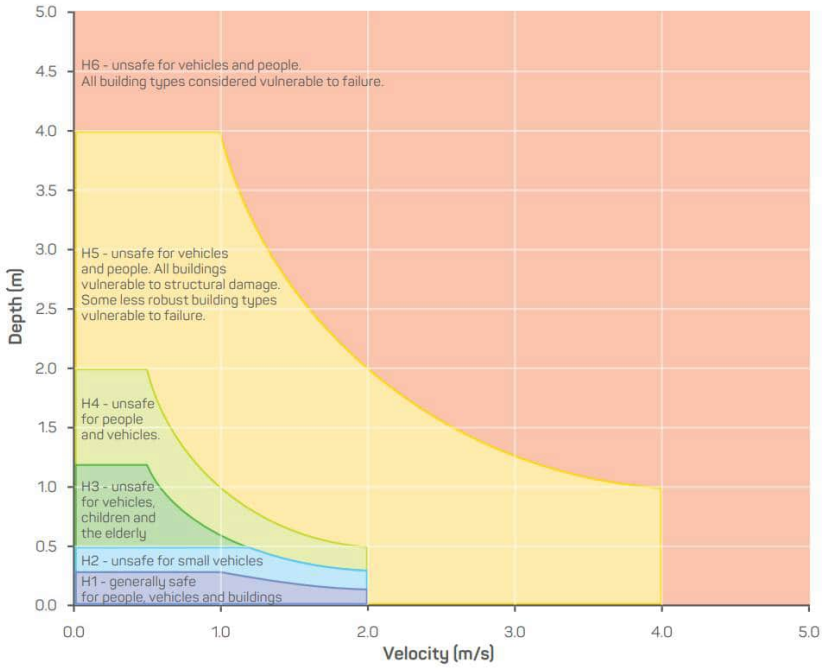


Figure 6: General flood hazard vulnerability curves

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Catchment & Design Flows

The Park Burn catchment covers an area of approximately 15.8 km². We estimate its critical event duration is in the order of 2.5 to 3 hrs, which is estimated to produce peak runoff flows in the orders given below.

Average Recurrence Interval (ARI), yrs	10	20	50	100	1000
Annual Exceedance Probability (AEP)	10%	5%	2%	1%	0.1%
Peak flow (including allowance for climate change), m³/s	9	11	13	15	20

The catchment is not gauged, so these are best estimates only, based on several assessment methods (Henderson & Collins 2018 (adopted), McKerchar & Pearson 1989 (supporting), TP108 (rejected), Rational Method (rejected)).

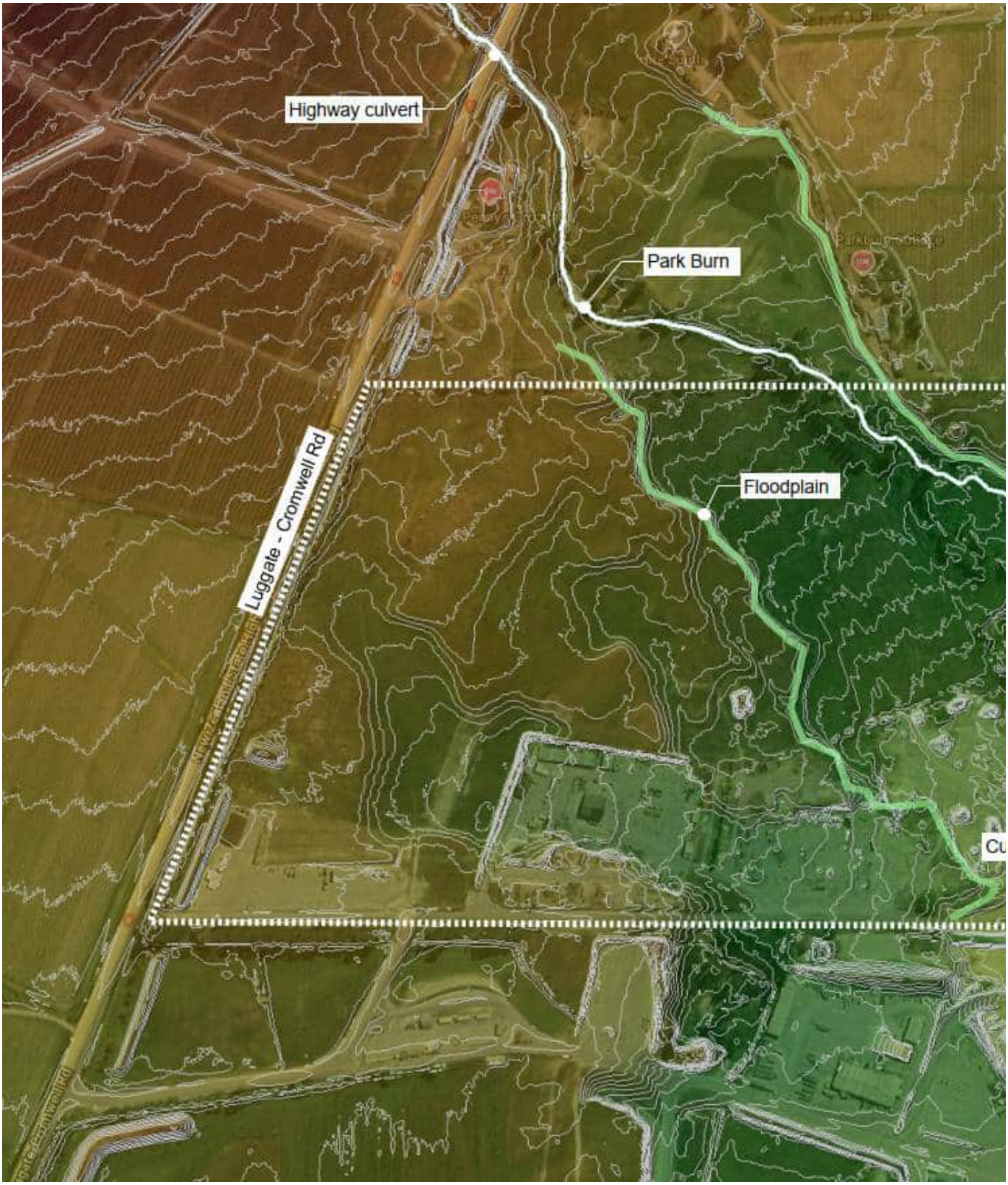
We include a modest allowance for climate change, approximately aligned with the RCP 6.0 (medium high) carbon emission scenario.

The precision is limited to the nearest 1 m³/s to discourage any impression of high accuracy.

Topology

The models consider only the existing topography of the area, derived by LiDAR survey circa December 2024. The site exhibits a notable alluvial floodplain, roughly 200m across. There is strong evidence of historical channel braiding through this area - see results below.

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Modelling Methodology

Preliminary flood modelling includes both two-dimensional and one-dimensional modelling. The latter acts as a sense check of the former. Reasonable to good agreement exists between the two.

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Both models consider a nominal steady state (continuous) flow equal to the peak flows given above.

The 2D model applies these flows to the existing channel approximately 1.4km upstream of the highway, in order to assess the channel capacity in this reach, as it flattens out into the floodplain. The results suggest that the channel contains most flows up to a 1 in 100yr event.

Other, minor inflow into the development site may exist, but we consider these are unlikely to induce a significant increase to the flows we adopt.

Similarly, once developed, the site itself will produce more runoff. However the development's response time will be much faster than the wider Park Burn catchment, so its impact in the kind of events that will produce peak flows in the Park Burn is expected to be minimal.

Hydraulic Structures

Park Burn passes through three culverts in the area (labelled above).

The existing 3-box concrete culvert under the Luggate Cromwell Highway is considered in two states:

1. maximum impedance: with the culvert fully blocked, such that all flows from upstream must spill over the highway.
2. minimum impedance: as an extension of the channel cross section through the highway, with no culvert roof / highway surface. Note that even in this case, for the large events considered, a portion of flows escape the channel and spill across the highway.

In reality the culvert is estimated to have a capacity (i.e immediately prior to overtopping the road) in the region of 5-15m^3/s.

Two culverts further downstream are modelled via the latter method. These produce a limited backwater effect, which leads to conservative results in the lower part of the site.

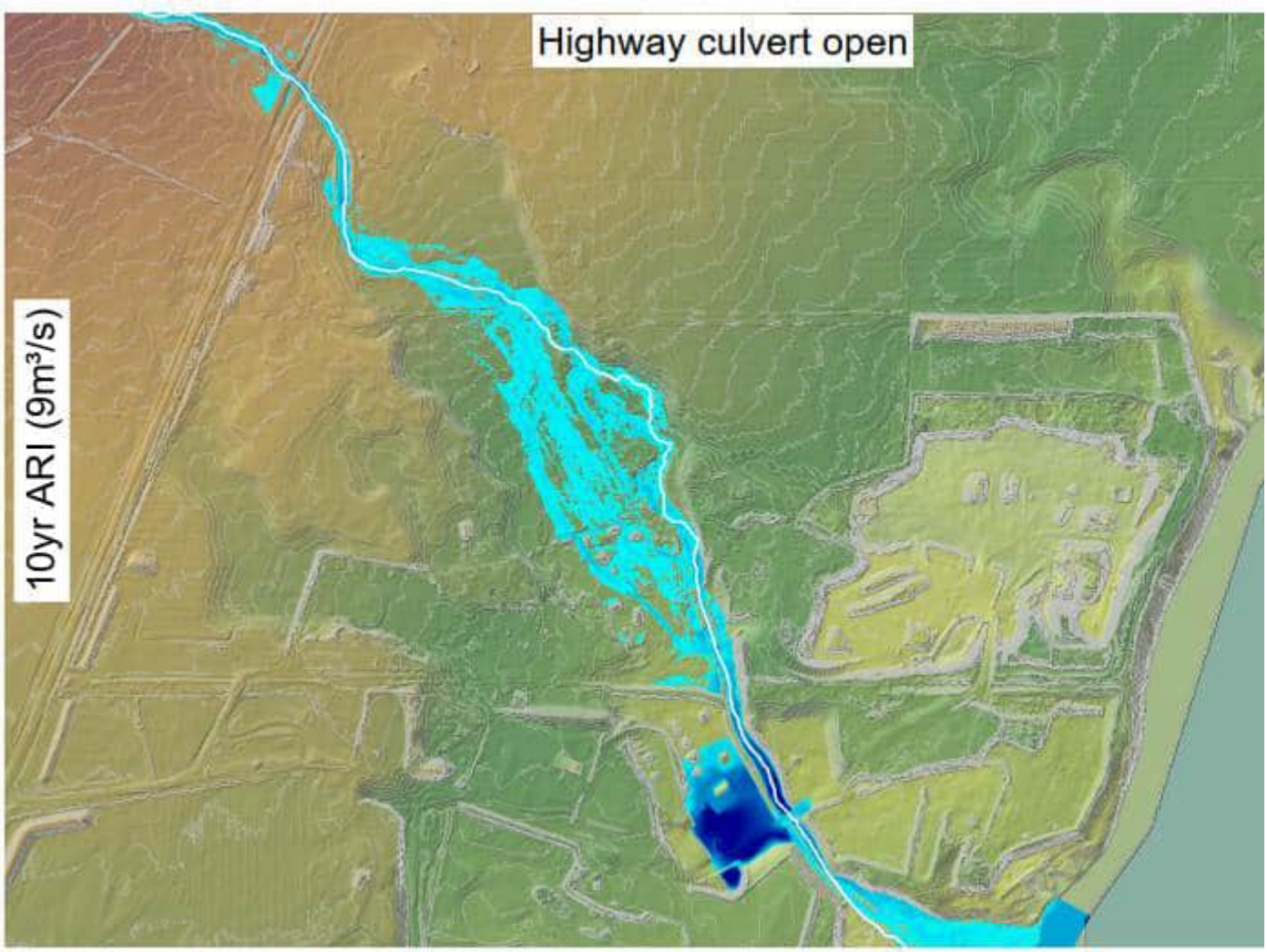
The behaviour of the culverts will be refined in future model revisions if required.

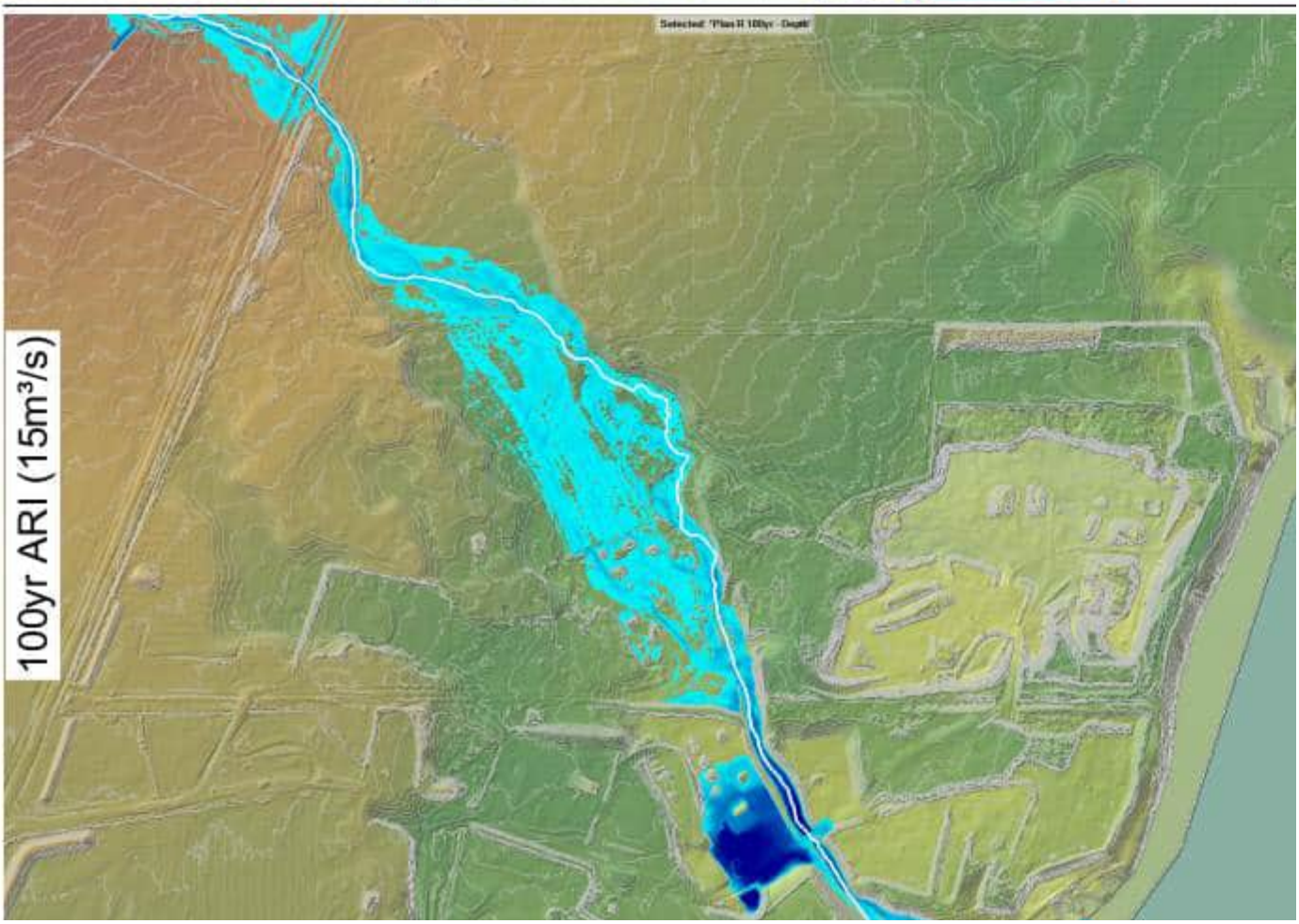
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Preliminary Flooding Extents

Peak flood extents for four scenarios are given below. These are the 10yr and 100yr flood, against the minimum (open) and maximum (blocked) highway culvert impedance:

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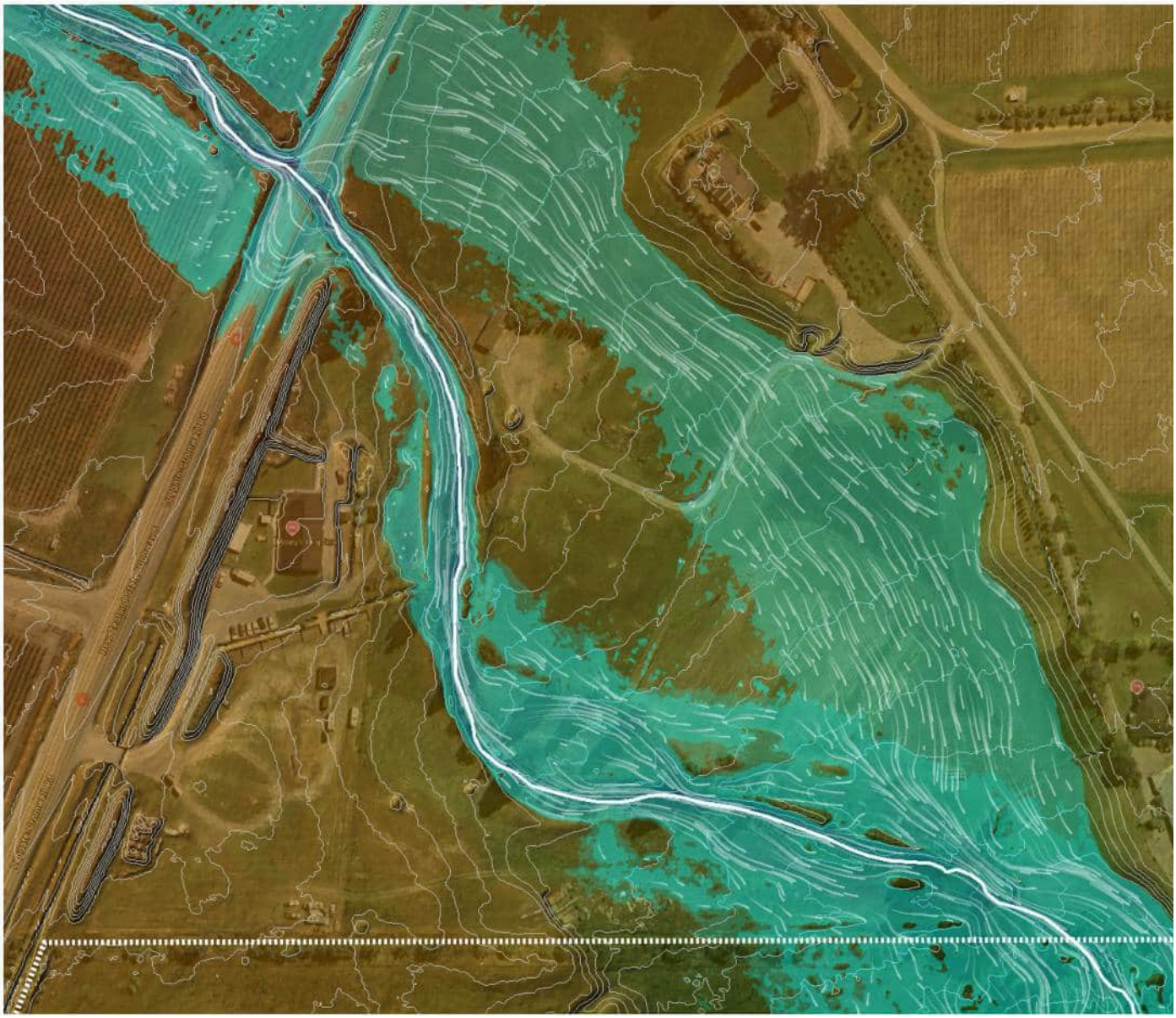




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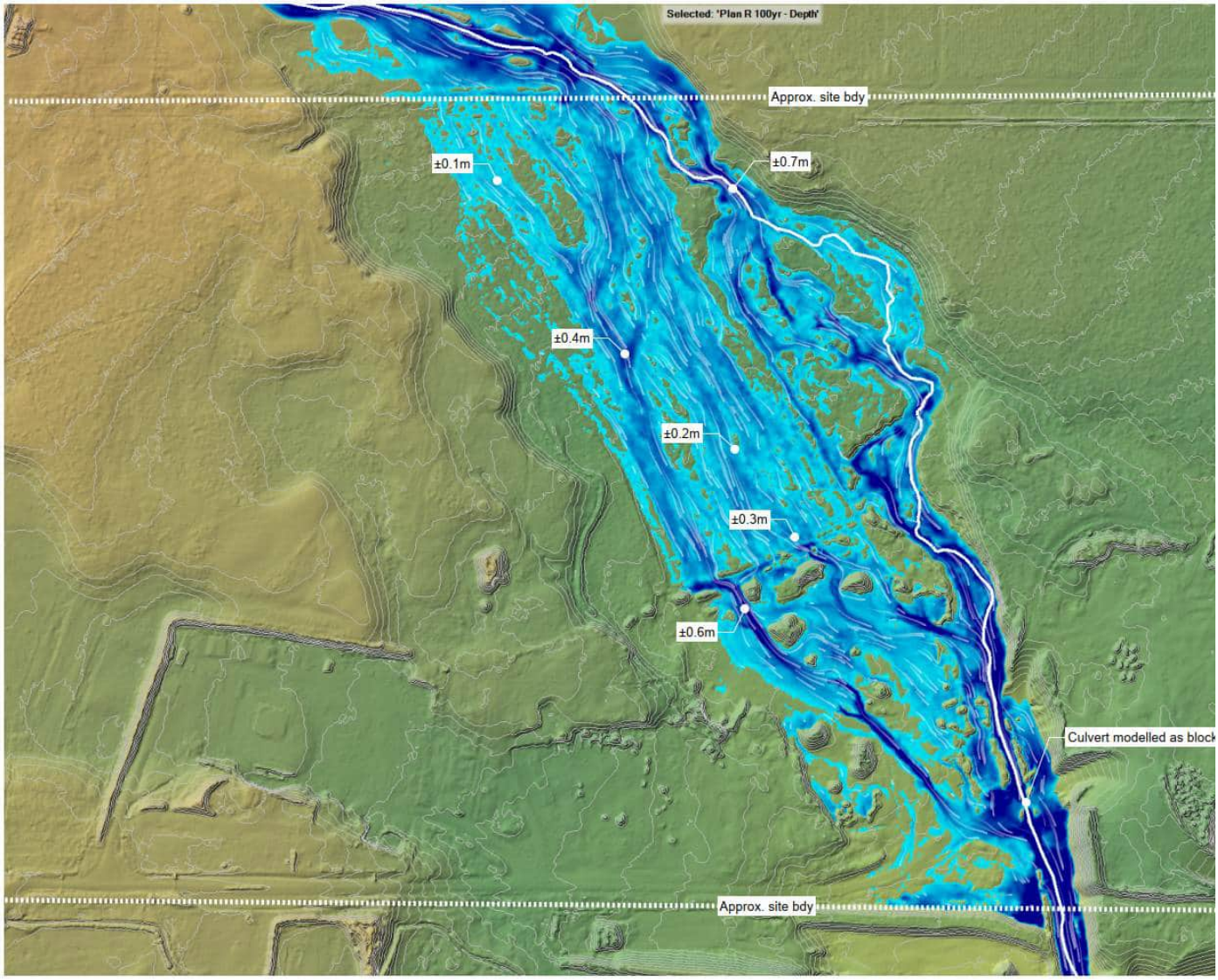
Commentary

Breakout flooding over the highway is largely recaptured by the channel prior to entering the site. Mild bunding along the north boundary appears to play a role in this, but the traversal of the channel from the true right to left of the floodplain appears to be a greater factor. We surmise then that the behaviour of the highway culvert, specifically its risk of blockage, is not critical to flood behaviour within the site. This is the 100yr event with the highway blocked:



Flooding within the site (outside of the channel) is generally in the region of 100-300mm, dispersed, and low velocity (<0.5m/s). Historical channel braids appear to recapture the flow and redirect it to the main channel towards the downstream end of the site. Again, the modified landforms on or near the south boundary - notably the quarry track and a significant bund on stream right / south site boundary - appear to play a significant part. This is the 100yr flood:

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The alluvial nature of the site itself and the upstream catchment (comprised of friable, erodable, sandy/loamy soils with high particulate rock content) will continue to produce significant debris flows, particularly during large events. We note the evidence of this presented in the StreetView images at the highway culvert:

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The topology of the developed site should be carefully considered to ensure this risk is well managed. The risk of debris flow needs to be assessed and quantified to inform the channel conveyance design through the site. The management of this risk needs to be understood also between the various parties including NZTA, CODC and ORC.

We believe it should be possible to convey the 100yr flood through the site within the corridor set aside in the Baxter Design "Parkburn Quarry Concept Masterplan". A preliminary hydraulic assessment suggests that a corridor in the region of 40 to 50m wide should suffice. This allows for some naturalisation of the channel (meander, riffle & run, pools, etc), landscaping improvement (planted areas, playgrounds, furniture, etc), and maintenance access (a trafficable track, suitable for an excavator & ancillary equipment, floodable when necessary).

Below is a 40m corridor (orange lines), offset from a centreline aligned with the existing Crown Land corridor through the site, overlaid on the above concept plan. We note:

- The area set aside by the concept layout appears to be marginal in terms of containing the 100yr flood and is almost certainly insufficient at its upstream end.
- The existing topography that results in recapturing the flow at the north boundary would need to be retained and potentially enhanced. We show a potential arrangement.

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- The impact on neighbouring property may need to be carefully considered, and the design amended accordingly, to avoid any significant departure from current geomorphological behaviours (e.g. debris flows).
- The two road crossings shown must provide adequate flood capacity such that they do not generate undue backwater effects.



Next Steps

- It is key to begin understanding debris flow risk from the upper catchment, and how this interfaces with the site.
- Further detailed modelling will be required as the site shaping and strategy is developed.

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LAND DEVELOPMENT SURVEYING PLANNING CIVIL ENGINEERING

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APPENDIX H – Fluent Solutions Irrigation Report

SUMMARY REPORT

TO:	Tim James	Job No.:	980
FROM:	Peter Dwyer	Date:	14 May 2026
SUBJECT:	Parkburn Quarry Development – Irrigation Infrastructure Planning		
		Reference:	*RP-260504PD-980 Irrigation-Rev2*

1.0 Background

The proposed Parkburn Development is located north of the existing Pisa Moorings development and will have potentially 989 lots as well as a school and a commercial area.

The development has up to 24 open public spaces comprising walkways, recreation reserve areas and local purpose (drainage) areas. The total area of open spaces is 14 Ha. There are also grass verges and median vegetation strips within the carriageways for the development, as well as slope buffering zone along the State Highway 6 boundary. The total area of verges, median and slope buffering vegetation and is estimated at 15.4 Ha.

This report documents the concept design for pumping and reticulation requirements to supply irrigation water from Lake Dunstan under an existing water take.

The limit of the permitted water take from Lake Dunstan for irrigation is 1,000m^3 per day.

This irrigation volume does not include irrigation of private lots as homeowners are permitted to use potable water supply for lawn and garden irrigation.

2.0 Concept Design Overview

Due to the varying types of irrigation needed it is proposed to provide two separate irrigation networks:

1. public road irrigation
2. open spaces irrigation

The public road irrigation system will feed subsurface drippers throughout the day. The flows and pressures in this reticulation are lower than in the open spaces reticulation and hence require a different system to supply them.

The open spaces irrigation will generally feed various types of spray irrigation (fixed, k-line, pop up (etc.). The open spaces irrigation is split into three zones. These zones will be fed one at a time sequentially during the night. The flows and pressures for this reticulation are higher than the public road irrigation reticulation.

The irrigation pump infrastructure for both irrigation systems is proposed to be located beside the boat ramp in Area 9. Refer to Figure 3.1 for location. Three sets of pumps are proposed as described below.

SUMMARY REPORT

3.0 Flow Calculations

3.1 Irrigation Application Rates

The following application rates have been assumed for this concept design.

- Open public spaces 5mm per day
- Public road verges and medians 3mm per day

The lower irrigation rate for the road verges and medians is prescribed so that they will not require excessive mowing.

3.2 Irrigation System

For the concept design the following has been assumed:

- Open spaces will typically be irrigated by sprinklers, these may be pop up, k-line, drip line or impact sprinklers. The open spaces will be irrigated at night to reduce water loss from evapotranspiration.
- The verges and medians will be irrigated with dripline and mulch system and can be run during the day. It has been assumed that the driplines will be fed over a maximum duration of 18 hours for the ultimate design.

3.3 Irrigation Areas – Open Spaces

The open space areas are set out in Figure 3.1 below and are quantified in Table 3.1:

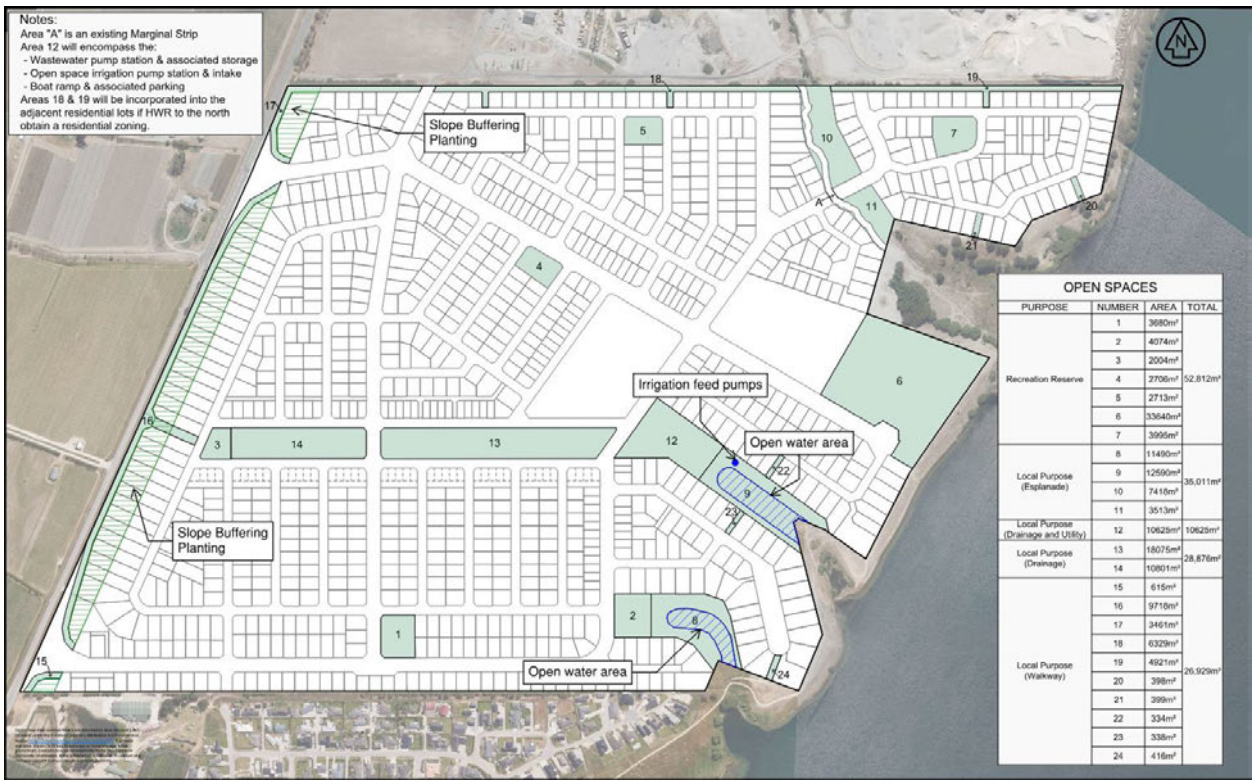


Figure 3.1: Open Space Areas Layout

SUMMARY REPORT

Table 3.1: Schedule of Open Space Areas

Numbers	Purpose	Area (m^2)	Comment
1-7	Recreation Reserve	52,812	
8-11	Local Purpose (Esplanade)	35,011	Note areas 8 and 9 contain large water bodies. For irrigation estimates this area reduces to 22,971m^2.
12	Local Purpose (Drainage and utility)	10,625	
13-14	Local Purpose (Drainage)	28,876	Stormwater detention
15-17	SH6 Slope Buffering	-	Refer Section 3.5
18-24	Local Purpose (Walkway)	13,135	See 3.4 Notes
	Total Area	**140,459**	

3.4 Notes

Areas 8 and 9 have large water areas as indicated in Figure 3.1. The total irrigated area is assumed to be 50% of the scheduled area shown in Figure 3.1 for these two areas.

For the walkways (areas 18-24) it has been assumed that these spaces will be irrigated by dripline due mainly to the size and width of these areas.

For SH6 Buffer Slopes (areas 15-17) it has been assumed that this area will initially be irrigated by sprinklers possibly utilising k-line to irrigate the sloped banks shown in the private lots. In the ultimate development this area may revert back to dripline irrigation. For this report we have assumed that all of the slope buffering will be irrigated by dripline.

3.5 Irrigation Areas – Public Roads and State Highway 6 Buffer Slopes

The irrigation areas for the SH6 buffer slopes are based on areas provided to us in the open spaces plan (March 2026).

The irrigation areas for the public roads have been estimated using the site masterplan and the typical road cross sections drawings (April 2026). The irrigation areas for the roads and State Highway 6 Buffer Slopes area presented in Table 3.2 below.

SUMMARY REPORT

Table 3.2: Schedule of Medians Verges and Buffer Slopes

Road Type	Road Reserve Width (m)	Berm and Verge Total Width	Total Road Length Assumed (m)	Vegetated Area (m^2)
A	28	14.8	883	13,068
B	23	9.8	2,857	27,999
C	18	7.2	1,180	8,496
D	15	6.0	9,234	55,404
			Total	**104,967**
Buffer Slopes				**Vegetated Area (m^2)**
15				1,792
16				40,492
17				7,445
			Total	**49,729**

3.6 Flow Rates

The flow rates for the ultimate development are presented in Table 3.3 below.

Table 3.3: Flow Rates for the Ultimate Development

Zone	Vegetated Area (m^2)	Application Rate (mm/day)	Irrigation Volume (m^3/day)	Irrigation Period (hours)	Peak Flow (L/sec)
Public Road Vegetation	104,967	3	315	18	4.9
Buffer Slopes (Areas 15-17)	49,729	3	149	18	2.3
Walkway Vegetation (Exclude Areas 15-17)	13,135	3	52	18	0.8
Open Spaces Zone A	20,345	5	102	2.0	14.1
Open Spaces Zone B	61,299	5	307	6	14.2
Open Spaces Zone C	33,640	5	168	3	15.6
			1093		

It is noted that the estimated total daily demand of 1093m^3 per day is very close to the irrigation water take limit of 1,000m^3/day. It is also noted that system losses have not been considered in these estimated flow rates.

It would be prudent to seek approval for an additional 15% volume (150m^3/day) to allow for losses and contingencies for the ultimate scheme.

SUMMARY REPORT

4.0 Staging

A staging plan for the construction of the proposed development has been provided. The project is split into 16 stages generally commencing in the South and finishing in the North East. The staging plan is shown below in Figure 4.1.

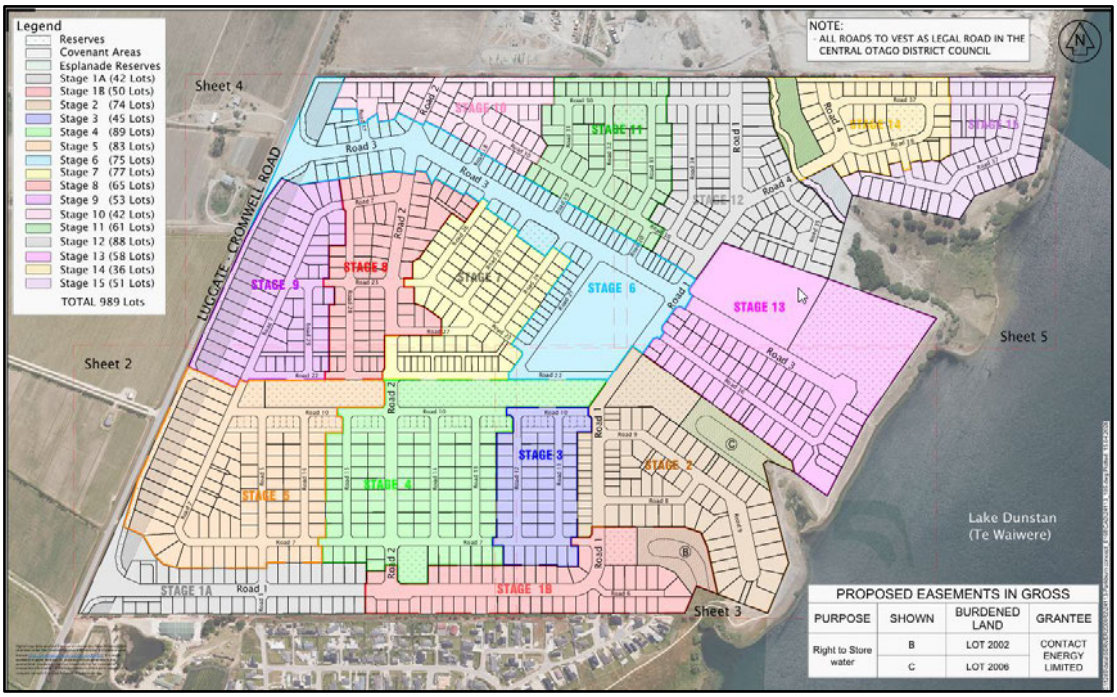


Figure 4.1: Proposed Parkburn Development Staging

4.1 Irrigation Pumping Open Spaces Zoning

For design the following parameters are noted:

- There will be a separate reticulation that feeds only the open spaces.
- The site has been split into three zones A, B, and C.
- There will be a set of pumps dedicated only to feeding the open space irrigation and these pumps have been sized to feed one zone at a time on a timed sequence and will operate on variable speed drives.
- Sequencing will be managed using electronic flowmeters and actuated control valves on the feed pipe to each zone.
- The zone boundaries align with the proposed staging for the development.
- Zone B encapsulates stages 1-5.
- Zone C encapsulates stage 13.
- Zone A encapsulates stages 6-12 and 14-15.
- The Zone boundaries are shown below in Figure 4.2.

SUMMARY REPORT

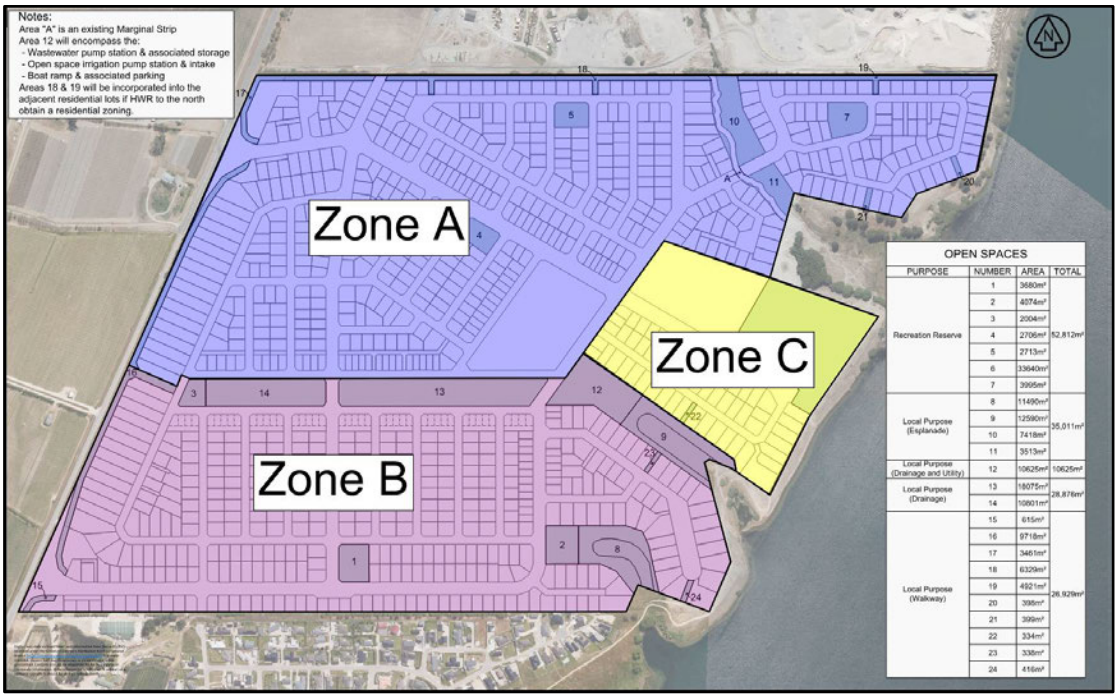


Figure 4.2: Open Spaces Irrigation Zone Boundaries

4.2 Irrigation Pumping Dripline Irrigation

For design the following parameters are noted:

- There will be a separate reticulation that feeds the dripline irrigation.
- There will be a set of pumps dedicated only to feeding the dripline irrigation.
- There will be three pumps, duty, duty-assist and standby.
- In the initial stages of the development the dripline irrigation demands will be low and will be met by a single duty pump on variable speed drive.
- In the initial stages of the development the pump run times each day will be short.
- For the ultimate development two duty pumps will run together to meet the ultimate demands.
- For the ultimate development two duty pumps pumping for 18 hours per day are proposed to meet the assumed irrigation demands.

5.0 Pumps

Irrigation water feed pumps are proposed to extract all the irrigation water for both systems from the lake at RL194 and pump it through a filter into underground storage tanks below the irrigation pump station at RL200. The feed pumps are proposed to be submersible centrifugal pumps that sit in a well beside the lake. A wedgewire screened intake pipeline will convey water from the lake into the well.

It is proposed that the irrigation water filter is housed in the proposed pump house building located near the intake well. The purpose of the filter is to prevent dirt and other material (that has managed to get through the screen) from fouling and blocking the small components of the irrigation system.

SUMMARY REPORT

The proposed **public road irrigation pumps** are surface mounted multi-stage centrifugal pumps that would be located in the pump house building beside the lake. It is proposed to supply two duty pumps and one standby pump to meet the irrigation demand. Less area will be irrigated in the initial stages of the development and as such only one pump will be required to meet the initial irrigation demands. As the development proceeds and the area of public road vegetation increases then the second pump will also be used to meet the demands. These pumps will run on variable speed drives to meet a range of irrigation demands.

The proposed **open spaces irrigation pumps** are surface mounted end suction centrifugal pumps and would also be located in the pump house. These pumps are sized to feed one zone at a time. The pumps will run on variable speed drives to meet a range of demands. In the early stages of the development only one zone will most likely be requiring irrigation.

In determining the pump pressure requirements, the ground elevation at each irrigated area has been considered. For the open spaces served by sprinklers it has been assumed that the minimum pressure at the furthest sprinkler is 100kPa. For the dripline irrigation it has been assumed that the minimum pressure at the start of each dripline connection is 100kPa.

6.0 Reticulation

The **public roads irrigation** reticulation extends to all the roads within the development to feed subsurface drippers.

The **open spaces irrigation** feeds each of the three zones; A, B and C. Electrically actuated valves downstream of the open spaces irrigation pumps will be used to direct the flow of water to each zone.

Refer to drawings attached to this memo for the concept design of the proposed irrigation pumping and reticulation systems.

- C100 – Sprinkler Irrigation Main Reticulation Layout Plan
- C200 – Dripline Irrigation Main Reticulation Layout Plan
- C300 – Irrigation Pumping Layout Plan
- C310 – Irrigation Pumping Schematics

7.0 Recommendations

This report is intended to support WFHs' proposed Parkburn development in their FTA application to CODC and ORC to show that an irrigation supply for the development is feasible and easily constructed.

It is recommended that the parties reviewing this document assess its content in conjunction with reviewing the attached concept design drawings.

Enclosure:

- Concept Design Drawings

SUMMARY REPORT

SPRINKLER LEGEND:

- 50 OD PE 100 PN10
- 63 OD PE 100 PN10
- 90 OD PE 100 PN10
- 110 OD PE 100 PN10
- 125 OD PE 100 PN10

LANDPRO LEGEND:

- Recreation Reserve
- Road Reserve
- Lot Development

Revision	Des	Drn	Rvd	App	Date
A For Review	PD	JP	AS	AS	06/05/26

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Client
FH Land Development LTD

Project Title
Parkburn Quarry Development
922 Luggate - Cromwell Road
Water & Wastewater Supply

Sheet Title
Sprinkler Irrigation Main Reticulation Layout Plan

Scale (A1 Original) 1:2500 m

Issue For Review

Project No	Sheet	Revision
000980	C100	A

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0 25 50 75 100 mm

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DRIPLINE LEGEND:

- 32 OD PE 100 PN10
- 40 OD PE 100 PN10
- 63 OD PE 100 PN10
- 90 OD PE 100 PN10

LANDPRO LEGEND:

- Recreation Reserve
- Road Reserve
- Lot Development

Revision		Des	Drn	Rvd	App	Date
A	For Review	PD	JP	AS	AS	06/05/26

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Project Title
Parkburn Quarry Development
922 Luggate - Cromwell Road
Water & Wastewater Supply

Sheet Title
Dripline Irrigation Main
Reticulation
Layout Plan

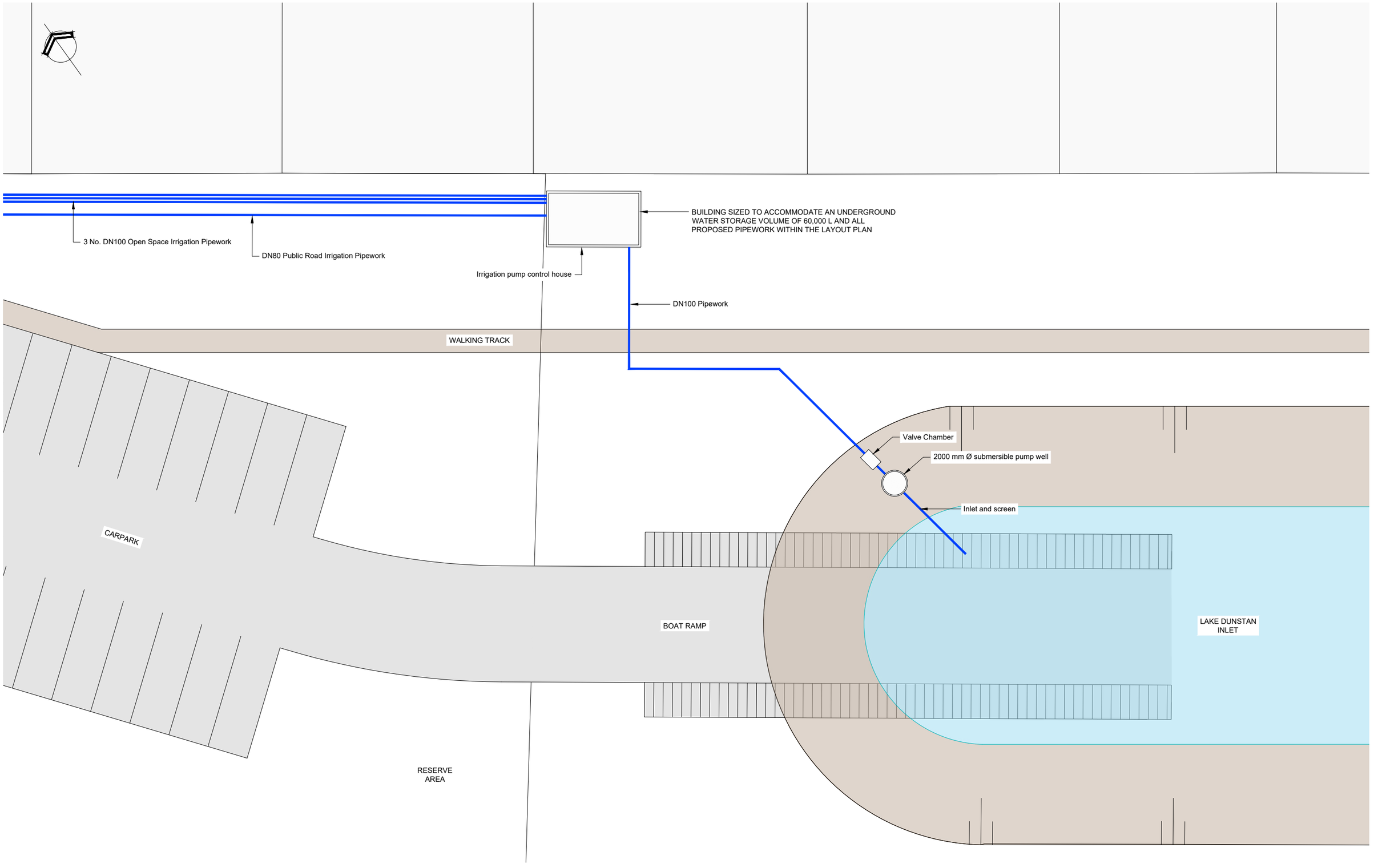
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Issue For Review

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B For Review	PD	JP	AS	AS	13/05/26
A For Review	PD	JP	AS	AS	06/05/26

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Water & Wastewater Supply

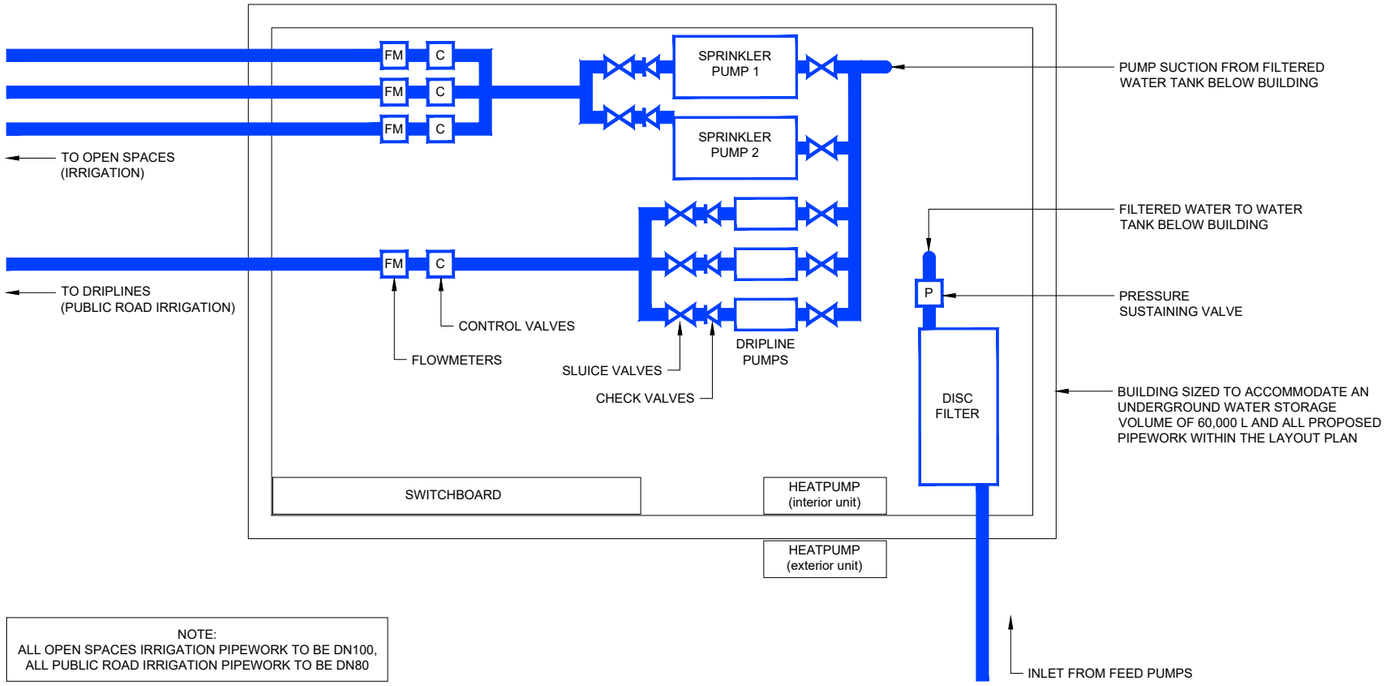
Sheet Title
Irrigation Pumping
Layout Plan

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Issue For Review

Project No	Sheet	Revision
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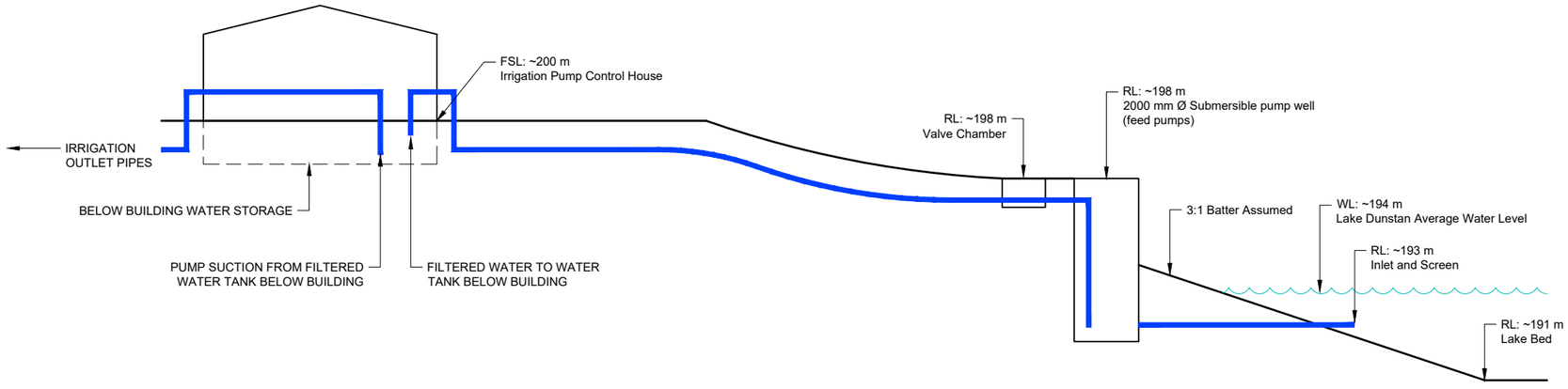
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NOTE:
ALL OPEN SPACES IRRIGATION PIPEWORK TO BE DN100,
ALL PUBLIC ROAD IRRIGATION PIPEWORK TO BE DN80

SCHEMATIC - IRRIGATION CONTROL PUMP HOUSE LAYOUT PLAN

N.T.S



SCHEMATIC SECTION - FEED PUMP INTAKE TO IRRIGATION CONTROL PUMP HOUSE

N.T.S

Revision	Des	Drn	Rvd	App	Date
B For Review	PD	JP	AS	AS	13/05/26
A For Review	PD	JP	AS	AS	06/05/26

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Project Title
Parkburn Quarry Development
922 Luggate - Cromwell Road
Water & Wastewater Supply

Sheet Title
Irrigation Pumping
Schematics

Scale (A1 Original) N.T.S
Issue For Review

Project No	Sheet	Revision
000980	C310	B

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APPENDIX I – Transportation Assessment, Carriageway Consulting

Fulton Hogan Land Development Limited

Proposed Mixed Use Subdivision
922 Luggate-Cromwell Road

Transportation Assessment

CARRIAGEWAY
CONSULTING
traffic engineering | transport planning

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1. Introduction

1.1. This Transportation Assessment has been prepared to support a Substantive Application made by Fulton Hogan Land Development Limited under the Fast Track Approval Acts 2024 in accordance with the requirements of Section 42. The proposal is a Referred Project and this report has been prepared to support an application for the Parkburn Development Project (**the Project**) which is a mixed use development at 922 Luggate-Cromwell Road (State Highway 6) (**the site**), located approximately 8km to the north of Cromwell township and adjoining Lake Dunstan / Te Wairere.

1.2. The Project provides for the establishment of a mixed-use urban development, including quarry rehabilitation, residential development, supporting commercial and community activities, open space, and associated infrastructure. Works are also proposed within the State Highway 6 (SH6) road reserve.

1.3. Section 43 of the Fast Track Approval Act sets out the information to be included in a substantive application, which includes an assessment of adverse effects of the project on the environment. This report has been prepared to assess the transportation effects of the project and presents the findings, conclusions and recommendations with respect to traffic generation, road safety and access considerations.

1.4. This Transportation Assessment sets out an evaluation of the transportation aspects associated with the proposed masterplan, including changes in travel patterns that are likely to arise. Where potential adverse effects are identified, potential options for ways in which these can be addressed are set out.

1.5. This report is cognisant of the guidance specified in the New Zealand Transport Agency's '*Integrated Transport Assessment Guidelines'* and although travel by private motor vehicle is addressed within this report, in accordance with best practice the importance of other transport modes is also recognised. Consequently, travel by walking, cycling and public transport is also considered.

1.6. The site which is the subject of this report was previously considered and assessed through a private plan change to the Central Otago District Plan (known as Plan Change 21 (**PC21**)). The current proposal represents an intensification of the expected residential development and removal of the industrial development provided for under PC21. As far as practical, the same methodology has been adopted for this assessment as was used, and accepted as being appropriate, for PC21.

1.7. This report has been prepared by Andy Carr, in accordance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023). Mr Carr's qualifications and experience are summarised in Annexure A.

2. Site Overview

2.1. Location

2.1.1. The site is located around 8km to the north of Cromwell, and adjacent to Lake Dunstan and the completed Pisa Mooring development to the south. The site has frontage onto State Highway 6 to the west, and there are two legal roads that connect the site onto the highway. One of these is presently formed as the access to the current quarrying operations on the site and the adjacent property to the north (discussed further below) and will be upgraded to a roundabout as part of the development, and the other will be closed (but for completeness, a second roundabout will also be formed to serve the site).

2.1.2. The majority of the site is zoned as Low Density Residential but with the northern section zoned as Industrial Area as well as a smaller commercial zoned area.

2.1.3. The location of the site in the context of the local area is shown in Figure 1 and in more detail in Figure 2.

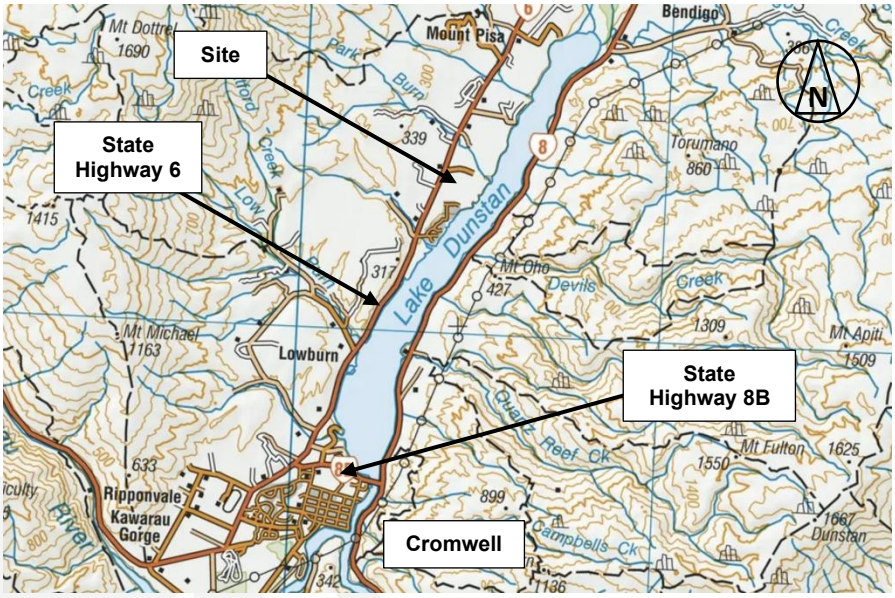


Figure 1: General Location of Site (Source: NZ Topo Map)

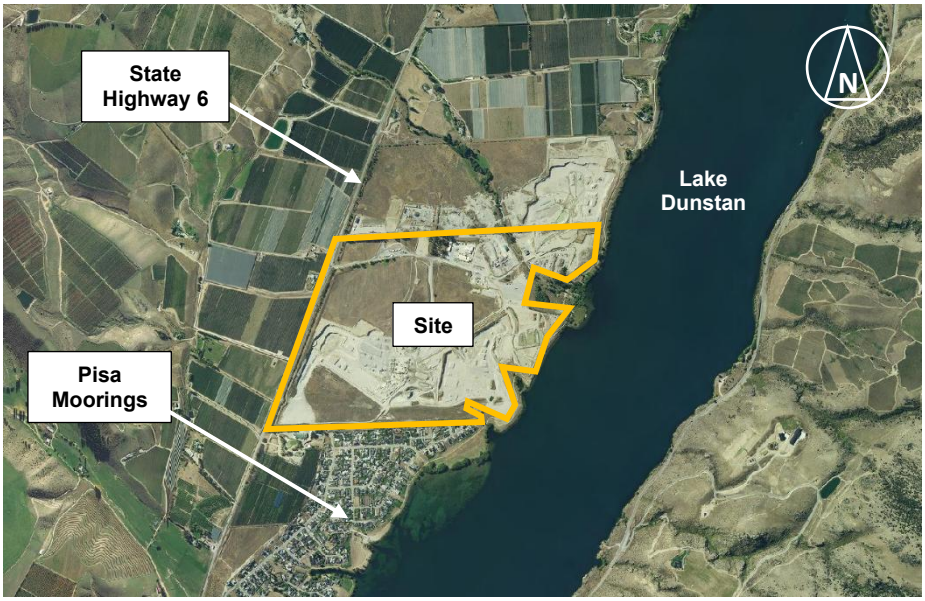


Figure 2: Aerial Photograph of Site and Environs

2.2. Roading Classification

2.2.1. The District Plan classifies State Highway 6 as a state highway, and therefore has the purpose of carrying through traffic, with direct property access being limited.

2.2.2. All other roads in the area are Local Roads, meaning they provide for local journeys and direct property access.

3. Current Transportation Networks

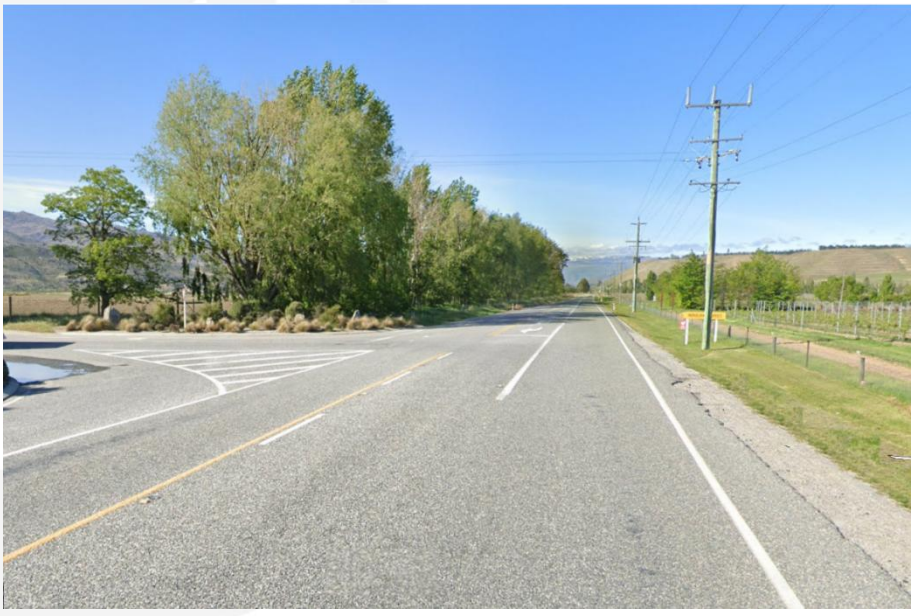
3.1. Roading Network

3.1.1. In the vicinity of the site (and in fact for 8km to the north and south of the site), State Highway 6 is characterised by a generally flat alignment and large-radii curves. The formation has one traffic lane in each direction of 3.6m width plus a sealed shoulder of around 0.5m width. The speed limit is 100km/h, with data indicating that the operating speed is around 5km/h greater than this (as would be expected in view of the highway geometry).



Photograph 1: Typical Cross-Section of State Highway 6

3.1.2. The existing legal road which presently connects the site to State Highway 6 is formed as the access to Parkburn Quarry and the adjacent property to the north. This has auxiliary right-turn land left-turn lanes for vehicles turning off the highway and widened shoulders. Sightlines at the intersection are excellent.



Photograph 2: State Highway 6 / Parkburn Quarry Access (Looking South)

3.1.3. Due to the presence of Lake Dunstan to the east and mountains (Pisa Range) to the west, the roading network in this general area is linear and broadly runs north-south. Consequently, to the north of the Parkburn Quarry access, the highway extends to Luggate some 25km away without any major roads connecting to it. Northwest of Luggate, State Highway 6 then runs to the outskirts of Wānaka before turning north to serve settlements on the West Coast.

3.1.4. Approximately 2km south of the Parkburn Quarry access and 1km south of the site's southern boundary, State Highway 6 passes through a priority ('give-way') crossroads, with Pisa Moorings Road forming the eastern approach and Clarke Road forming the western approach (although vehicles on the highway retain priority). Pisa Moorings Road serves the small settlement of Pisa Moorings (around 450 residences). The intersection has a right turn bay and a left turn deceleration lane for traffic turning into Pisa Moorings Road, and a widened shoulder for traffic turning left into Clark Road. Sightlines at the intersection are excellent.



Photograph 3: State Highway 6 / Pisa Moorings Road / Clarke Road Intersection (Looking North)

3.1.5. There are no further intersections for 3.7km south of Pisa Moorings, until Lowburn Valley Road connects to State Highway 6 from the west. This road serves the small settlement of Lowburn, with Lowburn Valley Road joining the highway at a priority ('give-way') intersection. The intersection does not have any auxiliary turning lanes but there are wide sealed shoulders on each side to enable vehicles to move clear of the through-traffic lanes before turning.



Photograph 4: State Highway 6 / Lowburn Valley Road Intersection (Looking South)

3.1.6. There are a freedom camping area and a seasonal water park on the eastern (lake) side of the highway, just south of Lowburn Valley Road which are served by an access that is formed as an intersection with an auxiliary right-turn bay. There are no further intersections for another 2.4km south of Lowburn Valley Road, until Burn Cottage Road connects to the highway at a priority ('give-way') intersection. The intersection does not have any auxiliary turning lanes but there are wide sealed shoulders on each side to enable vehicles to move clear of the through-traffic lanes before turning.



Photograph 5: State Highway 6 / Burn Cottage Road Intersection (Looking South)

3.1.7. The speed limit on the highway reduces to 80km/h approximately 150m to the south of Burn Cottage Road, with Shortcut Road connecting to the highway from the east some 250m south of the speed limit change. The State Highway 6 / Shortcut Road intersection is priority ('give-way') controlled and has a short left-turn lane and also has right-turn bays (one of which is for vehicles turning into a roadside stall located on the western side of the highway). Once again, the alignment of the highway means that sightlines for turning traffic are excellent.



Photograph 6: State Highway 6 / Shortcut Road Intersection (Looking North)

3.1.8. Shortcut Road provides a route for traffic that bypasses the majority of Cromwell township on its northern side, and connects to State Highway 8B to the east of the town centre.

3.1.9. Some 0.7km south of Shortcut Road, State Highway 6 meets State Highway 8B at a large (50m diameter) roundabout. This presently has one circulating lane, although it is understood that the design allows for a second lane to be added at some future time. There is presently one approach lane and one departure lane on each leg (but again, the layout allows for additional lanes to be added in future).



Photograph 7: State Highway 6 / State Highway 8B Roundabout (Looking South)

3.1.10. The roundabout replaced a priority intersection, and opened in mid-2022.

3.1.11. State Highway 8B runs eastwards from the roundabout providing access to Cromwell and connecting to State Highway 8 on the eastern side of Lake Dunstan. In turn this provides access to Alexandra and Dunedin to the southeast and to the northeast it connects to settlements on the east coast of the South Island. To the south of the roundabout, State

Highway 6 connects to the Wakatipu Basin before running southwards and terminating in Invercargill.

3.2. Non-Car Infrastructure

3.2.1. There is generally little specific provision for walking and cycling along State Highway 6. However, on the eastern side of the site is the Lake Dunstan Trail, which is a dedicated off-road route for walkers and cyclists. It runs along the shoreline of the lake at the site and southwards for approximately 2.7km before turning slightly westwards and running along the eastern side of the highway for around 4.3km.

3.2.2. Just north of Cromwell township the trail moves away from the highway and back to following the lake shoreline, and into the old town centre of Cromwell. Further south it connects to Clyde (around 19 southeast of Cromwell), and north of the site it runs to Smiths Way, a Local Road that is approximately 1.3km north of the site.

3.2.3. The Trail is described as Grade One (easy/flat) and is formed with a gravel surface of approximately 3.0m to 3.5m width.



Photograph 8: Example of Dunstan Trail Cross-Section (Looking South)

3.2.4. There is also provision for walking and cycling around the State Highway 6 / State Highway 8B roundabout, with a shared 1.8m wide route running around the circulating lane and through the deflection islands.



Photograph 9: Cycle Lane at the State Highway 6 / State Highway 8B Roundabout (Looking South)

3.2.5. There is no public transport in the area.

3.3. Future Changes

3.3.1. There are no known changes to the roading environment in the immediate area that are set out in any overarching strategies or guides at the time of writing.

4. Current Transportation Patterns

4.1. Traffic Flows

4.1.1. The New Zealand Transport Agency Waka Kotahi (**NZTA**) carries out a regular programme of monitoring the traffic volumes on the state highway network. There are no NZTA traffic counters in the immediate vicinity of the site, with the closest ones being 16km to the north and 6km to the south (counters 00600917 and 00600939 respectively).

4.1.2. Although the counter to the south is closest to the site, it lies to the south of Lowburn, the water park and the freedom camping site. As such, it will record traffic movements associated with these activities and which do not necessarily pass the site. Conversely, the counter towards the north will not count those vehicles that travel past the site but which turn off into private property between the site and the counter location.

4.1.3. For completeness, the Annual Average Daily Traffic Flows at the counters is shown below:

- Counter 00600917 (north of the site): 3,327 vehicles per day (two-way); and
- Counter 00600939 (south of the site): 6,627 vehicles per day (two-way).

4.1.4. In order to confirm the traffic flow past the site, a weekday morning and evening peak hour traffic count were undertaken at the State Highway 6 / Pisa Moorings Road / Clarke Road intersection in March 2025. The volumes recorded are set out below.

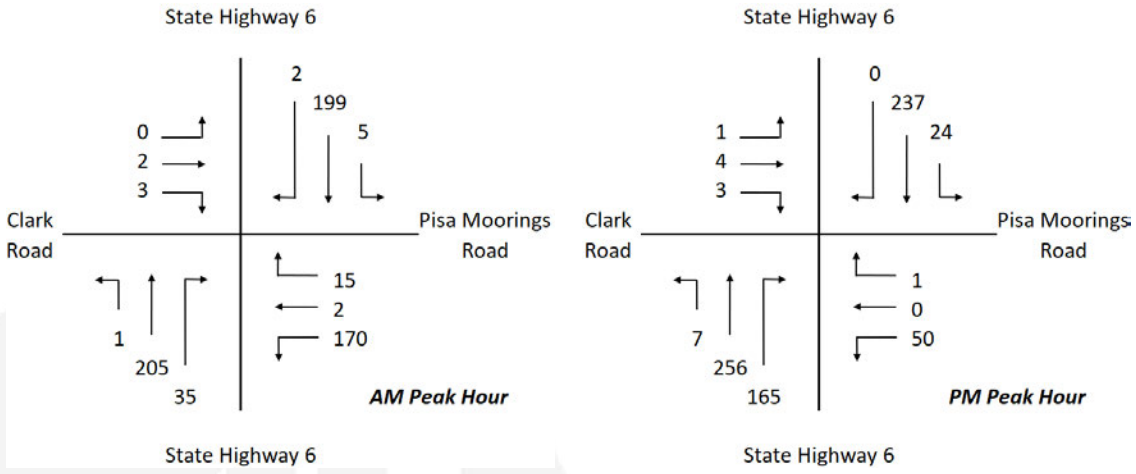


Figure 3: Turning Volumes at Access to Pisa Moorings, March 2025

4.1.5. This data has also been used to confirm the traffic generation rates for the site, as discussed below. As part of confirming the validity of the count, a comparison was carried out against the traffic flows observed at the two traffic counters and it was confirmed that the observed volumes at the intersection are typical. Details of this comparative exercise are shown in Annexure B.

4.1.6. As set out earlier in this report, a private plan change request for the site was previously advanced and subsequently approved by Central Otago District Council in 2024 (PC21). The approach which was utilised to assess the effects of the traffic generated by development of the site was to use a microsimulation transportation model, previously developed by the Council in order to assess and test large-scale proposals.

4.1.7. One advantage of using the model is that it makes allowance for the expected traffic volumes on the roading network in future Design Years, by taking into account the expected uptake of land around Cromwell (as anticipated by the Council). This therefore yields robust Design Year scenarios which can be used for assessment.

4.1.8. The model only includes the weekday evening peak period. It is understood that this was agreed by all parties assessing PC21 that this represented the 'worst case' traffic flows and that a weekday morning peak period assessment was not required. PC21 was approved on that basis.

4.1.9. The Council has made it's microsimulation model available for assessment of the current proposed development for the site. The Figure below shows the expected traffic volumes on the adjacent roading network for a Design Year of 2034[1], without any development of the site, as shown below:

[1] The model is only developed for particular future years, and 2034 is the closest year to the typical ten-year Design Year used for such analysis.

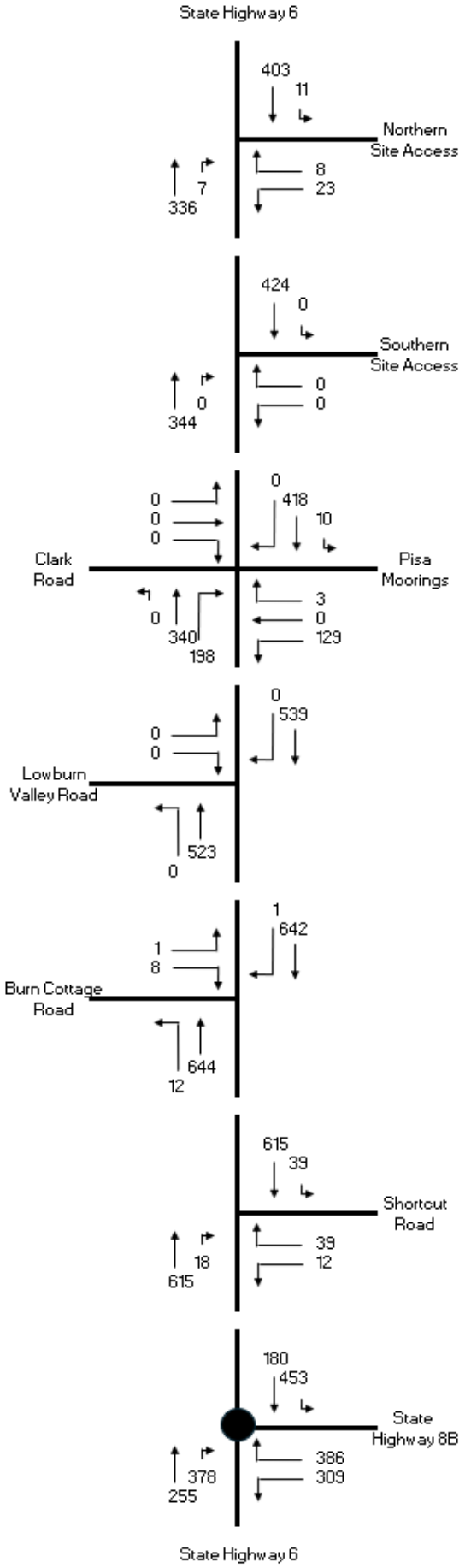


Figure 4: Design Year (2034) Traffic Volumes on State Highway 6, Evening Peak Hour

4.1.10. The model also calculates expected delays and the levels of service at each intersection. These are summarised below.

Intersection	Model Results		
	Total Veh/hr	Average Delay (s)	Level of Service
SH6 / Site Access South	768	3	A
SH6 / Site Access North	768	7	A
SH6 / Pisa Moorings Rd / Clark Rd	1,097	7	A
SH6 / Lowburn Valley Road	1,295	33	D
SH6 / Burn Cottage Road	1,308	20	C
SH6 / Shortcut Road	1,337	9	A
SH6 / SH8B Roundabout	1,960	9	A

Table 1: Intersection Performance, with no Site Development

4.1.11. It can be seen that most intersections operate with an excellent level of service. There are slightly lower levels of service expected at the Lowburn Valley Road and Burn Cottage Road intersections. These arise due to the volume of traffic on the highway which reduces the number of gaps into which traffic from the minor approaches can emerge.

4.1.12. As mentioned above, the site has already been subject to a plan change, and site development was also modelled using the microsimulation model. The results of this, as presented to the Hearing Panel for PC21, are shown below for 50% of the site development.

Intersection	N			E			S			W			Total		
	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS
SH6 / PC 21 South	406	2	A	121	8	A	457	4	A	-	-	-	984	8	A
SH6 / PC 21 North	355	2	A	75	7	A	302	3	A	-	-	-	732	7	A
SH6 / Pisa Moorings Rd / Clark Rd	512	5	A	274	16	C	870	12	B	0	0	0	1656	16	C
SH6 / Lowburn Valley Rd	762	6	A	-	-	-	960	8	A	82	>150	F	1804	>150	F
SH6 / Burn Cottage Rd	801	2	A	-	-	-	964	1	A	36	40	E	1801	40	E
SH6 / Shortcut Rd	835	1	A	49	22	C	941	2	A	-	-	-	1825	22	C
SH6 / SH8b	789	9	A	844	5	A	666	106	F	-	-	-	2299	35	D

Table 2: Intersection Performance, 50% Site Development According to PC21 Assessment (Source: Abley ITA for PC21)

4.1.13. With 50% development, it was concluded that improvements should be made to convert the State Highway 6 / Pisa Moorings / Clarke Road intersection to a roundabout and to add a second circulating lane onto the State Highway 6 / State Highway 8B roundabout. With these improvement measures in place, the model was run again and the results as presented to the Hearing Panel for PC21 are shown below:

Intersection	N			E			S			W			Total		
	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS	Veh/ hr	Delay (sec)	LOS
SH6 / PC 21 South	461	2	A	211	11	B	656	6	A	-	-	-	1328	11	B
SH6 / PC 21 North	385	2	A	113	7	A	371	4	A	-	-	-	869	7	A
SH6 / Pisa Moorings Rd / Clark Rd	649	9	A	276	8	A	1057	4	A	0	0	0	1982	6	A
SH6 / Lowburn Valley Rd	905	4	A	-	-	-	1126	10	A	97	>150	F	2127	>150	F
SH6 / Burn Cottage Rd	950	2	A	-	-	-	1117	1	A	28	>150	F	2095	>150	F
SH6 / Shortcut Rd	974	1	A	77	4	A	1067	3	A	-	-	-	2118	4	A
SH6 / SH8b	931	5	A	813	3	A	820	6	A	-	-	-	2564	5	A

Table 3: Intersection Performance, 100% Site Development According to PC21 Assessment (Source: Abley ITA for PC21)[2]

4.1.14. With these two improvement measures in place, the PC21 modelling showed that the transport network would operate satisfactorily, other than at the Lowburn Valley Road and Burn Cottage Road intersections. These were noted to arise due to a combination of zoned land which would increase traffic flows turning to and from those roads, plus volumes on the highway which limited the number of gaps which could be used by turning traffic. As such, the evidence for PC21 set out that these intersections were under pressure irrespective of PC21 and that the issue should be resolved by the Council and NZTA independently of the plan change. This position appears to have been accepted by the Hearing Panel for PC21 since no provision was made through PC21 to address or improve capacity.

4.2. Non-Car Modes of Travel

4.2.1. Given that the area is predominantly rural, it can reasonably be expected that it will be relatively lightly used by pedestrians and cyclists. It is considered that the absence of infrastructure for these road users is therefore not unreasonable. However, there are wide grassed berms available on the highway which can be used for walking.

4.2.2. The exception to this is the Lake Dunstan Trail, which can be expected to be well-used. Over the course of a year, up to 56,000 cyclists and pedestrians use at least part of the trail, although there are no specific numbers for the section of the trail to the north of Cromwell[3]. The width of the route generally aligns with the Austroads Guide to Road Design Part 6A ('Paths for Walking and Cycling') and there is no evidence that the current path is presenting operational or safety issues.

4.2.3. There are no regular bus services that pass the site. Although several longer-distance services pass nearby on State Highway 6, there are no bus stops provided within walking distance (as would be expected given the current activities on the site).

4.2.4. Cromwell itself is not served by scheduled public transport services due to its relatively small size (3,225 residences as per the most recent census) although there are inter-city services that stop in the township, and a shuttle bus that travels between Wānaka and Queenstown.

[2] For completeness, in preparing the assessment for the present Fast-Track proposal, a minor discrepancy was discovered in the previous modelling work. The Table above corrects this issue.
[3] https://www.centralotagonz.com/assets/PDFs/Central-Otago-Cycle-Trails-Demand-Projection-2024-to-2029.pdf

4.3. Road Safety

4.3.1. The NZTA Crash Analysis System has been used to establish the location and nature of the recorded traffic crashes in the vicinity of the site. All reported crashes between 2021 and 2025 were identified, plus the partial record for 2026, for State Highway 1 from 250m north of the site, to (and including) the State Highway 6 / State Highway 8B roundabout.

4.3.2. This shows that there has been a total of 22 crashes reported:

- Two crashes have been recorded on State Highway 6 between the site and Pisa Moorings Road:
  - One crash occurred adjacent to the site when a southbound driver failed to slow for roadworks, struck a patch of gravel and lost control, leaving the carriageway. The crash did not result in any injuries;
  - One crash occurred towards the north of Pisa Moorings when a southbound driver fell asleep and left the carriageway. The crash did not result in any injuries;
- Two crashes have been recorded at the State Highway 6 / Pisa Moorings Road / Clarke Road intersection:
  - One crash occurred when a southbound driver failed to notice that the car in front had slowed to turn right into Clark Road and ran into the rear. The crash did not result in any injuries, and the police report notes that the at-fault driver was disqualified and should not have been driving;
  - One crash occurred when a car did not turn left out of Pisa Moorings Road when the following driver assumed that they would, and the second driver ran into the rear of the first vehicle. The crash did not result in any injuries;
- Four crashes have been recorded on State Highway 6 between Pisa Moorings Road and Lowburn Valley Road:
  - One crash occurred when a northbound driver overtook a slower vehicle but failed to notice an oncoming southbound vehicle. In swerving to avoid a collision, the driver lost control and left the carriageway. The crash did not result in any injuries;
  - One crash occurred when a southbound driver fell asleep and collided with a northbound vehicle. The crash did not result in any injuries;
  - One crash occurred when a southbound driver fell asleep and crossed the centreline, causing a northbound vehicle to swerve and side-swipe the first vehicle. The crash resulted in minor injuries;
  - One crash occurred when a southbound driver slowed to pass a stationary (broken-down) school bus in the northbound lane. Another southbound driver also braked, but a third driver ran into the second vehicle and pushed it into the first vehicle. The crash resulted in minor injuries;
- Two crashes have been recorded at the State Highway 6 / Lowburn Valley Road intersection:
  - One crash occurred when a southbound driver failed to notice that the car in front had suddenly slowed to turn right into Lowburn Valley Road and ran into the rear. The crash did not result in any injuries;
  - One crash occurred when a driver turning right into Lowburn Valley Road initially moved to the centre of the highway prior to making the turn but then changed their mind and suddenly moved onto the shoulder, where they struck another southbound vehicle that had started to pass them. The crash did not result in any injuries;

- Four crashes have been recorded on State Highway 6 between Lowburn Valley Road and Burn Cottage Road:
    - One crash occurred when a driver turned right out of the freedom camping / water park site and failed to notice a southbound vehicle on the highway, and the two collided. The crash resulted in minor injuries;
    - One crash occurred when a northbound driver stopped prior to turning right into the freedom camping / water park site and was struck from behind by a driver that had been distracted by looking at the water park. The crash resulted in serious injuries. It should be noted that since this crash, a right-turn bay has been constructed in this location to separate turning and through traffic;
    - One crash occurred when a northbound driver intending to enter the water park moved into the southbound traffic lane prior to making the turn, and was then struck by a southbound vehicle. The crash did not result in any injuries;
    - One crash occurred when a northbound driver left the road. The police record sets out that the circumstances of the crash are unknown although it did not appear that any injuries had been caused;
- No crashes have been recorded at the State Highway 6 / Burn Cottage Road intersection:
- No crashes have been recorded on State Highway 6 between Burn Cottage Road and State Highway 8B:
- Four crashes have been recorded at the State Highway 6 / State Highway 8B roundabout:
    - One crash occurred on the westbound approach when a driver ran into the rear of another vehicle at the limit line. The crash did not result in any injuries;
    - One crash occurred when a southbound driver failed to notice the roundabout in thick fog and drove across the central island before turning eastwards. The crash did not result in any injuries;
    - One crash occurred when the load of a northbound truck shifted as the driver negotiated the roundabout, and the driver lost control with the vehicle toppling over. The crash resulted in minor injuries;
    - One crash occurred when a slow moving vehicle travelling northbound moved to the side to let other vehicles pass, but struck a lamp post. The crash did not result in any injuries;
- Four crashes were recorded at the State Highway 6 / State Highway 8B intersection prior to it being converted to a roundabout. Because the intersection geometry is now different, these types of crashes cannot now occur but are recorded here for completeness:
    - Two crashes occurred when a northbound driver turned right into State Highway 8B and struck a southbound vehicle on State Highway 6;
    - One crash occurred when a driver turned right from State Highway 8B onto State Highway 6 and struck a southbound vehicle on State Highway 6;
    - One crash occurred when two northbound drivers both attempted to turn right onto State Highway 8B at the same time and collided with one another.

4.3.3. Of the 22 crashes set out above, five have been addressed through changes to the road geometry, with four at the State Highway 6 / State Highway 8B intersection occurring prior to its conversion to a roundabout and one occurring at the access to the freedom camping / water park site prior to the installation of a right-turn bay. Of the remaining 17 crashes, only four resulted in injuries and all of these were minor.

4.3.4. The historic pattern of crashes does not indicate any particular safety-related deficiencies on this part of the roading network, with the crashes occurring in different locations and with different contributing factors.

5. Proposal

5.1. The Project) involves the staged subdivision and development of land at 922 Luggate-Cromwell Road (State Highway 6), approximately 8km north of Cromwell township and adjoining Lake Dunstan / Te Wairere. The site includes part of the existing Parkburn Quarry.

5.2. From a transportation perspective, the Project comprises the following components:

- Subdivision and development to enable approximately 1,000 residential allotments, supporting the construction of approximately 1,000 residential units;
- Subdivision and development to establish a neighbourhood centre, including retail, commercial, medical, and early childhood education activities, together with land for a primary school; and
- Construction of associated infrastructure, including internal transport networks and external access works connecting the site to State Highway 6 in two locations.

5.3. The proposed masterplan is shown below:



Figure 5: Proposed Masterplan (Extract from Woods Drawing)

5.4. Discussions with NZTA have identified that the southernmost intersection on the highway is expected to be formed as a roundabout. NZTA has also requested that the northernmost intersection is also formed as a roundabout. Accordingly, the masterplan makes provision for this. The detailed design of the roundabouts is a matter for subsequently agreement with NZTA but at the present time, the masterplan allows for the same design of roundabout as constructed by NZTA at the State Highway 6 / State Highway 8B intersection in 2022. These can be accommodated within the existing road designation and the subject site.

5.5. The roundabouts form the only points of access between the site and the highway, and no direct property access is contemplated.

5.6. The masterplan allows for roading connections to the immediate north to serve an adjacent site which it is understood will be brought forward for a private plan change in the future (for clarity, this does not form part of the current application). There is also a link to the south, to a road within Pisa Moorings known as Pony Court. The significance of this is discussed below.

6. Traffic Generation and Distribution

6.1. Traffic Generation

6.1.1. PC21 adopted a standard urban trip generation rate for the site, of 1.33 vehicle movements per residence in the peak hours and with all residences being occupied. However, traffic generated by residential developments is known to vary for a variety of reasons, with one such reason being the proximity (or otherwise) and need to travel to employment and community facilities. Where a dwelling is some distance from these types of facilities, the traffic generation rates tend to be lower than for residences that are closer due to 'trip chaining', that is, the tendency of a resident to carry out multiple visits to different destinations during the same trip away from the dwelling.

6.1.2. This being the case, it would be reasonable to anticipate that the trip generation rate per household will be lower than this. Accordingly, a detailed evaluation of the appropriate trip rate was carried out, based upon applying the surveyed volumes of the adjacent Pisa Moorings. Care was taken to ensure that Pisa Moorings did not have any unusual characteristics that might mean the trip rate could not be applied to the site and that the day of the survey did not exhibit any unusual characteristics.

6.1.3. The detail of this is included in Annexure B to this report. In short though, it is considered that the rate of 1.33 trips per household in the peak hours that was applied through PC21 is too large based on the available information. Rather, a rate of 0 0.56 trips per household is considered to be the most robust.

6.1.4. For the purposes of the assessment exercise, a yield for the site of 1,047 residences has been allowed for. The application set out that "*approximately 1,000 residential units*" was proposed, but an additional 5% has been allowed for to ensure the final yield lies within the scope of the modelling exercise.

6.1.5. The trip rate calculated for Pisa Moorings takes into account that residents have the need to travel to Cromwell for education and most commercial activities. The proposal also makes allowance for a school and neighbourhood centre. If these do not progress for any reason, then residents of the site will also have the need to travel for these purposes, and accordingly, the trip rate will be unchanged. However, if the school and/or the neighbourhood centre progress, trips made by residents that would otherwise be made to Cromwell will instead be made wholly within the site. In other words, the number of trips that occur on the external highway will decrease. Consequently, the application of the calculated trip rate yields a 'worst case traffic generation figure which may be lower in practice.

6.1.6. As might be evident, the lower trip rate and greater yield tend to offset one another. By way of comparison, the 543 residential lots assessed for PC21 at a rate of 1.33 vehicle movements per unit, generate a total of 722 vehicles (two-way). The potential 1,047 residential lots tested at a rate of 0.56 trips per unit generate 586 vehicles (two-way), around 20% lower than was evaluated for PC21.

6.2. Trip Distribution

6.2.1. PC21 adopted a distribution of trips which allowed for 90% of traffic to be associated with origins and destinations to the south of the site. The March 2025 survey of Pisa Moorings confirmed this distribution and therefore the current analysis is based on the same distribution.

7. Effects on the Transportation Networks

7.1. Roading Capacity

7.1.1. The traffic generated by the development has been added into the microsimulation model and the model has then been re-run. The results of this exercise are included and discussed in detail within Annexure C to this report, and in short, this includes for several scenarios.

7.1.2. The full development of the site to the density expected under PC21 has been remodelled. For this analysis, the calculated trip rate of 0.56 vehicles per residential units has been adopted, rather than the higher rate used for PC21.The analysis shows that this level of traffic (generated from 543 residences) can be accommodated on the highway without the need for any improvement measures.

7.1.3. As development increases within the site, it becomes progressively harder for drivers to turn right and exit Pisa Moorings. This is because there are fewer gaps in the traffic stream into which they can emerge, and as a result, queues and delays increase. The option that has been considered to address this is to form a link between Pony Court within Pisa Moorings and the site.

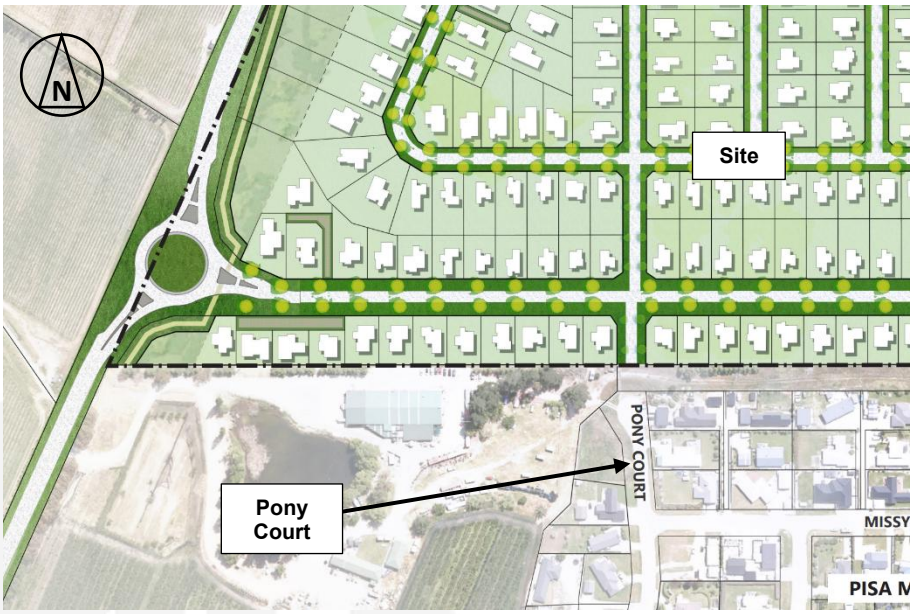


Figure 6: Link to Pony Court (Extract from Woods Drawing, Annotated)

7.1.4. The formation of this link means that drivers wishing to turn north will no longer be required to turn right from the priority intersection at State Highway 6 / Pisa Moorings Road / Clarke Road intersection. Rather, they will be able to travel north into the site and exit onto the highway using the new roundabout. The link also provides a secondary purpose because it means that residents of Pisa Moorings do not need to exit that subdivision in order to gain access to the neighbourhood centre or primary school within the site, but can instead use solely the internal roading network. This therefore takes more pressure off the highway and associated intersections. In addition this link provides an alternative access point for Pisa Moorings which currently has only one road in and out of the development.

7.1.5. It is stressed that the benefits of this direct link arise irrespective of its specific location. Pony Court appears to the most obvious and direct manner in which the link could be provided. It is presently formed as a cul-de-sac with an 8m carriageway but no footpaths. However, it has a

legal width of a 18m, meaning that it is easily capable of being upgraded to carry additional traffic within the available legal width. Nevertheless, from a transportation perspective, providing a direct link from other locations towards the northwest of Pisa Moorings would create the same outcomes.

7.1.6. In order to identify the point at which this direct link should be formed and drivers may have difficulties existing Pisa Moorings Road, the point at which Level of Service D changes to E has been found. This is the point at which average delays per vehicle increase to more than 35 seconds. The way this has been identified is to run the model at different yields and then interpolate between the results. This shows that Level of Service D transitions to Level of Service E when there are 710 residences occupied within the site.

7.1.7. Accordingly, as set out in Annexure C, it is recommended that development within the site should be limited to 710 residences until a direct link between the site and Pisa Moorings is created.

7.1.8. Finally, full development of the site (1,047 residences) has been modelled (including for a direct link between the site and Pisa Moorings). This shows that levels of service and the extent of delay remain good, although further investigation of the results shows that although the overall level of service at the State Highway 6 / State Highway 8B roundabout is acceptable, this masks that Level of Service E arises on the southern approach to the roundabout.

7.1.9. Accordingly, an evaluation has been carried out of the point at which Level of Service D transitions to Level of Service E, using the same approach described above of testing various scenario and extrapolating between them. This shows that the transition occurs when there are 875 residences occupied within the site.

7.1.10. Accordingly, as set out in Annexure C, it is recommended that development within the site should be limited to 875 residences until the roundabout is improved. The nature of the improvements is a matter than can be addressed at that time in conjunction with NZTA. However as discussed above, the roundabout was designed to be ‘future-proofed’ an allow for additional approach lanes and a second circulating lane, meaning that there can be confidence that there is sufficient area within the legal highway reserve for any necessary improvement scheme to be constructed.

7.1.11. Overall, it is considered that the traffic generated by the site can be accommodated on the roading network subject to the following two provisions:

- Development within the site should be limited to 710 residences until a direct link between the site and Pisa Moorings is created; and
- Development within the site should be limited to 875 residences until the southern approach to the State Highway 6 / State Highway 8B roundabout is improved to create additional capacity.

7.1.12. As identified in PC21 and confirmed above, both the State Highway 6 / Lowburn Valley Road and State Highway 6 / Burn Cottage Road intersections experience poor levels of service with development of the site. This is due to the reduction in the number of gaps in the State Highway 6 traffic stream into which vehicles can turn from those two minor roads. However as set out above, because the larger number of lots is offset by the expected low trip rate, the extent of queues and delays at the two intersections is forecast to be little different to the analysis presented for PC21. The Hearing Panel for PC21 ultimately determined that no mitigation measures for these two intersections were required to form part of the plan change provisions.

Given that the proposed scenario has comparable queues and delays, it is reasonable that the same conclusion applies and that no interventions are required at these two locations.

7.1.13. The modelling discussed above and in Annexure C was undertaken prior to NZTA identifying that roundabouts were its preferred intersection layout to serve the site. Accordingly, an assessment has been undertaken of the performance of the roundabouts using the expected traffic volumes output from the modelling (and allowing for the same layout as at the State Highway 6 / State Highway 8B roundabout).

7.1.14. For this exercise, to avoid the need to re-run the whole microsimulation model, different modelling software (Sidra Intersection) has been used. The results are summarised below:

Road and Movement	Southern Site Access			Northern Site Access		
	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 6 (south)	7.9	3.5	A	7.0	1.9	A
Site Access	4.6	1.3	A	4.6	0.5	A
State Highway 6 (north)	7.0	2.7	A	6.0	1.9	A

Table 4: Peak Hour Levels of Service at the State Highway 6 / Site Access Roundabouts, with Site Fully Developed

7.1.15. It can be seen that the queues and delays are very low and the roundabouts have ample spare capacity.

7.1.16. The modelling set out above is based on the split of traffic generated by the site at full development, with each roundabout carrying some of the development traffic. However it is understood that development of the site will occur from south to north, and thus there may be a time when the southern roundabout carries more traffic than it would at full development (where a proportion of the traffic uses the northern roundabout). In order to evaluate such an interim scenario, the southern roundabout has been tested allowing for **all** development related traffic to pass through it, and the results are shown below.

Road and Movement	Southern Site Access		
	Avg Delay (secs)	95 %ile Queue (veh)	Level of Service
State Highway 6 (south)	8.9	3.7	A
Site Access	4.6	1.9	A
State Highway 6 (north)	7.6	2.7	A

Table 5: Peak Hour Levels of Service at the Southern State Highway 6 / Site Access Roundabout, with Site Fully Developed and without Northern Roundabout

7.1.17. It can be seen that even under this extreme scenario, the roundabout has ample available capacity and provides excellent Levels of Service on each approach.

7.1.18. On that basis, it is not only considered that the traffic generated by the site can be accommodated on the roading network subject to the two provisions set out above (regarding a direct link between the site and Pisa Mooring, and improvements to the State Highway 6 /

State Highway 8B roundabout) but also that the proposed roundabout serving the site are easily able to accommodate the expected traffic generation.

7.2. Non-Car Modes of Travel

7.2.1. The development of the site may result in increased levels of walking and cycling in the immediate area. It is typically accepted that people will walk a maximum of 1km to reach a particular destination, and will cycle a maximum distance of 3km, but the site lies 8km from the nearest settlement of Cromwell and it is therefore expected that the bulk of movements will be internal to the site or between the site and Pisa Moorings (the latter being especially relevant for movements to/from the school and neighbourhood centre).

7.2.2. The design of the roading network within the site makes provision for a shared walking and cycling route on the more heavily-trafficked roads, with footpaths provided on both sides of all other roads. This will ensure a high-quality route for cyclists, as well as supporting ease of walking trips.

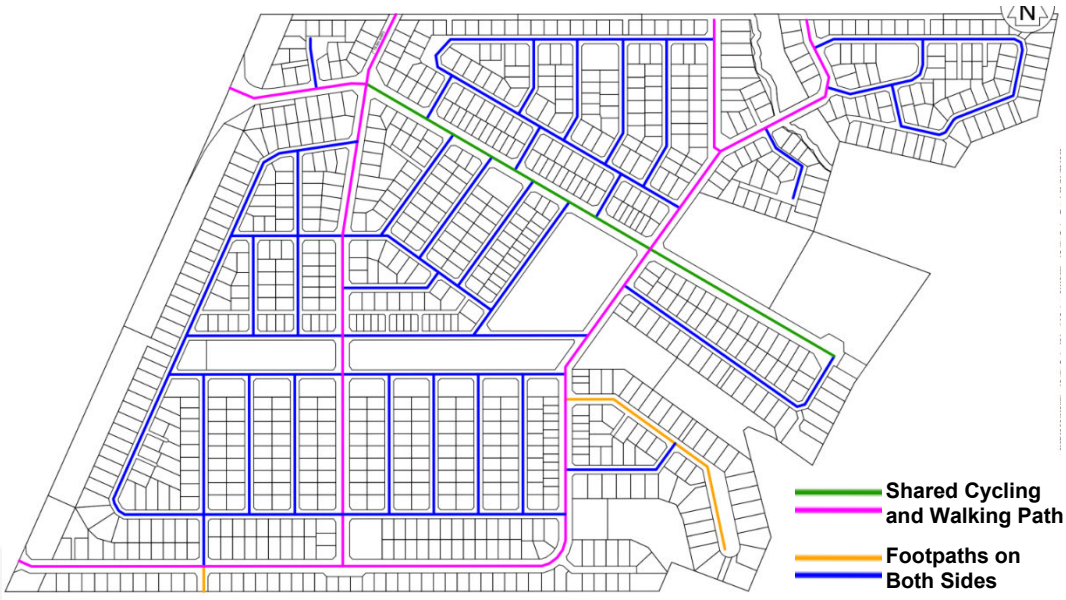


Figure 7: Footpath and Shared Walking/Cycling Path Provision (Extract from Landpro Drawing, Annotated)

7.2.3. Because the site has frontage onto the Lake Dunstan Trail, it is likely that this will be used for recreational cycling/walking but it is also possible that using e-bikes, commuting may take place. The trail is sufficiently wide for this and it is not considered that improvements are required to it. Although it is unsealed, it is well-maintained and flat, and it is not considered that formally sealing the Trail would create a material increase in its use. Cycling between the site and Cromwell would take in the order of half an hour, with a walking trip taking about two hours.

7.2.4. Cromwell itself is not served by scheduled public transport services. Typically the ability to provide economically-viable services increases as the size of a settlement increases, but it is relevant that even with Parkburn fully developed, the number of residences in Cromwell plus Parkburn would still be a third smaller than Wānaka, which despite being larger, does not have a scheduled public transport service. Accordingly, it is not considered that Parkburn will give rise to the need for public transport.

7.2.5. That said, the masterplan layout shows that a loop road is provided within the site than connects the two roundabouts via the neighbourhood centre and the school. This therefore provides a viable route option in the event that a public transport service was to operate in future. It is understood that this arrangement was sought by Otago Regional Council.

7.3. Road Safety

7.3.1. Based on a review of the road safety records, the proposal is unlikely to result in adverse road safety effects arising as a result of the increase in traffic flows on the road network.

7.3.2. The roundabouts serving the site and other infrastructure improvements can be developed to meet current guides and standards, and there are no reasons why departure from these should be necessary. It can also be expected that schemes that affect the state highway network will be subject to a road safety audit / safe system audit by NZTA which further protects the safety and operation of the state highway network. The flat and straight nature of the highway means that sight distances will be excellent.

7.3.3. The roundabouts create the opportunity for a reduction in the speed limit, and a reduced speed is likely to lead to improved road safety outcomes. However, a speed limit reduction is not a prerequisite for construction of the roundabouts, as there are already roundabouts on state highways that are subject to 100km/h speed limits elsewhere in the South Island.

7.3.4. Within the site itself, the topography is relatively flat and so it is not expected that there will be any difficulties in achieving appropriate road alignment or sight distances.

8. District Plan and Engineering Code of Practice

8.1. Introduction

8.1.1. The District Plan sets out a number of transportation-related rules with which any development is expected to comply. An assessment of the transportation rules has been undertaken and the results are summarised below.

8.2. District Plan Part 12.7.1: Access Standards from Roads

8.2.1. Part (ii): Sight Distances

8.2.1.1. Under the District Plan, assuming that roads within the site are subject to a speed limit of 50km/h (being typical for a residential subdivision) then each lot requires a sight distance of 40m at its access. The generally flat and straight nature of the roads means that this will be achieved, but it is possible that for those lots that are close to intersections or curves, sightlines may be shorter.

8.2.1.2. The length of a sightline is based on the time that is required for a driver to see the road ahead, assimilate what is happening, and bring their vehicle to a stop. As such, the sightline is proportional to the speed of the vehicle. Consequently at lower speeds, shorter sight distances can be supported.

8.2.1.3. At curves and intersections, drivers must slow considerably in order to negotiate the road geometry and thus because their speed is slower, shorter sight distances are appropriate for these locations. Accordingly, it is considered that *if* there are lots with sight distances of less than 40m, these can be supported.

8.2.2. Part (iii): Access to Rural Arterial Roads

8.2.2.1. Although State Highway 6 is notionally a Rural Arterial Road, the points of access onto it have been devised based on discussions with NZTA. As such, the parameters set out in this section of the District Plan are not applicable in this case.

8.2.3. Part (vii): Access to Urban Local Roads

8.2.3.1. The District Plan requires that accesses to Urban Local Roads must be sealed and any access must be at least 15m from a state highway. These are achieved under the proposed masterplan.

8.3. District Plan Part 12.7.2: Parking

8.3.1. Part (i): Number of Spaces

8.3.1.1. At this stage, no detailed layout has been produced for the individual lots. However their size means that each will be able to provide several car parking spaces, meeting Plan requirements.

8.3.2. Part (ii): Parking in Excess of Three Spaces

8.3.2.1. It is not expected that any residential lots will provide more than three parking spaces.

8.3.2.2. For the non-residential lots, the car parks can be sealed and drained (Parts (a) and (b)), and they will have a defined point of entry and exit to avoid drivers using informal accesses (Part (c)). Parking areas can have sufficient manoeuvring space (Part (d)) and queuing space (Part (e)).

8.4. District Plan Part 12.7.3: Loading and Manoeuvring

8.4.1. Part (i): Servicing Activities

8.4.1.1. Much of the proposal is for residential activities and therefore the loading and unloading of goods is not expected to occur frequently.

8.4.1.2. For the neighbourhood centre, loading facilities will be provided in a manner that means loading will not take place from the frontage road.

8.5. Council's Engineering Code of Practice

8.5.1. The Council has a Code of Practice for Land Development and Subdivision Engineering, based on national Standard NZS4404 published in 2004. This version of the national Standard was superseded and formally withdrawn in 2010, although the Council still uses the 2004 variant. It is understood that the Council is presently updating the Code of Practice to reflect the most recent guidance, although the new version is not yet available.

8.5.2. The road cross-sections are matters relating to the Engineering Code of Practice is addressed by other consultants and is not included within this report.

8.6. Summary

8.6.1. It is considered that the site layout complies with all the transportation requirements of the District Plan, other than for the sightlines at a small number of lots which are close to intersections or curves. The effects of these shortfalls has been considered and the layout can be supported in light of the reduced sightlines arising because of roading features (curves and intersections) which also reduce the operating speed of the road.

9. Conclusions

9.1. This report has identified, evaluated and assessed the various transport and access elements of a proposed subdivision of 1,047 residential lots plus neighbourhood centre (which may include retail, commercial, medical and early childhood education activities) and a possible primary school.

9.2. The site has previously been assessed through a private plan change to the Central Otago District Plan (**PC21**). As far as practical, the same methodology has been adopted for this assessment as was used, and accepted as being appropriate, for PC21.

9.3. PC21 adopted a generic urban trip generation rate for the expected site development. However this did not take into account that sites that are outside the urban area typically have lower rates. An evaluation of the expected rate in this case has been carried out, which indicates that the rate per residential unit is lower than previously used, and this offsets the increase in the number of lots.

9.4. The transport modelling of the proposal indicates that the full development of the site can be accommodated by the roading network subject to two staging thresholds:

- Development within the site should be limited to 710 residences until a direct link between the site and Pisa Moorings is created; and
- Development within the site should be limited to 875 residences until the southern approach to the State Highway 6 / State Highway 8B roundabout is improved to create additional capacity.

9.5. Access to the site is proposed via two roundabouts at the northwest and southwest of the site (roundabouts have been required by NZTA). These have been modelled and have ample available capacity to accommodate the expected traffic flows. The masterplan makes allowance for suitable roundabouts to be implemented.

9.6. As identified in PC21 and confirmed through the modelling carried out for this proposal, both the State Highway 6 / Lowburn Valley Road and State Highway 6 / Burn Cottage Road intersections experience poor levels of service, due to the elevated traffic volumes on State Highway 6. However, the extent of queues and delays at the two intersections is forecast to have little difference to the analysis presented for PC21, where the Hearings Panel determined that no mitigation measures for these two intersections were required to form part of the plan change provisions.

9.7. The location of the site means that it is unlikely there will be a large walking and cycling movements to and from external destinations but any such movements to/from Cromwell can take place using the Lake Dunstan Trail. Internally the site provides for walking and cycling movements by way of footpaths on all roads, and a shared walking/cycling route on the main roads.

9.8. The size of the proposal is not such that a public transport service is justified albeit the roading layout has been designed to cater for possible future services along a route past the neighbourhood centre and possible school, and which would therefore serve the key trip attractors in the site. It is understood that this arrangement was sought by Otago Regional Council.

9.9. The crash history in the vicinity of the site does not indicate that there would be any adverse safety effects from the proposal. The roading network within the site and the improvements required for intersections on State Highway 6 can be developed to meet current guides and standards

9.10. It is expected that there will be a high degree of compliance with the transportation requirements of the District Plan. Non-compliances are likely at a small number of lots with regard to sightlines, but the effects of these shortfalls have been considered and it is considered that the layout can be supported, noting that in such locations, the operating speed of the road can be expected to be lower than the posted limit due to the roading geometry.

9.11. Overall, and subject to the preceding comments, the proposal can be supported from a traffic and transportation perspective and it is considered that there are no traffic and transportation reasons why the consent could not be approved.

Carriageway Consulting Limited
June 2026

Appendix A

Qualifications and Experience of Report Author

CARRIAGEWAY
CONSULTING
traffic engineering | transport planning

Qualifications and Experience

Report Author: Andy Carr

Professional Qualifications

1988	Bachelor of Science with Honours (Computing Science), University of Newcastle upon Tyne
1989	Master of Science (Transport Engineering and Operations), University of Newcastle upon Tyne
1998	Master of Business Administration (Distinction): University of Newcastle upon Tyne
2006 - present	Chartered Professional Engineer (Practice field: Transportation engineering)
2006 - present	International Professional Engineer (NZ)
2006 - present	APEC Engineer
2006 - present	Chartered Member, Engineering New Zealand

Employment Profile

2014 - present	Director and Owner, Carriageway Consulting Limited – involved in numerous transportation engineering projects from transportation assessments for new developments and plan changes, to roading design, road safety audits, and independent peer reviews for local authorities and government departments. Preparation and presentation of expert evidence to Council Hearings and the Environment Court.
2012 - 2014	Associate Principal, Abley Limited - leading a range of transportation assessments for land-use projects throughout the country, and provision of expert evidence.
2005 - 2012	Senior Transport Planner and progressing to Senior Associate / Office Manager, Traffic Design Group - responsible for sourcing, managing and overall technical direction of the transportation assessments for land use development projects throughout the South Island.
2004 - 2005	Senior Transport Planner, Beca - assisting in a variety of roading projects with particular responsibility for writing the first New Zealand Pedestrian Planning Guide.
1990 - 2004	Traffic engineer in various private sector roles in the UK, ranging from Graduate (1990-1992) to Principal (2000-2004) with a range of roles, initially assisting with a variety of projects assessing land use changes, road safety and strategic transportation studies, and ultimately managing a local team with technical oversight of all work carried out, client liaison and sourcing commissions.

Additional Information

Member, Resource Management Law Association

Member, Engineering New Zealand Transportation Group

Associate Member, New Zealand Planning Institute

Annexure B

Assessment of Trip Generation Rate

CARRIAGEWAY
CONSULTING

CCL Ref: 15090-160326-dewe

16 March 2026

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Greg Dewe
Fulton Hogan Land Development Limited

By e-mail only: Gregory.Dewe@fultonhogan.com

Dear Greg

Parkburn: Residential Trip Generation Rate

Further to our discussions and modelling work, as you know, NZTA has sought further information regarding the trip generation rate that we adopted for the assessment of the Parkburn subdivision. This letter sets out relevant background information to this.

In preparing this letter we have completely reassessed the traffic survey information, to ensure that no calculation errors inadvertently occurred in our previous assessment. For clarity, this has led to some very minor differences in the numbers below compared to earlier reporting, largely due to rounding discrepancies.

Background

The Parkburn site was considered for residential development through Plan Change 21 (**PC21**) to the Central Otago District Plan. When the present proposal for Parkburn was initially advanced, it emerged during initial discussions with the modelling team that the traffic generation rate used for residential activities at PC21 had been based on a typical residential subdivision within urban Cromwell. The rate used in the peak hours was 1.33 vehicle movements per household, with all households being occupied.

Intuitively this introduces a potential over-estimation in the trip rate, because residences that are some distance from settlements usually have different trip-making characteristics to those that are within towns. For example, drivers living more remotely will set off earlier on their journey due to longer travel distances, and trips into town will be organised to visit several different destinations as part of the same trip ('trip-chaining').

Consequently prior to undertaking any assessment of Parkburn, additional data was collected to assess the appropriate trip rate to be used.

Location for Traffic Survey

Parkburn is adjacent to Pisa Moorings, and so it is plausible that the trip generation of Pisa Moorings would be the same as for Parkburn. A number of assessments were carried out to ensure that this was the case.

Firstly we considered the need to travel, which is likely to be due to the need to travel to work and education. The 2023 census showed the following proportions of retirees:

- Median age:
  - Pisa Moorings: 40.5 years;
  - Cromwell East (Statistical Area 2): 40.4 years;
  - Cromwell West (Statistical Area 2): 41.3%;
  - New Zealand overall: 38.1 years;
- Proportion of people aged 65 and over:
  - Pisa Moorings: 15.6%;
  - Cromwell East (Statistical Area 2): 20.1%;
  - Cromwell West (Statistical Area 2): 21.8%;
  - New Zealand overall: 16.6%

The data does not support Pisa Moorings having a high proportion of retirees, as the percentage is lower than for Cromwell overall and similar to New Zealand overall.

We then assessed the matter of employment, as people that are not employed will not travel to work. The census showed the following:

- Unemployed or not in labour force:
  - Pisa Moorings: 23.5%;
  - Cromwell East (Statistical Area 2): 27.6%;
  - Cromwell West (Statistical Area 2): 30.7%;
  - New Zealand overall: 35.4%

The data showed that the proportion of employed residents in Pisa Moorings is greater than from Cromwell and for the whole of New Zealand. This does not indicate that a lower trip rate would arise from a diminished need to travel to work.

We then assessed how residents travel to work:

- Travel to work: Drove a car / passenger in a car, truck or van:
  - Pisa Moorings: 79.9%%
  - Cromwell East (Statistical Area 2): 78.0%
  - Cromwell West (Statistical Area 2): 75.3%;
  - New Zealand overall: 70.6%

The data shows that slightly more residents travel to work using a car, truck or van at Pisa Moorings than the remainder of Cromwell and New Zealand as a whole.

We then considered the need to travel for education (that is, to carry out the ‘school run’). The census showed the following:

- Family or sole parent with child:
  - Pisa Moorings: 46.3%
  - Cromwell East (Statistical Area 2): 45.6%;
  - Cromwell West (Statistical Area 2): 47.1%;
  - New Zealand overall: 58.5%
- Average number of residents per household:
  - Pisa Moorings: 2.8 residents
  - Cromwell East (Statistical Area 2): 2.5 residents
  - Cromwell West (Statistical Area 2): 2.5 residents

    - New Zealand overall: 2.7 residents
- Travel to education: Drove a car / passenger in a car, truck or van:
    - Pisa Moorings: 60.9%
    - Cromwell East (Statistical Area 2): 37.9%
    - Cromwell West (Statistical Area 2): 30.6%
    - New Zealand overall: 51.2%

The data shows that a similar number of families in Pisa Moorings had children as the rest of Cromwell (although this is lower than for New Zealand as a whole). Families in Pisa Moorings are larger, and more travel to education is made by car.

We also evaluated the extent to which homes might not be occupied as they were second or holiday homes.

- Unoccupied dwellings on census night:
    - Pisa Moorings: 18.8%
    - Cromwell East (Statistical Area 2): 18.1%
    - Cromwell West (Statistical Area 2): 16.9%
    - New Zealand overall: 10.9%

This data set suggests that slightly more dwellings were unoccupied in Pisa Moorings than in Cromwell. Overall though the rate of occupancy in Cromwell differs from New Zealand overall.

In summary then, we do not consider that the data shows that Pisa Moorings exhibits significantly different characteristics to the remainder of Cromwell. Accordingly, Pisa Moorings is an appropriate survey location to adopt to derive a trip rate for application to Parkburn.

Survey and Results

Helpfully, there is only one point of vehicular access to Pisa Moorings, and accordingly, we arranged for a traffic survey to be undertaken at the State Highway 6 / Pisa Moorings Road / Clark Road intersection during a typical weekday in March 2025, in the periods 7:30am to 9:30am and 3:45pm to 6:15pm.

Appendix A to this letter sets out the full results of the survey, which was collected through an observer using a mobile app. Use of this system meant that traffic flows could be collected on a minute-by-minute basis.

On this basis, the observed peak hours were as follows:

- Morning peak hour: 7:44am to 8:43am:
    - Entering Pisa Moorings: 42 vehicles;
    - Exiting Pisa Moorings:188 vehicles;
    - 82% of traffic exiting, 18% entering;
- Evening peak hour: 5:03pm to 6:02pm:
    - Entering Pisa Moorings: 197 vehicles;
    - Exiting Pisa Moorings: 54 vehicles;
    - 22% of traffic exiting, 78% entering.

Notwithstanding that these are the peak hour, when the whole of the data set is examined, there is very low 'peakiness' in the traffic flows:

- In the morning peak hour:
  - The peak traffic generation was 230 vehicles (two-way) occurring between 7:44am to 8:43am;
  - However in every consecutive 60-minute period between 7:31am and 9:09am (that is, for 39 60-minute periods), the traffic volume was within 10% of this (a 60-minute volume of 208 vehicles or more);
- In the evening peak hour:
  - The peak traffic generation was 251 vehicles (two-way) occurring between 5:03pm to 6:02pm;
  - However in every consecutive 60-minute period ending between 5:39pm and 6:15pm, (that is, for 37 60-minute periods), the traffic volume was within 10% of this (a 60-minute volume of 226 vehicles or more).

This can be seen when each 60-minute period is plotted, as below:

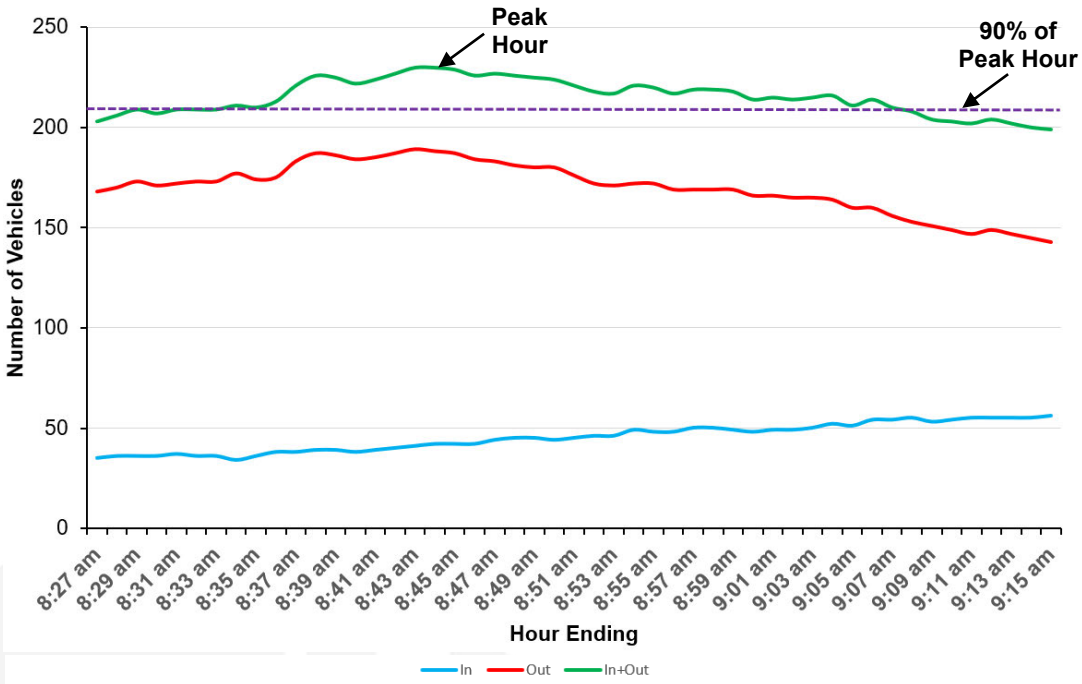


Figure 1: Cumulative Traffic Flows in Each 60-minute Period, Morning Survey Period

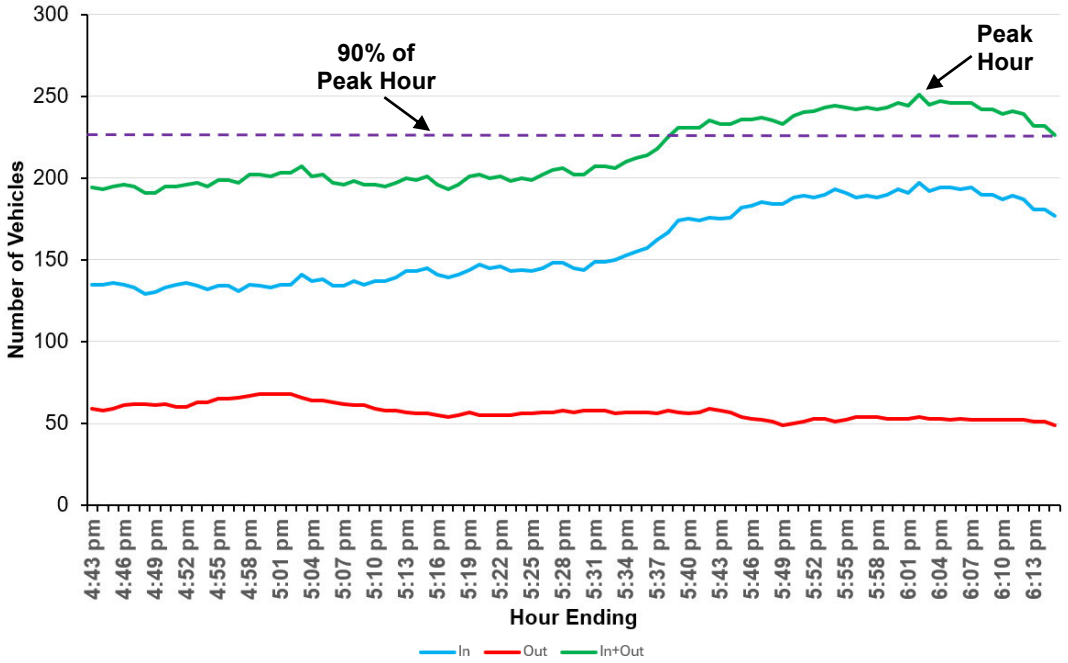


Figure 2: Cumulative Traffic Flows in Each 60-minute Period, Evening Survey Period

The graph of the morning peak period visually demonstrates that the trip generation of the Pisa Moorings remains very similar over much of the period surveyed. In the evening peak period, the traffic generation is lower for the first part of the survey (up to around 5:34pm) before then increasing and remaining high after around 5:30pm.

In our view this indicates that the period when higher traffic flows enter and exit Pisa Moorings occur is elongated. Peak spreading of this nature is common in congested conditions but the roading network in this area is generally not under stress. One possible explanation for this is the location of Pisa Moorings. At any given time it is likely that residents will be working in Wānaka, Luggate and the Wakatipu Basin, and due to the extended journey distances will therefore leave earlier to travel and arrive back later. Some residents will travel to work in Cromwell, and others will carry out the 'school run'. All of these journeys will be of a different duration and so it is reasonable that they will start and end at different times, thus giving rise to peak spreading.

There is some evidence for this when the traffic volumes are collated into ten-minute periods as shown below.

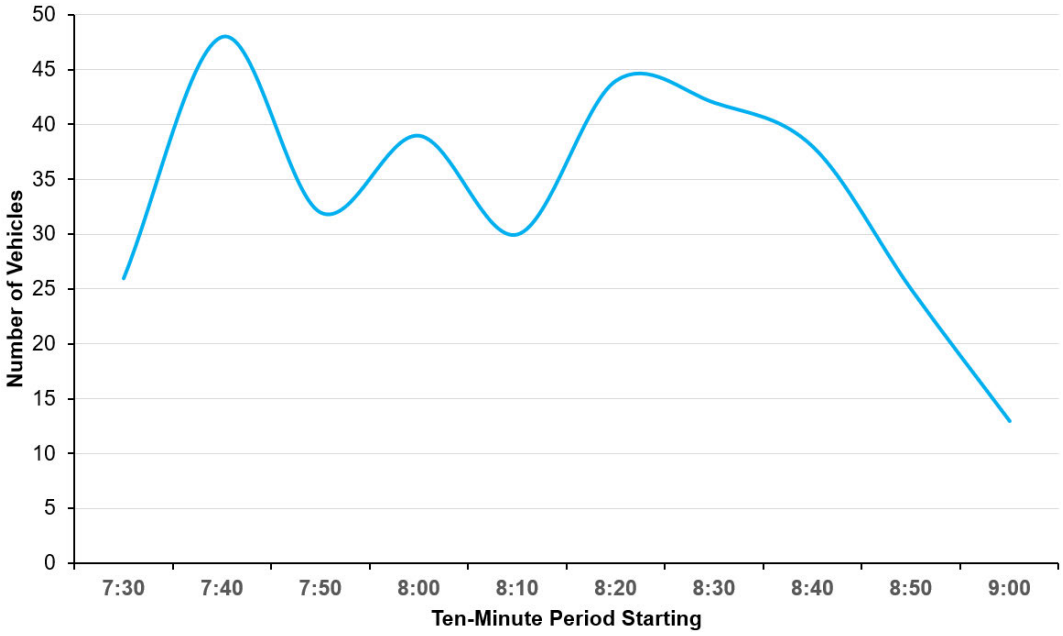


Figure 3: Traffic Flows in Each 10-minute Period, Morning Survey Period

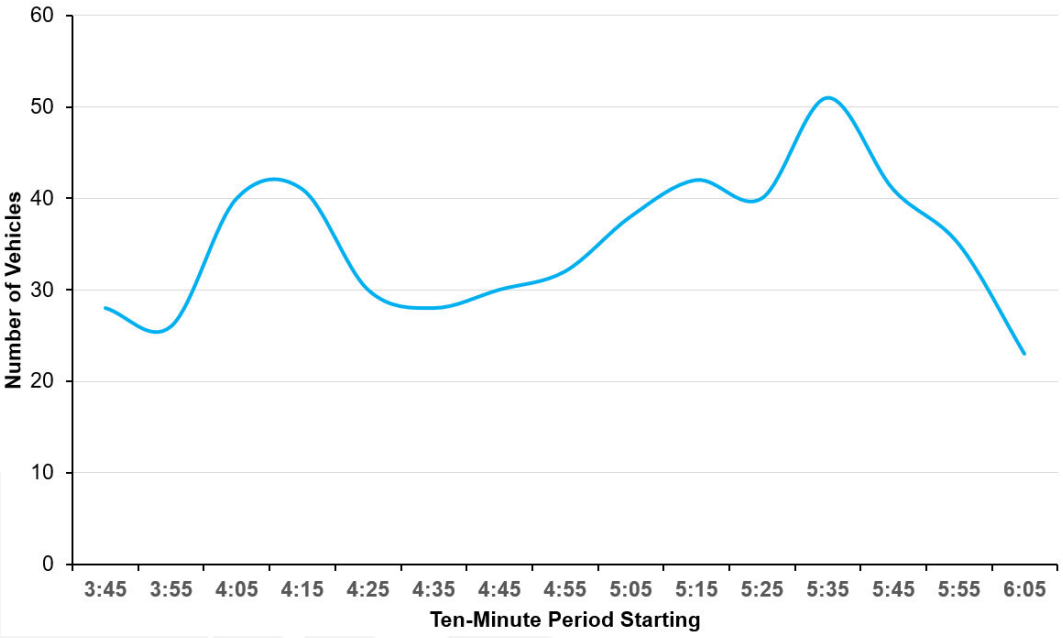


Figure 4: Traffic Flows in Each 10-minute Period, Evening Survey Period

In the morning survey period, a short-term peak is seen at both 7:40am and 8:00am, which would be commensurate with residents leaving to travel to destinations further afield. In that regard the busiest period occurs at 7:40am, which is earlier than needed to travel to Cromwell but potentially would be appropriate for Wānaka and Queenstown. Traffic volumes peak again around 8:20am which would align with travel into Cromwell and then remain high (commensurate with school travel) until declining after 8:40am.

The evening peak survey shows two clear peaks, with a peak at around 4:10pm before the volume falls and then rises again to the busiest period at 5:35pm.

In summary then, in our view, the surveys show that the peak traffic flows are spread over an extended timeframe, with one explanation for this being the location of Pisa Moorings in relation to the likely trip destinations.

Number of Residences in Pisa Moorings

The number of residences in Pisa Moorings is an important aspect of understanding the trip generation rate per unit and so was found in two ways.

In the first instance, aerial photographs of Pisa Moorings in 2025 were obtained and the number of lots was manually counted.

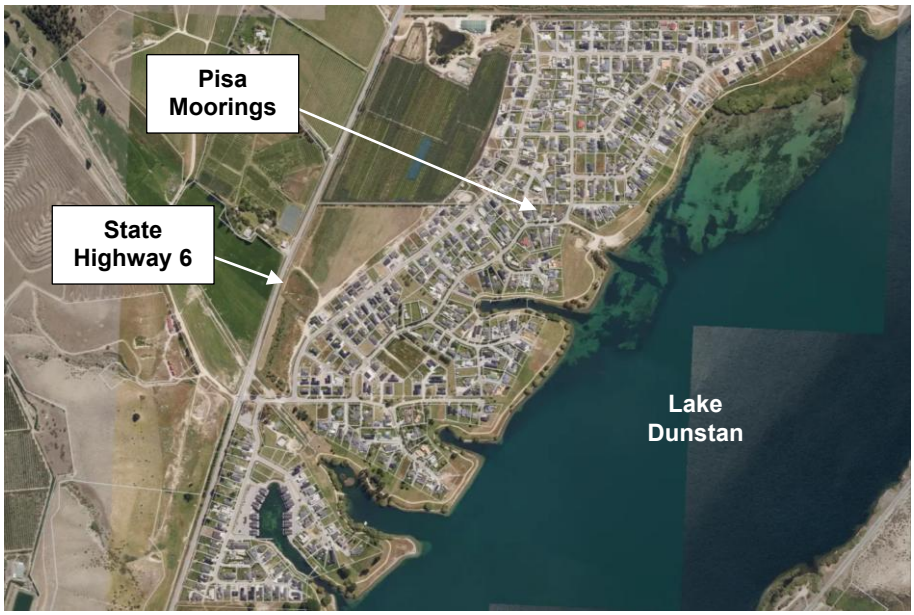


Figure 5: Pisa Moorings Showing Individual Lots

This manual approach yielded approximately 450 residences.

The 2023 census was also assessed, and this showed 420 residences. However aerial photographs from 2023 show vacant sections in Pisa Moorings that were occupied by houses in 2025, showing that there were more houses in Pisa Moorings in 2025 than in 2023. On this basis, the figure of 230 residences will be lower than is present, and so the figure of 450 residences has been adopted as it can be visually observed on photographs.

In common with other settlements in the area, there is the potential for houses to be holiday/second homes. The 2023 census showed 18.8% unoccupied properties in Pisa Moorings which is greater than nationally (10.9%).

By coincidence, census night in 2023 was Tuesday 7 March and our traffic survey was carried out on Tuesday 4 March. This means that it is highly likely that there was the same pattern of household occupancy at the time of the survey as the census, almost exactly two years prior. In other words, we can expect, with a reasonable degree of confidence, that during our survey 81.2% of the households were occupied.

Trip Rate

On this basis then, Pisa Moorings had 365 occupied properties generating 230 vehicles (two-way) in the morning peak hour and 251 vehicles (two-way) in the evening peak hour. This equates to peak hour rates of 0.63 and 0.69 trips per occupied residence in the peak hours, or peak hour rates of 0.51 and 0.56 trips per residence (occupied and unoccupied) in the peak hours. To reiterate, the trip generation rate used in the PC21 assessment was 1.33 trips per household in the peak hours.

Further Checks on the Data

Assessment of Whether Surveyed Flows were Typical

One reason for a low traffic count can be that there is some form of disruption on the roading network which means people travel less or travel at different times. To allow an assessment of this, the 2025 traffic count also observed 'through' traffic on the highway (also shown in Appendix B).

There are no NZTA traffic counters in the immediate vicinity of the site, with the closest ones being 16km to the north and 6km to the south (counters 00600917 and 00600939). Counter 00600917 is not continuous, but we have therefore compared the average for 2025 to the observed traffic counts:

- 8am to 9am:
  - NZTA counter: 272 vehicles (two-way);
  - Survey: 349 vehicles (two-way);
- 4pm to 5pm:
  - NZTA counter: 332 vehicles (two-way);
  - Survey: 418 vehicles (two-way);
- 5pm to 6pm:
  - NZTA counter: 339 vehicles (two-way);
  - Survey: 483 vehicles (two-way).

Because the NZTA data is an average there is inevitably some difference in the figures. However the surveyed data consistently shows higher volumes compared to the NZTA data.

The traffic counter towards the south (counter 00600939) is continuous and so it is therefore possible to compare the volumes recorded on the day of the survey with those recorded in the period before and after. This is shown below:

- 7am to 8am:
  - NZTA counter on 4 March: 625 vehicles (two-way);
  - NZTA counter average in February and March: 552 vehicles (two-way);
  - Survey day 13% higher than average;
- 8am to 9am:
  - NZTA counter on 4 March: 628 vehicles (two-way);
  - NZTA counter average in February and March: 594 vehicles (two-way);
  - Survey day 6% higher than average;
- 4pm to 5pm:
  - NZTA counter on 4 March: 678 vehicles (two-way);
  - NZTA counter average in February and March: 695 vehicles (two-way);
  - Survey day 3% lower than average;
- 5pm to 6pm:
  - NZTA counter on 4 March: 756 vehicles (two-way);
  - NZTA counter average in February and March: 706 vehicles (two-way);
  - Survey day 7% higher than average.

The data indicates that on the day of the survey, volume were generally higher compared to the average weekday in the weeks immediately prior or following. This does not indicate that traffic volumes were suppressed on the survey day.

The continuous counter also enables a comparison to be made between the volumes observed in the survey and those at the counter. The counter location is located to the south of Lowburn and

it therefore records traffic travelling to and from the Water Park and also the Lowburn Harbour Camping and Campervan Site, and Lowburn itself, none of which will be passing the site. Consequently it can be expected that the automatic traffic counter will record volumes greater than seen during the survey.

- 8am to 9am:
  - NZTA counter on 4 March: 628 vehicles (two-way);
  - Survey: 524 vehicles (two-way);
- 4pm to 5pm:
  - NZTA counter on 4 March: 678 vehicles (two-way);
  - Survey: 582 vehicles (two-way);
- 5pm to 6pm:
  - NZTA counter on 4 March: 756 vehicles (two-way);
  - Survey: 684 vehicles (two-way).

In each case, the automatic traffic count data is 70-100 vehicles (two-way) greater than seen during the manual survey. This difference would not be out-of-keeping with the extent of travel to/from Lowburn and the camp site.

On this basis, we conclude that conditions on the roading network on the day of the survey were typical.

Comparison with Other Locations

We have recently reviewed trip rates for residential households in the Queenstown area as part of another commission. Of note is that the recently-approved Fast-Track application for Homestead Bay was based on reported rates of 0.58 to 0.89 trips per household. Other surveys showed values of 0.44 to 0.87 trips per residence (occupied and unoccupied) in the peak hours, with a mean value of 0.7 trips per residence (occupied and unoccupied) in the peak hours.

This data cannot be directly applied to Pisa Moorings and to Cromwell, as the Wakatipu Basin has a public transport service (although the uptake of this is small). The purpose of presenting it is that no trip rates were as high as the previous rate applied to the PC21 area.

Effects of Variation in the Number of Residences

It might be considered that the number of residences in Pisa Moorings has been underestimated. However if the number of units was to be greater, then the trip rate per unit would be lower than calculated.

In that regard, a traffic survey was carried out at the State Highway 6 / Pisa Moorings Road intersection in 2017. This was undertaken for five weekdays and showed an average volume of 112 vehicles (two-way) in the morning peak hour and 117 vehicles (two-way) in the evening peak hour. The 2018 census (carried out a year later) indicates that there were 276 residences in Pisa Moorings. As the dates of the survey and census do not align, the data cannot be fully relied upon but we highlight that the data suggests a trip rate aligned with the 2025 observations rather than a higher rate used in PC21.

Travel to Commercial Development

Finally, we note that Parkburn includes commercial development. Thus while residents of Pisa Moorings presently have to travel into Cromwell for goods and services, residents of Parkburn will have some of those facilities available on site (once developed). Consequently a proportion of trips observed in 2025 at Pisa Moorings will instead be made wholly internally to the Parkburn site and

will therefore not occur on the state highway[1]. This will therefore result in a further reduction in the external trip rate per residence.

Summary and Conclusions

The census data shows that Pisa Moorings is a suitable location for a survey to determine the expected trip generation of Parkburn, as Pisa Moorings does not show any characteristics that would affect trip-making when compared to the rest of Cromwell.

The survey showed a rate in the peak hour that is lower than was previously used for PC21. One plausible explanation for this is that the distance of Pisa Moorings from other settlements means that the 'peak' traffic generation occurs over an extended period as some residents travel to destinations further afield and other travel to destinations that are closer. The survey data supports this (and in fact NZTA counter 00600917 also supports this, with 625 vehicles (two-way) recorded on the survey day between 7am and 8am, and 628 vehicles (two-way) recorded between 8am and 9am).

The survey for Pisa Moorings shows peak hour rates of 0.51 and 0.56 trips per residence (occupied and unoccupied) in the morning and evening peak hours respectively. Anticipating that the same proportion of occupied and unoccupied dwellings is present at Parkburn, the same trip rate has been applied, plus an additional 5% to conservatively allow for any day-to-day variation in the rate.

No allowance has been made for reductions to the trip rate associated with the ability to visit commercial activities within the site (and to not have to travel into Cromwell for this).

We trust that this provides a full assessment of the justification for the trip rate, but we would be pleased to discuss this letter with you at your convenience.

Kind regards
Carriageway Consulting Limited

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[1] With the proposed connection being made between Pisa Moorings and Parkburn, this will also mean that a proportion of trips associated with Pisa Moorings will also be made internally, contributing to a further reduction in the current external trip generation.

Appendix

Results of Traffic Survey

CARRIAGEWAY
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Cars	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
7:28 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:29 am	0	2	0	2	0	2	0	2	0	0	0	0	0	0	0	0	4
7:30 am	0	4	0	4	0	2	0	2	0	0	0	0	2	0	0	2	8
7:31 am	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2
7:32 am	0	1	1	2	0	3	0	3	0	0	0	0	2	0	0	2	7
7:33 am	0	2	1	3	0	4	0	4	0	0	0	0	2	0	0	2	9
7:34 am	0	6	2	8	0	4	0	4	0	0	0	0	2	0	0	2	14
7:35 am	0	0	0	0	0	5	0	5	0	0	0	0	2	0	1	3	8
7:36 am	0	4	0	4	0	1	0	1	0	0	0	0	3	0	1	4	9
7:37 am	0	4	0	4	0	6	0	6	0	0	0	0	1	0	0	1	11
7:38 am	0	1	0	1	0	2	0	2	0	0	0	0	1	0	0	1	4
7:39 am	0	3	0	3	0	3	0	3	0	0	0	0	3	0	0	3	9
7:40 am	0	7	1	8	0	2	0	2	0	0	0	0	3	0	2	5	15
7:41 am	0	4	0	4	0	2	0	2	0	0	0	0	2	0	0	2	8
7:42 am	0	4	0	4	0	1	0	1	0	0	0	0	1	0	0	1	6
7:43 am	0	2	0	2	0	0	0	0	0	0	0	0	2	0	0	2	4
7:44 am	0	2	0	2	0	2	0	2	0	0	0	0	2	0	1	3	7
7:45 am	0	4	0	4	0	1	0	1	0	0	0	0	2	0	0	2	7
7:46 am	0	1	0	1	0	4	0	4	0	0	0	0	6	0	2	8	13
7:47 am	0	2	0	2	0	6	0	6	0	0	0	0	3	0	0	3	11
7:48 am	0	0	0	0	0	7	0	7	0	0	0	0	5	0	0	5	12
7:49 am	0	8	0	8	1	2	0	3	0	0	0	0	5	0	0	5	16
7:50 am	0	12	0	12	0	3	0	3	0	0	0	0	2	0	1	3	18
7:51 am	0	4	1	5	0	2	0	2	0	0	0	0	4	0	0	4	11
7:52 am	0	5	0	5	0	4	0	4	0	0	0	0	4	0	1	5	14
7:53 am	0	3	0	3	0	4	0	4	0	0	0	0	3	0	0	3	10
7:54 am	0	0	0	0	0	2	0	2	0	0	0	0	3	0	0	3	5
7:55 am	0	1	1	2	0	3	0	3	0	0	0	0	1	0	0	1	6
7:56 am	0	1	0	1	0	1	0	1	0	0	1	1	4	0	0	4	7
7:57 am	0	1	2	3	0	1	0	1	0	0	0	0	0	0	0	0	4
7:58 am	0	5	0	5	0	1	0	1	0	0	0	0	0	0	0	0	6
7:59 am	0	2	1	3	0	2	0	2	0	1	0	1	2	0	0	2	8
8:00 am	0	0	2	2	0	1	0	1	0	0	0	0	4	0	0	4	7
8:01 am	0	3	0	3	0	1	0	1	0	0	0	0	2	0	0	2	6
8:02 am	0	0	2	2	0	1	0	1	0	0	0	0	2	0	1	3	6
8:03 am	0	2	1	3	0	4	0	4	0	0	0	0	1	0	1	2	9
8:04 am	0	3	0	3	0	2	0	2	0	1	0	1	3	0	0	3	9
8:05 am	0	6	1	7	0	3	0	3	0	0	0	0	4	0	0	4	14
8:06 am	0	2	0	2	0	4	0	4	0	0	0	0	0	0	0	0	6
8:07 am	0	2	1	3	0	2	0	2	0	0	0	0	2	0	2	4	9
8:08 am	0	0	0	0	0	3	0	3	0	0	1	1	3	0	0	3	7
8:09 am	0	2	2	4	0	3	0	3	0	0	0	0	2	0	0	2	9
8:10 am	0	1	0	1	1	0	0	1	0	0	0	0	2	0	0	2	4
8:11 am	0	1	1	2	0	6	0	6	0	0	0	0	0	1	1	2	10
8:12 am	0	6	0	6	0	1	0	1	0	0	0	0	1	0	0	1	8
8:13 am	0	5	0	5	0	0	0	0	0	0	0	0	2	0	0	2	7
8:14 am	0	1	0	1	0	5	0	5	0	0	0	0	2	0	0	2	8
8:15 am	0	0	0	0	0	2	0	2	0	0	0	0	2	0	0	2	4
8:16 am	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2
8:17 am	0	4	0	4	0	3	0	3	0	0	0	0	5	0	0	5	12
8:18 am	0	3	0	3	0	1	0	1	0	0	0	0	4	0	0	4	8
8:19 am	0	2	0	2	0	2	0	2	0	0	0	0	6	0	0	6	10
8:20 am	0	4	2	6	0	2	0	2	0	0	0	0	3	0	1	4	12
8:21 am	1	2	0	3	0	6	0	6	0	0	0	0	2	0	0	2	11
8:22 am	0	4	1	5	0	4	0	4	0	0	0	0	1	0	1	2	11
8:23 am	0	4	1	5	0	1	0	1	0	0	0	0	4	0	0	4	10
8:24 am	0	3	1	4	0	0	0	0	0	0	0	0	4	0	0	4	8
8:25 am	0	2	1	3	0	8	0	8	0	0	0	0	4	0	1	5	16
8:26 am	0	10	1	11	0	5	0	5	0	0	0	0	2	0	0	2	18
8:27 am	0	4	1	5	0	2	0	2	0	0	0	0	5	0	1	6	13
8:28 am	0	0	1	1	0	3	0	3	0	0	0	0	2	0	0	2	6
8:29 am	0	4	0	4	0	3	0	3	0	0	0	0	2	0	1	3	10
8:30 am	0	2	0	2	0	3	0	3	0	0	0	0	1	0	0	1	6
8:31 am	0	4	1	5	0	2	1	3	0	0	0	0	2	0	0	2	10
8:32 am	0	1	0	1	0	3	0	3	0	0	1	1	3	0	0	3	8
8:33 am	0	2	1	3	0	1	0	1	0	0	0	0	2	0	0	2	6
8:34 am	0	3	0	3	0	4	0	4	0	0	0	0	6	0	0	6	13
8:35 am	0	5	1	6	1	1	0	2	0	0	0	0	0	0	0	0	8
8:36 am	0	6	2	8	0	5	0	5	0	0	0	0	5	0	0	5	18
8:37 am	0	0	0	0	0	3	0	3	0	0	0	0	9	0	0	9	12
8:38 am	0	3	1	4	0	4	0	4	0	0	0	0	5	0	0	5	13
8:39 am	0	1	0	1	0	7	0	7	0	0	0	0	2	0	0	2	10
8:40 am	0	0	0	0	0	2	0	2	0	0	0	0	2	1	0	3	5
8:41 am	0	3	0	3	1	5	0	6	0	0	0	0	3	0	0	3	12
8:42 am	0	2	1	3	0	2	0	2	0	0	0	0	3	0	0	3	8
8:43 am	0	1	0	1	1	4	0	5	0	0	0	0	3	0	1	4	10
8:44 am	0	3	1	4	0	1	0	1	0	0	0	0	2	0	0	2	7
8:45 am	0	4	0	4	0	7	1	8	0	0	0	0	1	0	0	1	13
8:46 am	0	2	0	2	0	3	0	3	0	0	1	1	4	0	1	5	11
8:47 am	0	3	2	5	0	2	0	2	0	0	0	0	2	0	0	2	9
8:48 am	0	0	1	1	0	2	0	2	0	0	0	0	3	0	0	3	6
8:49 am	0	2	1	3	0	9	0	9	0	0	0	0	2	0	2	4	16
8:50 am	0	1	0	1	0	1	0	1	0	0	0	0	3	0	0	3	5
8:51 am	0	2	2	4	0	1	0	1	0	0	0	0	0	0	0	0	5
8:52 am	0	5	1	6	0	7	0	7	0	0	0	0	1	0	0	1	14
8:53 am	0	3	0	3	0	7	0	7	0	0	0	0	1	0	1	2	12
8:54 am	0	3	3	6	0	2	0	2	0	0	0	0	4	0	0	4	12
8:55 am	0	4	0	4	0	2	0	2	0	0	0	0	1	0	0	1	7
8:56 am	0	1	0	1	0	3	0	3	0	0	0	0	1	0	0	1	5
8:57 am	0	4	4	8	0	1	0	1	0	0	0	0	0	0	0	0	9
8:58 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:59 am	0	2	1	3	0	3	0	3	0	0	0	0	2	0	0	2	8
9:00 am	0	0	0	0	0	1	0	1	0	1	0	1	1	0	1	2	4
9:01 am	0	7	1	8	0	3	0	3	0	0	0	0	2	0	0	2	13
9:02 am	0	1	2	3	0	3	0	3	0	0	0	0	2	0	0	2	8
9:03 am	0	0	2	2	0	1	0	1	0	0	0	0	2	0	0	2	5
9:04 am	0	4	3	7	0	5	0	5	0	0	0	0	2	0	0	2	14
9:05 am	0	2	1	3	0	1	0	1	0	0	0	0	0	0	0	0	4
9:06 am	0	2	2	4	1	0	0	1	0	0	0	0	0	0	0	0	5
9:07 am	0	0	1	1	0	3	0	3	0	0	0	0	0	0	0	0	4
9:08 am	0	1	1	2	0	1	0	1	0	0	0	0	0	0	0	0	3
9:09 am	0	2	0	2	0	1	0	1	0	0	0	0	0	0	0	0	3
9:10 am	0	0	2	2	0	2	0	2	0	0	0	0	0	0	0	0	4
9:11 am	0	5	2	7	0	1	0	1	0	0	0	0	0	0	0	0	8
9:12 am	0	1	0	1	0	0	0	0	0	0	0	0	3	0	0	3	4
9:13 am	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
9:14 am	0	2	0	2	0	2	0	2	0	0	0	0	0	0	0	0	4
9:15 am	0	1	1	2	0	1	0	1	0	0	0	0	0	0	0	0	3
Total	1	100	41	142	4	123	2	129	0	1	2	3	85	1	6	92	366

Light Trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
7:28 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:29 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 am	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
7:31 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:32 am	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	3
7:33 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:34 am	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
7:35 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:36 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:37 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:38 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:39 am	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
7:40 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:41 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:42 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:43 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:44 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:45 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
7:46 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:47 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:48 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:49 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:50 am	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:51 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:52 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:53 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:54 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:55 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:56 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:57 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:58 am	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
7:59 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 am	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2
8:01 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:02 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:03 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:04 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:05 am	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:06 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:07 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:08 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:09 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:10 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:11 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:12 am	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
8:13 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:14 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:16 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:17 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:18 am	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	3
8:19 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:20 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:21 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:22 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:23 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:24 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:25 am	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
8:26 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:27 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:28 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:29 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1

Light Trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
8:30 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:31 am	0	1	0	1	0	2	0	2	0	0	0	0	0	0	0	0	3
8:32 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:33 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:34 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:35 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:36 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:37 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:38 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:39 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:40 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:41 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:42 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:43 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:44 am	0	2	0	2	0	1	0	1	0	0	0	0	0	0	0	0	3
8:45 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:46 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:47 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:48 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:49 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:50 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:51 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:52 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:53 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:54 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:55 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:56 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:57 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:58 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:59 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:00 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:01 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:02 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:03 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:04 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:05 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:06 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:07 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:08 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:09 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:10 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:11 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
9:12 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:13 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:14 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 am	0	2	0	2	0	1	0	1	0	0	0	0	0	0	0	0	3
Total	0	49	3	18	0	28	0	28	0	0	0	0	0	0	0	0	30

Heavy Trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
7:28 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:29 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:30 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:31 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:32 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:33 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:34 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:35 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:36 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:37 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:38 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:39 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:40 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:41 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:42 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:43 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:44 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:46 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:47 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:48 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:49 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:50 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:51 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:52 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:53 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:54 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:55 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:56 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:57 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:58 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
7:59 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:01 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:02 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:03 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:04 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:05 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:06 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:07 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:08 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:09 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:10 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:11 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:12 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:13 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:14 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:16 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:17 am	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
8:18 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:19 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:20 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:21 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:22 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:23 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:24 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:25 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:26 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:27 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:28 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:29 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1

Heavy Trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
8:30 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:31 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:32 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:33 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:34 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:35 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:36 am	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
8:37 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:38 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:39 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:40 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:41 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:42 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:43 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:44 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:46 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:47 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:48 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:49 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:50 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:51 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:52 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:53 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
8:54 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:55 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:56 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:57 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:58 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:59 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:00 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:01 am	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
9:02 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:03 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:04 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:05 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:06 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:07 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:08 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:09 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:10 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:11 am	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
9:12 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:13 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:14 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	11	0	4	0	16	0	16	0	0	0	0	0	0	0	0	27

Cars	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
3:44 pm	0	2	1	3	1	4	0	5	0	0	0	0	1	0	1	2	10
3:45 pm	0	1	0	1	0	7	0	7	0	0	0	0	2	0	0	2	10
3:46 pm	0	1	1	2	0	2	0	2	0	0	0	0	0	0	1	1	5
3:47 pm	0	8	1	9	1	2	0	3	0	0	0	0	0	0	0	0	12
3:48 pm	3	8	6	17	0	6	0	6	0	0	0	0	2	0	0	2	25
3:49 pm	0	0	0	0	0	3	0	3	0	0	0	0	2	0	1	3	6
3:50 pm	0	2	1	3	0	5	0	5	0	0	0	0	0	0	0	0	8
3:51 pm	0	3	0	3	0	6	0	6	0	0	0	0	1	0	0	1	10
3:52 pm	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2
3:53 pm	0	1	3	4	0	4	0	4	0	0	0	0	0	0	0	0	8
3:54 pm	0	3	2	5	0	2	0	2	0	0	0	0	2	0	0	2	9
3:55 pm	0	3	0	3	1	2	0	3	0	0	0	0	0	0	0	0	6
3:56 pm	0	1	1	2	2	7	0	9	0	0	0	0	0	0	0	0	11
3:57 pm	0	6	3	9	0	3	0	3	0	0	0	0	1	0	0	1	13
3:58 pm	0	4	1	5	1	6	0	7	0	0	0	0	0	0	0	0	12
3:59 pm	0	1	1	2	1	3	0	4	0	0	0	0	0	0	0	0	6
4:00 pm	0	5	1	6	0	3	0	3	0	0	0	0	1	0	0	1	10
4:01 pm	0	3	1	4	0	1	0	1	0	0	0	0	1	0	0	1	6
4:02 pm	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
4:03 pm	0	3	0	3	0	7	0	7	0	0	0	0	2	0	1	3	13
4:04 pm	0	3	4	7	0	5	0	5	0	0	0	0	2	0	0	2	14
4:05 pm	0	2	2	4	0	2	0	2	0	0	0	0	0	0	0	0	6
4:06 pm	0	5	6	11	0	7	0	7	0	0	0	0	1	0	0	1	19
4:07 pm	0	0	2	2	0	7	0	7	0	0	0	0	2	0	0	2	11
4:08 pm	0	4	2	6	0	3	0	3	0	0	0	0	0	0	1	1	10
4:09 pm	0	0	3	3	0	6	0	6	0	0	0	0	0	0	0	0	9
4:10 pm	0	3	2	5	0	8	0	8	0	0	0	0	2	0	1	3	16
4:11 pm	0	4	1	5	0	2	0	2	0	0	0	0	1	0	0	1	8
4:12 pm	0	3	2	5	0	3	0	3	0	0	0	0	0	0	0	0	8
4:13 pm	0	7	3	10	0	6	0	6	0	0	0	0	2	1	0	3	19
4:14 pm	0	2	2	4	1	6	0	7	0	0	0	0	1	0	0	1	12
4:15 pm	0	2	2	4	0	5	0	5	0	1	0	1	2	0	0	2	12
4:16 pm	0	5	4	9	1	5	0	6	0	0	0	0	2	0	0	2	17
4:17 pm	0	4	4	8	0	2	0	2	0	1	0	1	1	0	0	1	12
4:18 pm	0	5	3	8	0	6	0	6	0	0	0	0	0	0	0	0	14
4:19 pm	1	2	1	4	0	3	0	3	0	0	0	0	0	0	0	0	7
4:20 pm	0	2	2	4	1	2	0	3	0	0	0	0	3	0	0	3	10
4:21 pm	0	3	3	6	0	1	0	1	0	0	0	0	1	0	0	1	8
4:22 pm	0	3	2	5	0	7	0	7	0	0	0	0	0	0	0	0	12
4:23 pm	0	9	4	13	0	4	0	4	0	0	0	0	1	0	0	1	18
4:24 pm	1	4	2	7	0	2	0	2	0	0	0	0	0	0	0	0	9
4:25 pm	0	2	1	3	0	5	0	5	0	0	0	0	0	0	0	0	8
4:26 pm	0	4	2	6	0	2	0	2	0	0	0	0	1	0	0	1	9
4:27 pm	0	2	1	3	0	3	0	3	0	0	0	0	0	0	0	0	6
4:28 pm	0	2	4	6	0	5	0	5	0	0	0	0	0	0	0	0	11
4:29 pm	0	2	3	5	0	3	0	3	0	0	0	0	0	0	0	0	8
4:30 pm	0	2	3	5	1	1	0	2	0	0	0	0	0	0	0	0	7
4:31 pm	0	4	0	4	0	1	0	1	0	0	0	0	0	0	0	0	5
4:32 pm	0	5	2	7	2	7	0	9	0	0	0	0	2	0	0	2	18
4:33 pm	0	7	2	9	0	1	0	1	0	0	0	0	2	0	0	2	12
4:34 pm	1	3	1	5	0	2	0	2	0	0	0	0	0	0	0	0	7
4:35 pm	0	2	1	3	0	1	0	1	0	0	0	0	0	0	0	0	4
4:36 pm	0	9	2	11	0	2	0	2	0	0	0	0	0	0	0	0	13
4:37 pm	0	1	1	2	0	4	0	4	0	0	0	0	1	0	0	1	7
4:38 pm	1	1	0	2	0	1	0	1	0	0	0	0	2	0	0	2	5
4:39 pm	0	4	1	5	0	3	0	3	0	0	0	0	1	0	0	1	9
4:40 pm	0	6	2	8	0	3	0	3	1	0	0	1	3	0	0	3	15
4:41 pm	0	6	4	10	0	4	0	4	0	0	1	1	0	0	0	0	15
4:42 pm	0	1	2	3	0	6	0	6	0	0	0	0	0	0	0	0	9
4:43 pm	0	7	3	10	0	1	0	1	0	0	0	0	1	0	0	1	12
4:44 pm	0	4	1	5	1	2	0	3	0	0	0	0	1	0	0	1	9
4:45 pm	0	2	0	2	1	2	0	3	0	0	0	0	3	0	0	3	8
4:46 pm	0	4	0	4	0	3	0	3	0	0	0	0	3	0	0	3	10
4:47 pm	0	2	0	2	0	2	0	2	0	0	0	0	0	0	1	1	5
4:48 pm	0	2	2	4	0	7	0	7	0	0	0	0	2	0	0	2	13
4:49 pm	0	4	1	5	0	0	0	0	0	0	0	0	2	0	0	2	7
4:50 pm	0	2	4	6	0	0	0	0	0	0	0	0	1	0	0	1	7
4:51 pm	0	5	2	7	0	5	0	5	0	0	0	0	0	0	0	0	12
4:52 pm	0	0	2	2	0	3	0	3	0	0	0	0	0	0	0	0	5
4:53 pm	0	2	1	3	0	4	0	4	0	0	0	0	0	0	0	0	7
4:54 pm	0	1	0	1	0	1	0	1	0	0	0	0	2	0	0	2	4
4:55 pm	0	3	1	4	2	2	0	4	0	0	0	0	2	0	0	2	10
4:56 pm	0	5	3	8	0	3	0	3	0	0	0	0	0	0	0	0	11
4:57 pm	0	13	0	13	0	4	0	4	0	0	0	0	2	0	0	2	19
4:58 pm	0	0	6	6	0	1	0	1	0	0	0	0	1	0	0	1	8
4:59 pm	0	2	0	2	0	0	0	0	0	0	0	0	1	0	0	1	3

Cars	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
5:00 pm	0	3	1	4	0	4	0	4	0	0	0	0	1	0	0	1	9
5:01 pm	0	3	3	6	0	4	0	4	0	0	0	0	1	0	0	1	11
5:02 pm	0	4	0	4	0	5	0	5	0	0	0	0	0	0	0	0	9
5:03 pm	1	7	6	14	0	10	0	10	0	0	0	0	1	0	0	1	25
5:04 pm	0	3	0	3	0	7	0	7	0	0	1	1	0	0	0	0	11
5:05 pm	0	8	3	11	0	8	0	8	0	0	0	0	1	0	0	1	20
5:06 pm	0	4	2	6	0	3	0	3	0	0	0	0	0	0	0	0	9
5:07 pm	0	4	2	6	0	10	0	10	0	0	0	0	1	0	0	1	17
5:08 pm	1	3	5	9	0	1	0	1	0	0	0	0	0	0	0	0	10
5:09 pm	0	10	2	12	0	0	0	0	0	0	0	0	0	0	0	0	12
5:10 pm	0	8	3	11	1	8	0	9	0	0	0	0	1	0	0	1	21
5:11 pm	0	4	1	5	0	2	0	2	0	0	0	0	0	0	0	0	7
5:12 pm	0	7	4	11	0	8	0	8	0	0	0	0	0	0	0	0	19
5:13 pm	0	4	6	10	0	2	0	2	0	1	0	1	2	0	0	2	15
5:14 pm	0	5	2	7	1	5	0	6	0	0	0	0	0	0	0	0	13
5:15 pm	0	3	5	8	0	3	0	3	0	0	0	0	2	0	0	2	13
5:16 pm	0	4	0	4	1	5	0	6	0	0	0	0	1	0	0	1	11
5:17 pm	0	3	2	5	1	7	0	8	0	0	0	0	0	0	0	0	13
5:18 pm	0	1	5	6	0	2	0	2	0	0	0	0	1	0	0	1	9
5:19 pm	1	8	4	13	0	1	0	1	0	0	0	0	2	0	0	2	16
5:20 pm	0	6	4	10	2	1	0	3	0	0	0	0	1	0	0	1	14
5:21 pm	1	0	1	2	0	7	0	7	0	0	0	0	1	0	0	1	10
5:22 pm	0	4	3	7	0	1	0	1	0	0	0	0	0	0	0	0	8
5:23 pm	0	2	0	2	1	5	0	6	0	0	0	0	1	0	0	1	9
5:24 pm	1	3	3	7	0	6	0	6	1	0	0	1	1	0	0	1	15
5:25 pm	1	6	0	7	0	4	0	4	0	0	0	0	0	0	0	0	11
5:26 pm	0	6	5	11	0	3	0	3	0	0	0	0	2	0	0	2	16
5:27 pm	0	3	4	7	0	2	0	2	0	0	0	0	0	0	0	0	9
5:28 pm	0	3	4	7	0	3	0	3	0	0	0	0	1	0	0	1	11
5:29 pm	0	4	0	4	0	6	0	6	0	0	0	0	0	0	0	0	10
5:30 pm	0	2	3	5	0	3	0	3	0	0	0	0	1	0	0	1	9
5:31 pm	0	4	5	9	1	1	0	2	0	0	0	0	0	0	0	0	11
5:32 pm	0	1	4	5	0	6	0	6	0	0	0	0	2	0	0	2	13
5:33 pm	0	4	2	6	1	6	0	7	0	0	1	1	0	0	0	0	14
5:34 pm	0	5	3	8	1	5	0	6	0	0	0	0	1	0	0	1	15
5:35 pm	0	3	2	5	1	3	0	4	0	0	0	0	0	0	0	0	9
5:36 pm	0	7	4	11	0	2	0	2	0	0	0	0	0	0	0	0	13
5:37 pm	0	3	5	8	1	4	0	5	0	0	0	0	0	0	0	0	13
5:38 pm	0	4	4	8	1	2	0	3	0	0	0	0	4	0	0	4	15
5:39 pm	0	3	8	11	0	3	0	3	0	0	0	0	0	0	0	0	14
5:40 pm	0	6	3	9	0	3	0	3	0	0	0	0	2	0	0	2	14
5:41 pm	0	9	2	11	1	5	0	6	0	0	0	0	1	0	0	1	18
5:42 pm	0	6	4	10	0	0	0	0	0	0	0	0	2	0	0	2	12
5:43 pm	0	4	3	7	0	7	0	7	0	0	0	0	0	0	0	0	14
5:44 pm	0	1	2	3	1	5	0	6	0	0	0	0	0	0	0	0	9
5:45 pm	0	3	7	10	0	2	0	2	0	0	0	0	0	0	0	0	12
5:46 pm	0	1	1	2	0	4	0	4	0	0	1	1	2	0	0	2	9
5:47 pm	0	1	0	1	2	0	0	2	0	0	0	0	0	0	0	0	3
5:48 pm	1	4	1	6	0	2	0	2	0	0	0	0	1	0	0	1	9
5:49 pm	0	3	0	3	1	1	0	2	0	0	0	0	0	0	0	0	5
5:50 pm	0	4	3	7	2	3	0	5	0	0	0	0	2	0	0	2	14
5:51 pm	0	4	3	7	0	3	0	3	0	0	0	0	1	0	0	1	11
5:52 pm	0	3	1	4	0	4	0	4	0	0	0	0	2	0	0	2	10
5:53 pm	0	1	3	4	0	1	0	1	0	0	0	0	2	0	1	3	8
5:54 pm	0	2	1	3	2	2	0	4	0	0	0	0	0	0	0	0	7
5:55 pm	0	2	1	3	0	2	0	2	0	0	0	0	3	0	0	3	8
5:56 pm	0	2	0	2	0	1	0	1	0	0	0	0	2	0	0	2	5
5:57 pm	0	0	1	1	0	1	0	1	0	0	0	0	1	1	0	2	4
5:58 pm	0	4	5	9	0	7	0	7	0	0	0	0	1	0	0	1	17
5:59 pm	0	3	3	6	0	6	0	6	0	0	0	0	0	0	0	0	12
6:00 pm	1	3	3	7	1	2	0	3	0	0	0	0	1	0	0	1	11
6:01 pm	0	0	0	0	1	2	0	3	0	0	0	0	1	0	0	1	4
6:02 pm	0	1	6	7	0	5	0	5	0	0	0	0	1	0	0	1	13
6:03 pm	0	4	1	5	0	3	0	3	0	0	0	0	0	0	0	0	8
6:04 pm	0	2	1	3	1	8	0	9	0	0	0	0	0	0	0	0	12
6:05 pm	0	0	2	2	1	4	0	5	0	0	0	0	0	0	0	0	7
6:06 pm	0	4	1	5	0	6	0	6	0	0	0	0	1	0	0	1	12
6:07 pm	0	1	3	4	0	1	0	1	0	0	0	0	0	0	0	0	5
6:08 pm	0	1	1	2	0	8	0	8	0	0	0	0	0	0	0	0	10
6:09 pm	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	3
6:10 pm	0	0	1	1	0	5	0	5	0	0	0	0	1	0	0	1	7
6:11 pm	0	0	2	2	1	5	0	6	0	0	0	0	0	0	0	0	8
6:12 pm	0	0	2	2	0	4	0	4	0	0	0	0	0	0	0	0	6
6:13 pm	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	2
6:14 pm	0	2	3	5	0	5	0	5	0	0	0	0	0	0	0	0	10
6:15 pm	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	15	502	332	849	44	544	0	588	2	3	4	9	126	2	8	136	1582

Light trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
3:44 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
3:45 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:46 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:47 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:48 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:49 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:50 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
3:51 pm	0	2	0	2	0	1	0	1	0	0	0	0	1	0	0	1	4
3:52 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:53 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
3:54 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:55 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:56 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
3:57 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:58 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
3:59 pm	0	1	0	1	0	2	0	2	0	0	0	0	0	0	0	0	3
4:00 pm	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	2
4:01 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:02 pm	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
4:03 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:04 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:05 pm	0	0	0	0	0	2	0	2	0	0	0	0	0	1	0	1	3
4:06 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:07 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:08 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:09 pm	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2
4:10 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:11 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:12 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:13 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:14 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:15 pm	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	2
4:16 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:17 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:18 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:19 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:20 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:21 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:22 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:23 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:24 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:25 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:26 pm	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:27 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:28 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:29 pm	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
4:30 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:31 pm	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2
4:32 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:33 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:34 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:35 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:36 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:37 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:38 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:39 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:40 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:41 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:42 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:43 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:44 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:45 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:46 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:47 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:48 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:49 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:50 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:51 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:52 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:53 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:54 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:55 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:56 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:57 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:58 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:59 pm	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	2

Light trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
5:00 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:01 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:02 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:03 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:04 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:05 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:06 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:07 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:08 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:09 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:10 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:11 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:12 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:13 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:14 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:16 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:17 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:18 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:19 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:20 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:21 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:22 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:23 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:24 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:25 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:26 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:27 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:28 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:29 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:31 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:32 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:33 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:34 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:35 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:36 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:37 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:38 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:39 pm	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
5:40 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:41 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:42 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:43 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:44 pm	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	2
5:45 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:46 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:47 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:48 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:49 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:50 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:51 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:52 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:53 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:54 pm	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	2
5:55 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:56 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:57 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:58 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:59 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:01 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:02 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:03 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
6:04 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:05 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:06 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:07 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:08 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
6:09 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:10 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:11 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:12 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:13 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
6:14 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
6:15 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	30	4	34	0	33	0	33	0	1	0	1	2	1	0	3	71

Heavy trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
3:44 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:45 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:46 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:47 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:48 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:49 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
3:50 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:51 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:52 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:53 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:54 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:55 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:56 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:57 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:58 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:59 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:01 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:02 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:03 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:04 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:05 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:06 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:07 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:08 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:09 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:10 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:11 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:12 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:13 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:14 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:15 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:16 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:17 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:18 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:19 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:20 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:21 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:22 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:23 pm	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	2
4:24 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:25 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:26 pm	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
4:27 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:28 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:29 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:31 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:32 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:33 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:34 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:35 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:36 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:37 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:38 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:39 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:40 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:41 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:42 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:43 pm	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	2
4:44 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:46 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:47 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:48 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
4:49 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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4:56 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:57 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:58 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:59 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Heavy trucks	State Highway 6 Northbound				State Highway 6 Southbound				Clark Road Eastbound				Pisa Moorings Road Westbound				
Start Time	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Left	Thru	Right	Total	Total All
5:00 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:01 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:02 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:03 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
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5:06 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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5:29 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:31 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
5:32 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:33 pm	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
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5:35 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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6:10 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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6:12 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:13 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:14 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	7	0	8	1	19	0	20	0	0	0	0	0	0	0	0	28

Annexure C

Modelling Results

CARRIAGEWAY
CONSULTING

CCL Ref: 15090-311025-dewe

31 October 2025

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Greg Dewe
Fulton Hogan Land Development Limited

By e-mail only: Gregory.Dewe@fultonhogan.com

Dear Greg

Parkburn: Update of Transportation Matters

This letter sets out an update to the transportation modelling associated with the Parkburn subdivision, adjacent to Pisa Moorings, Cromwell. It builds on and updates the analysis that was carried out for Plan Change 21 (**PC21**), and consequently we have not repeated much of the background information associated with PC21 other than where needed to understand this outcomes of this letter.

Much of this letter report replicates information previously provided in our letter of 4 July 2025. However subsequent to this being issued, an error was identified in the modelling undertaken for two intersections (State Highway 6 / Lowburn Valley Road and State Highway 6 / Burn Cottage Road) and we therefore consider it appropriate to include the revised modelling outcomes within an updated letter report. We stress however that these changes do not materially affect our previous conclusions.

Site Location and Previous Analysis for PC21

The Parkburn site is located approximately 9km north of Cromwell (with Cromwell being the closest settlement). Wanaka lies approximately 45km towards the northwest, with Queenstown being 67km to the west. To the immediate south lies the small settlement of Pisa Moorings, and to the immediate north lies a site owned by HWR Property Limited which is presently being quarried.

Because Lake Dunstan lies to the immediate east of the site, vehicular access to the site can only be achieved via State Highway 6, which runs along the western site boundary. State Highway 6 provides the primary roading connection to Cromwell, Wanaka and Queenstown.

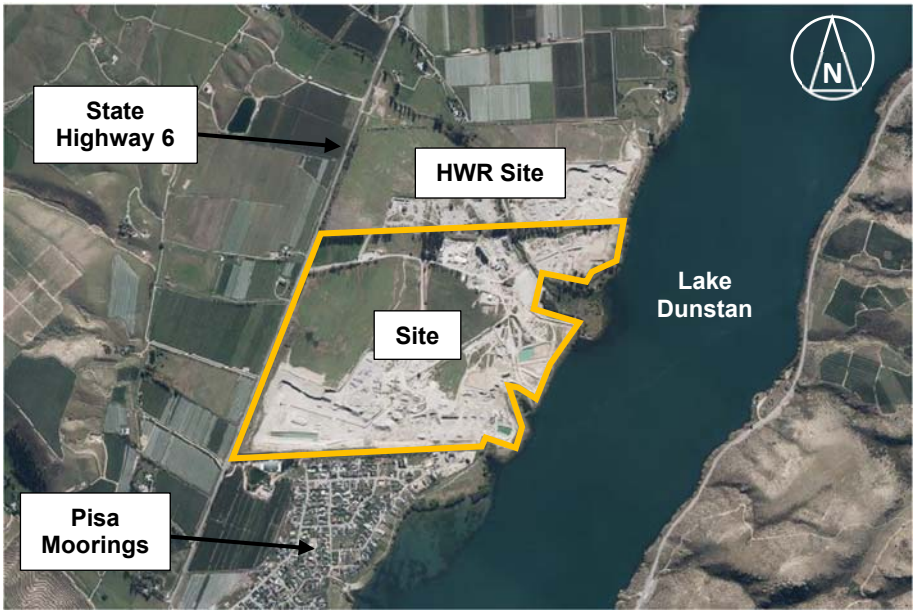


Figure 1: Site Location and Environs

Given that the site is required to gain access onto State Highway 6, the function and performance of the intersections on the highway are of critical importance to the accessibility of the development. This depends on the traffic generation of the proposal and this in turn is influenced by the nature and scale of land use activities. These have been revisited as part of the current project.

The nature of the traffic is that it will approach from, and depart towards, the north and south of the site via the state highway. There are no major roads that connect to State Highway 6 to the immediate north and south of the site, and so traffic travelling to and from the site will pass through intersections some distance from the site itself. The effects on the performance of these that arises from the development also needs to be evaluated.

In considering the development of the site through PC21, the effects on roading capacity were modelled using the Council's transportation model. The current proposal has also been assessed using the Council's transportation model[1], which provides a consistent approach between the two. We highlight that the Council only has a weekday evening peak hour model not a morning peak hour model.

The masterplan tested within PC21 is shown below:

[1] Council's permission to use the model was received by mail on 26 March 2025



Figure 2: Masterplan Proposed in PC21 (Extract from Baxter Design Drawing)

This scale of development allowed for:

- 81.15ha of Residential Resource Area (Low-Density Residential);
- 10.09ha of Residential Resource Area (Medium-Density Residential);
- 4.72ha of Business Resource Area (3);
- 2.32ha of Industrial Resource Area (2); and
- 22.28ha of Industrial Resource Area (3).

Current Proposal

An updated masterplan for the proposed layout has been received and is shown below:



Figure 3: Proposed Masterplan (Extract from Woods Drawing)

It can be seen that the current proposal anticipates a more intensive use of the area for residential activity, with a corresponding reduction in the extent of commercial / non-residential use.

Traffic Generation of Pisa Moorings

During initial discussions with the modelling team, it emerged that the traffic generation rate used for residential activities for PC21 had been based on a typical residential subdivision within Cromwell. Intuitively this introduces a potential error, because residences that are some distance from settlements usually have different trip-making characteristics to those that are within towns. For example, drivers living more remotely will set off earlier on their journey due to longer travel distances, and trips into town will be organised to visit several different destinations as part of the same trip ('trip-chaining').

Given that the site is proximate to Pisa Moorings, we anticipate that the trip generation per household of the site will be the same (or very similar) to that of Pisa Moorings. Helpfully, there is only one point of access to Pisa Moorings, and accordingly, we arranged for a traffic survey to be undertaken at the State Highway 6 / Pisa Moorings Road / Clark Road intersection during a typical weekday in March 2025, in the periods 7:30am to 9:30am and 3:45pm to 6:15pm. The results for the peak hours are summarised below.

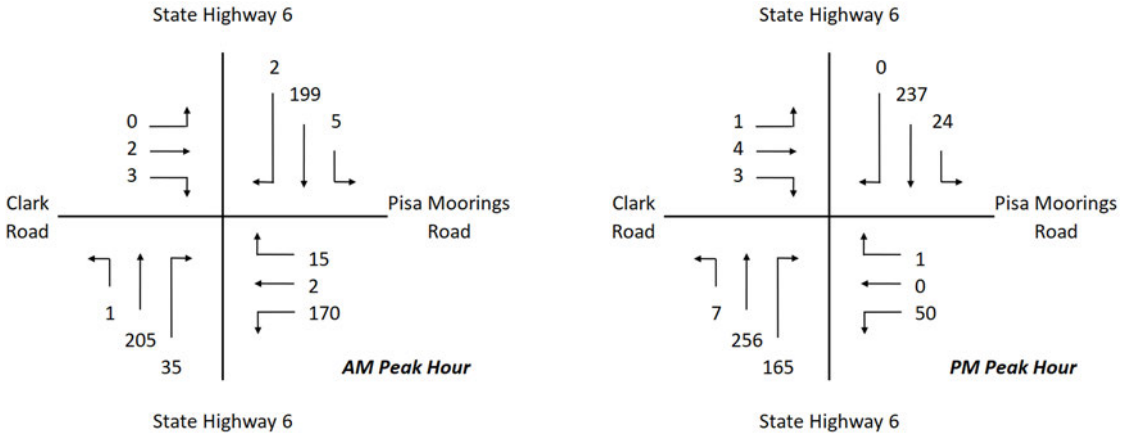


Figure 4: Turning Volumes at Access to Pisa Moorings, March 2025

When these results are compared to the assumed traffic generation at Pisa Moorings used within the PC21 assessment, considerable differences are noted. The PC21 work was based on a peak hour traffic generation rate for Pisa Moorings (and the site) of 1.33 vehicle movements per household, with all households being occupied. We have counted the current extent of development within Pisa Moorings and have identified approximately 450 residences. The survey shows peak hour volumes of 229 and 244 vehicles (two-way) on Pisa Moorings Road, and this equates to a traffic generation rate of 0.51 to 0.54 vehicle movements per household, that is, around 60% lower than had previously been anticipated.

This outcome could occur if a high proportion of holiday/second homes were present in Pisa Moorings. If, say, 50% of the houses were unoccupied, then this would equate to a traffic generation rate per occupied residence of 1.02 to 1.08 vehicle movements per household, much closer to the original estimates. However the 2023 census showed that on census night (held on Tuesday 7 March 2023), only 19% of residences in Pisa Moorings were unoccupied. While the extent of occupancy can vary, our traffic survey was fortuitously carried out on Tuesday 4 March 2025. This means that it is highly likely that there was the same pattern of household occupancy at the time of the survey as for the census, almost exactly two years prior. In other words, we can expect, with a reasonable degree of confidence, that during our survey 81% of the households were occupied.

We also assessed the traffic passing by the site on the state highway to ensure that it was consistent with the previous analysis. This was to eliminate the possibility that there had been some event elsewhere on the roading network that resulted in fewer vehicles entering and exiting Pisa

Moorings. While the observed volumes were slightly lower than the modelled volumes, this alone would not account for the difference in the trip generation rate per household.

With this in mind, we consider that the previous modelling carried out for PC21 adopted a trip generation rate that was too high. For the assessment of the masterplan, we have adopted a rate of 0.57 vehicle movements per household for both Pisa Moorings and also for the development site. This is the higher of the observed values from the survey, plus an additional 5% for day-to-day variability.

As a final comment, the surveys show that 90% of the traffic associated with Pisa Moorings was travelling to or from the south. This is consistent with the assumptions made through PC21 and so it has not proved necessary to adjust the distribution of traffic (only the traffic volume has been changed).

Additional Modelling Undertaken

The new masterplan has been coded into the model. We have then critically reviewed the model inputs.

Parameters Used in the Model

The initial PC21 yield was for 543 residences and this has now been increased to 1,047 residences based on the plans provided. As set out above though, the trip rate per household has been reduced.

Scaling from the plans, the masterplan includes approximately 6,500sqm GFA of commercial activities and a potential primary school. In view of the location of the site, we have assumed that the final scale of the commercial activities will be appropriate only for servicing Pisa Moorings and the development site (and also the HWR site to the north, if it is developed). This matter is important because if the commercial development was to attract traffic from further afield then this would increase the turning volumes at the new intersections onto the highway. Conversely, serving the immediate area only means that the traffic generation of the commercial activities is contained wholly within the sites (subject to a road link being provided between them, as discussed subsequently).

PC21 was modelled on the basis of a 'design year' of 2034, and the same approach has been taken for the new modelling. As noted above, the Council only has a weekday evening peak period model, and thus at this stage no analysis has been carried out for the morning peak hour.

With regard to the speed environment at the access points into the site, the State Highway 6 / Pisa Moorings Road / Clark Road intersection presently operates with a 100km/h speed limit on the highway, although the average operating speed across all traffic is affected by the slower speeds of vehicles as they slow to enter the side roads and accelerate after exiting. The model has adopted the same parameter as for PC21, of a free-flow speed of 85km/h past the site. This is lower than the maximum speed limit, but in practice, there is little difference between this and allowing for a 100km/h speed past the site (and again, this speed environment is the same as per the earlier PC21 assessment).

We consider that in due course, it is possible that the speed limit on the highway past Pisa Moorings and the site (and potentially further north) will be reduced. Crashes involving a side-on collision, as is common at priority intersections, typically have a higher rate of injury and more severe injuries than nose-to-tail crashes, and so there may be a case for implementing a lower (80km/h) speed

limit. However this is not included within the modelling at this stage since there can be no reliance on this being implemented.

The modelling has allowed for the site accesses to be priority intersections, with auxiliary left-turn and right-turn lanes. This is aligned with the approach taken in PC21. It also means that through traffic on the highway will not be delayed by vehicles that are slowing to enter the site.

Delay at intersections is typically expressed in terms of a Level of Service, on a scale of A (the best) to F (the worst). Levels of Service A, B, C and D are considered to represent a situation of 'stable' flow but where Level of Service D represents the point at which 'congestion' starts to occur. As such, Level of Service E is considered to be 'unstable' operating conditions, which delays are significant and Level of Service F represents severe queues and delays. For the purposes of this exercise then, we have identified the thresholds for development where Level of Service D changes to Level of Service E as being the point just prior to which intersection improvement schemes are required.

Results

Introduction

PC21 reported on three scenarios:

- Scenario 0: 2034, with no development of the site;
- Scenario 1: 2034, with 50% development of the site; and
- Scenario 2: 2034, with 100% development of the site

To enable comparison of the outputs, we have endeavoured to retain some degree of consistency with this approach. We have extracted the relevant results from the model and summarised these below, alongside the results that were previously presented in the Transportation Assessment for PC21.

PC21 Scenario 0: No Site Development

Although this scenario does not include any development traffic, there are differences in the results because of the lower traffic generation rate at Pisa Moorings.

Intersection	PC21 Modelling as per ITA			Updated Modelling		
	Veh/hr	Delay (s)	LoS	Veh/hr	Delay (s)	LoS
SH6 / PC21 South	651	2	A	768	3	A
SH6 / PC21 North	667	5	A	786	7	A
SH6 / Pisa Moorings Rd / Clark Rd	1,329	8	A	1,097	7	A
SH6 / Lowburn Valley Road	1,429	>150	F	1,295	33	D
SH6 / Burn Cottage Road	1,499	36	E	1,308	20	C
SH6 / Shortcut Road	1,529	14	B	1,337	9	A
SH6 / SH8B	2,109	12	B	1,960	9	A

Table 1: Intersection Performance, No Site Development

It can be seen that with the updated modelling, most intersections operate with an excellent level of service. Lower levels of service arise at the Lowburn Valley Road and Burn Cottage Road intersections.

The previous Integrated Transportation Assessment (**ITA**) for PC21 identified that the SH6 / Lowburn Valley Road intersection would have a poor level of service and although this is shown to be improved under the recent modelling, it is on the cusp of moving into Level of Service E (the delay for right-turning vehicles is 34.2 seconds and Level of Service E commences at 35 seconds).

The SH6 / Burn Cottage Road intersection was similarly identified in PC21 as being close to capacity, but again, this appears to be improved through the more recent modelling.

PC21 identified that the poor levels of service arose at these two intersections arose due to extraneous factors rather than the plan change itself, and accordingly, that solutions should be progressed independently to the plan change (that is, PC21). On our reading of the commissioner's decision, this appears to have been accepted and we note that the final plan change provisions did not make any mention of the need to upgrade these intersections.

PC21 Scenario 1: 50% Development of the PC21 Site (270 households)

Under the ITA, 50% of the site development was considered as an option because at this threshold, it would be necessary to upgrade the SH6 / SH8B roundabout with a second circulating lane, and the SH6 / Pisa Moorings Road / Clark Road intersection needed to be converted to a roundabout.

Due to the lower traffic flows generated by the site, no modelling has been carried out of this scenario.

PC21 Scenario 2: 100% Development of the PC21 Site (543 households)

Under the ITA, this scenario required intersection improvements. In the results set out below for the new modelling, no intersection improvements have been modelled.

Intersection	PC21 Modelling as per ITA (Incl Intersection Improvements)			Updated Modelling (No Intersection Improvements)		
	Veh/hr	Delay (s)	LoS	Veh/hr	Delay (s)	LoS
SH6 / PC21 South	1,328	11	B	1,187	19	C
SH6 / PC21 North	869	7	A	952	8	A
SH6 / Pisa Moorings Rd / Clark Rd	1,982	6	A	1,512	28	D
SH6 / Lowburn Valley Road	2,127	>150	F	1,553	166	F
SH6 / Burn Cottage Road	2,095	10	A	1,551	36	E
SH6 / Shortcut Road	2,118	4	A	1,575	13	B
SH6 / SH8b	2,564	5	A	2,163	15	B

Table 2: Intersection Performance, 543 Households in the Site

It can be seen that under this scenario, both the SH6 / Lowburn Valley Road and SH6 / Burn Cottage Road intersection continue to provide a poor level of service (as would be expected).

At the SH6 / SH8B roundabout, the ITA for PC21 commented that the delay on the southern approach was 106 seconds and Level of Service F. Under the revised modelling, this has been reduced to 35 seconds and Level of Service C (again noting that this is due to the lower trip rate used and without any upgrading). and As set out above, Level of Service C lies within a range that indicates that an intersection is functioning satisfactorily.

The situation is more complex at the SH6 / Pisa Moorings Road / Clark Road intersection. In this case, an overall Level of Service D arises for traffic approaching from the east (the Pisa Moorings

Road approach) which is unable to exit onto the highway. This occurs because the traffic travelling to and from the site reduces the gaps in the traffic stream on the highway, and limits the ability for drivers to exit Pisa Moorings. Further, the site traffic also limits the ability of drivers to turn right into Pisa Moorings Road, and these vehicles then obstruct drivers attempting to turning right out of Pisa Moorings Road.

Level of Service D spans a range of 25 to 35 seconds delay per vehicle, and the modelling shows that the delay is 28 seconds, meaning it falls mid-way in the range. As set out above, Level of Service D represents satisfactory performance.

New Scenario 3: Assessment of When Level of Service D at the SH6 / Pisa Moorings Road / Clark Road Intersection Changes to Level of Service E

In order to identify where the extent of development results in a change to Level of Service E and an unsatisfactory outcome, in practice the only approach is to repeatedly run the model with different amounts of development and review the results. This could be done by increasing the yield by one lot each time and re-running the model but this would be highly time-consuming. Consequently the approach taken in this instance has been to model yields in increments of 200 residences, and then interpolate between these results to identify the point where Level of Service E arises.

On this basis, we find that Level of Service D changes to Level of Service E at a yield of 710 residences.

Consequently we recommend that development within Parkburn is limited to 710 residences until such time as roading improvements are put in place. We discuss options for this below.

Variation to Scenario 3

One way to achieve greater capacity for traffic turning onto State Highway 6 is to create an additional point of access. Under this scenario, drivers would therefore have a second option for exiting Pisa Moorings.

One option in this regard is Pony Court. This is presently a cul-de-sac located at the northwestern corner of Pisa Moorings, but is close to the southern boundary of the site. If a roading link could be formed in this location, then this would create additional capacity for traffic that is attempting to exit Pisa Moorings – drivers would not be obliged to exit via Pisa Moorings Road but could instead make use of the southern site access. Furthermore, trips that are presently made for a short distance on State Highway 6 (such as between Pisa Moorings and the commercial area within the site) would occur wholly internally and this would also reduce the amount of traffic turning to and from the highway and providing a further beneficial effect.

The option of a Pony Court link has been modelled and the interpolation of the results shows that with 710 dwellings within the site, the SH6 / Pisa Moorings Rd / Clark Rd intersection would operate with Level of Service C. That is, if there is a connection to Pony Court and options to gain access to the highway via alternative routes, then the level of service at the SH6 / Pisa Moorings Road / Clark Road intersection improves such that an intersection improvement scheme would not be required in that location.

On this basis then, we consider that one condition of consent for the site could be that development within Parkburn is limited to 710 residences until such time as a direct roading link is provided between the site and Pisa Moorings to the south.

New Scenario 4: 100% Development of the Site (1,047 households)

The result shown below set out the outcomes of the full extent of development within the site, and including for the Pony Court link. For clarity, no intersection improvements are included within these results.

Intersection	Updated Modelling (No Intersection Improvements) with Pony Court Link		
	Veh/hr	Delay (s)	LoS
SH6 / PC21 South	1,389	30	D
SH6 / PC21 North	985	9	A
SH6 / Pisa Moorings Rd / Clark Rd	1,657	25	C
SH6 / Lowburn Valley Road	1,776	665	F
SH6 / Burn Cottage Road	1,799	52	F
SH6 / Shortcut Road	1,823	22	C
SH6 / SH8b	2,393	26	C

Table 3: Intersection Performance, 1,047 Households in the Site with a Pony Court Link

It can be seen that the effects of the Pony Court link mean that the level of service at the SH6 / Pisa Moorings Road / Clark Road intersection remains appropriate, and no intersection improvement would be required to provide additional capacity.

Upon more detailed review of the results, we find that although the overall level of service at the SH6 / SH8B roundabout is acceptable (Level of Service C), this masks that Level of Service E arises on the southern approach to the roundabout (a similar outcome was seen for the previous PC21 work). As such, we have assessed the point at which this transitions from Level of Service D to E, using the interpolation approach described above. This shows that Level of Service E arises at a threshold of 875 residences within the site.

Consequently we recommend that once development within Parkburn reaches 875 residences, some form of improvement scheme is required at the SH6 / SH8B roundabout (for example, the installation of a second northbound approach lane).

Summary and Conclusions

The traffic survey carried out at Pisa Moorings indicates that the trip generation rate used for the development contemplated in PC21 was too high, although the direction of vehicle movements was appropriate. The use of a revised trip generation rate has identified that a greater proportion of the site can be developed before intersection improvements are required. However it continues to show that full site development cannot occur unless improvements are put in place, albeit that the site is anticipated to be more intensively developed than was initially evaluated.

It is possible to model any scale of yield in the site, but to maintain consistency with the work carried out previously, the modelling work to date has considered the previous full development of the site (543 residences) and the new full development of the site (1,047 residences). While other parameters in the model have been reviewed, these have not been changed from the PC21 modelling.

The model shows that without development of the site, the key intersections on the roading network operate with an excellent level of service. The intersections of Lowburn Valley Road and Burn Cottage Road with the highway have lower levels of service, but this outcome is consistent with the

earlier modelling work carried out for PC21 where it was identified that improvements to those intersections would need to be progressed separately to that plan change.

With 543 residences (being the previous full development of the site through PC21 and approximately 50% of the new yield), the key intersections on the roading network generally continue to provide a good level of service. This is based on the site accesses being formed as priority intersections, with auxiliary left-turn and right-turn lanes. However the SH6 / Pisa Moorings Road / Clark Road intersection is starting to approach an unsatisfactory level of service and further testing (and interpolation of results) shows that development within the site should be limited to 710 residences until roading improvements are put in place. In practice, the formation of a direct link between the site and Pisa Moorings addresses this issue without the need for any intersection improvements.

When the new full development of the site is considered (1,047 residences), the key intersections continue to provide a good level of service. However Level of Service E arises on the southern approach to the SH6 / SH8B roundabout (and a similar outcome was seen through the previous PC21 modelling). Further assessment shows that this reaches an unsatisfactory level of service at 875 residences and so we consider that improvement of the southern roundabout approach will be justified at this point.

We have compared the PC21 provisions with the new modelling results:

PC21 Provision (SUB-S2)	Comment / Assessment
2. No more than 559 residential allotments shall be created (titled) within the Schedule 19.28 Parkburn Structure Plan area	The modelling now shows that additional residential lots can be accommodated
3. No residential allotments shall be created (titled) within the Schedule 19.28 Parkburn Structure Plan, until:	
i. The existing northern priority intersection onto SH6 is upgraded to include a separated left turn lane; and	We consider that this remains a valid provision, given that NZTA now seeks separated left-turn lanes at priority intersections for safety reasons
ii. The new intersection to the south of the existing northern intersection onto SH6 is constructed as a priority controlled intersection or single lane roundabout	The modelling shows that a priority intersection has sufficient capacity and that a roundabout is not required at this point.
4. No more than 286 residential allotments shall be created (titled) within Schedule 19.28 Parkburn Structure Plan, until:	
i. The SH6/SH8B intersection has been upgraded to a dual lane roundabout	The modelling shows that this upgrading is not needed at 286 lots, but rather, at 875 lots.
ii. The SH6/Pisa Moorings Road has been upgraded to a single lane roundabout	The modelling shows that such an upgrade is not needed at 286 lots, and that the full site development can be achieved provided that a direct link to Pisa Moorings is formed
OR	
other upgrade solution including banning turns and/or providing an alternative roundabout connection to SH6 through the Schedule 19.28 Parkburn Structure Plan area.	We have not assessed alternative options as part of this exercise

5. No residential allotments shall be created (titled) within Lot 16 DP 514674 of the Schedule 19.28 Parkburn Structure Plan, until:	
i. The Pony Court road connection has been vested as road.	The modelling shows that the Pony Court connection provides a benefit to the site, but it is not needed at lower numbers of lots as discussed above.

Table 4: Commentary on PC21 Provisions

Concluding Comments

As set out in PC21 and earlier emails, one limitation of the modelling carried out is that the Council's model only assesses the weekday evening peak hour, and it is intuitive that travel patterns are different during the weekday mornings. However the modelling of the evening peak was used to confirm PC21 and consequently at this stage we anticipate that an assessment of the evening peak hour will be sufficient for this exercise also.

NZTA's submission to PC21 sought a direct connection between Pisa Moorings and the site, in order to ensure that short-distance trips between the two areas were not carried out on the highway. In our view, the modelling supports the benefits of such a link (from an efficiency perspective) at a threshold of 710 residences within the site. For clarity, although we have referred to a 'Pony Court link', the same positive outcomes would be achieved if a direct link was able to be provided elsewhere (in other words, the link does not have to be via Pony Court to be beneficial).

In summary, we consider that development within the site can be supported subject to the following:

- Development within the site should be limited to 710 residences until a direct link between the site and Pisa Moorings is created; and
- Development within the site should be limited to 875 residences until the southern approach to the SH6 / SH8B roundabout is improved to create additional capacity.

As always, we would be pleased to discuss this letter with you at your convenience.

Kind regards
Carriageway Consulting Limited



Andy Carr
Traffic Engineer | Director
Mobile 027 561 1967
Email andy.carr@carriageway.co.nz

CARRIAGEWAY
CONSULTING

traffic engineering | transport planning

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APPENDIX J – Utility Provider Correspondence

AURORA ENERGY LIMITED
PO Box 5140, Dunedin 9058
PH 0800 22 00 05
WEB www.auroraenergy.co.nz

10/03/2026

Nathan Archer
Landpro

Sent via email only: nathan@landpro.co.nz

Dear Nathan,

ELECTRICITY SUPPLY AVAILABILITY FOR A PROPOSED 1025 LOT SUBDIVISION. 992 LUGGATE – CROMWELL ROAD, CROMWELL. PART SECTION 62-63 BLOCK IV WAKEFIELD SURVEY DISTRICT & SECTION 1 SURVEY OFFICE PLAN 365897 & SECTION 4 SURVEY OFFICE PLAN 557380 & SECTION 64-65 BLOCK IV WAKEFIELD SURVEY DISTRICT.

Thank you for your inquiry outlining the above proposed development.

Subject to technical, legal and commercial requirements, Aurora Energy can make a Point of Supply[1] (PoS) available for this development.

Disclaimer

This letter confirms that a PoS **can** be made available. This letter **does not** imply that a PoS is available now, or that Aurora Energy will make a PoS available at its cost.

Next Steps

To arrange an electricity connection to the Aurora Energy network, a connection application will be required. General and technical requirements for electricity connections are contained in Aurora Energy's Network Connection Standard. Connection application forms and the Network Connection Standard are available from www.auroraenergy.co.nz.

Yours sincerely

Evan Dickson
CUSTOMER SOLUTIONS MANAGER

[1] Point of Supply is defined in section 2(3) of the Electricity Act 1993.

Chorus NZ Ltd
4 Graham Street
Auckland CBD

Nathan Archer
Survey Manager
Landpro
Cromwell

16th March 2026

Hi Nathan,

Thank you for providing an indication of your development plans in this area.

I can confirm that we have UFB fibre infrastructure in the area that you are proposing to develop. Chorus will be able to extend our network to provide connection availability to **"PARKBURN QUARRY DEVELOPMENT 922 LUGGATE - CROMWELL ROAD".**

However, please note that this undertaking would of course be subject to Chorus understanding the final total property connections that we would be providing, roll-out of future property releases/dates and what investment may or may not be required from yourselves and Chorus to deliver any further infrastructure to and throughout the site in as seamless and practical way as possible.

The costs for any future works involved can only be finalised at the time that you are ready to proceed.

Chorus is happy to work with you on this project as the network infrastructure provider of choice. What this ultimately means is that the end customers (business and home owners) will have their choice of any retail service providers to take their end use services from once we work with you to provide the physical infrastructure.

Please reapply with a detailed site plan when you are ready to proceed.

Thanks

Kind Regards,

Danny Masterson
Business Development Manager
021849233
Chorus NZ Ltd