BEFORE AN INDEPENDENT HEARINGS PANEL

THE PROPOSED WAIKATO DISTRICT PLAN

IN THE MATTER OF the Resource Management Act 1991 (**RMA**)

IN THE MATTER OF hearing submissions and further submissions on Variation 3 Enabling Housing Intensification to the Proposed Waikato District Plan

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SUPPLEMENTARY EVIDENCE OF RYAN JAMES PITKETHLEY ON BEHALF OF HAVELOCK VILLAGE LIMITED [Submitter 105] FOR SUBSTANTIVE HEARING

CIVIL ENGINEERING AND STORMWATER

21 July 2023

BUDDLE FINDLAY

Barristers and Solicitors
Auckland
Solicitor Acting: **Vanessa Evitt / Mathew Gribben**
Email: vanessa.evitt@buddlefindlay.com / mathew.gribben@buddlefindlay.com
Tel 64-9-358 2555 PO Box 1433 DX CP24024 Auckland 1140

1. EXECUTIVE SUMMARY

1.1 My full name is Ryan James Pitkethley. I am a Senior Civil Engineer, Director and Engineering Manager at CivilPlan Consultants Limited. I am providing evidence on behalf of Havelock Village Limited (HVL) with a particular focus on its Havelock site.

1.2 On I provided primary evidence for Variation 3 dated 4 July 2023 in which I referred to my previous evidence from the hearings for the Proposed Waikato District Plan (**PDP**) in 2021.

1.3 The purpose of this supplementary statement is to provide the relevant extracts from my primary and rebuttal evidence statements from the PDP hearings to support the analysis and conclusions in my primary evidence for Variation 3.

2. INTRODUCTION

2.1 My full name is Ryan James Pitkethley. My qualifications and experience are set out in my primary statement of evidence dated 4 July 2023.

2.2 I confirm that I have the qualifications and expertise previously set out in my primary evidence.

3. SCOPE OF EVIDENCE

3.1 The purpose of this supplementary statement is to provide extracts from my statements of evidence in relation to the PDP Topic 25 Zone Extents, which are referred to in my primary evidence for Variation 3 dated 4 July 2023.

3.2 For the PDP, I prepared statements of evidence dated17 February 2021 (primary) and 3 May 2021 (rebuttal).

4. RELEVANT EXTRACTS OF TOPIC 25 – ZONE EXTENTS EVIDENCE

Primary evidence dated 17 February 2021

4.1 At paragraph 4.2 of my primary evidence for Variation 3,[1] I conclude that:

The stormwater management philosophy is to address both runoff quality and quantity at the time of subdivision and development. A key principle of the

[1] Evidence on behalf of Ryan James Pikethley on behalf of Havelock Village Limited dated 4 July 2023.

stormwater design for Havelock is to attenuate post development peak flows up to and including the 1% AEP to 80% of pre development peak flows.

4.2 My conclusion is based upon paragraphs 8.10-8.23 and Fig 4 of my 17 February 2021 evidence brief. I attach these extracts as **Appendix A** to this evidence.

Rebuttal evidence dated 3 May 2021

4.3 At paragraph 4.5 of my primary evidence for Variation 3, I discuss and refer to my rebuttal evidence[2] for the PDP and the explanation it provided in relation to landform, infrastructure, roading and channels on the Havelock site.

4.4 The full extracts that I referred to in this paragraph are attached at **Appendix B** to this evidence.

Ryan Pitkethley
21 July 2023

[2] At [3.25]-[3.17] and Appendices 1-4.

Appendix A

the developer. No local authority funding is required to achieve the roading network or connections.

8.9 I conclude that appropriate roading networks and connections can be developed as part of a subdivision resource consent process to support the development of the proposed Residential Zone.

Stormwater

8.10 The Site falls outside of any approved WRC stormwater discharge consent area. In my experience with development and stormwater catchment planning in Pokeno stormwater discharge consent(s) are obtained from the WRC alongside subdivision and/or development-based land use consents.

8.11 The Site is close to the top of the catchment and stormwater flows to existing streams within the Site and to the downstream networks as shown on the figure below:

(a) The northern side of the Site drains to Pokeno industrial area. This flows ultimately to the Tanitewhiora, Mangatawhiri then Waikato Rivers via the piped network servicing Graham Block.

(b) The eastern side of the Site drains to existing rural land. This flows through to the Mangatawhiri then Waikato Rivers via existing farm drains and ponds.

(c) The southern side of the Site drains to Tata Valley either directly or through the 3rd party stream running through 316 Bluff Road (Lot 1 DP 167329). Tata Valley then discharges to the Waikato River via farm drains.

(d) The western side of the Site drains to Pokeno rural area to the west and north, west of the NIMT line. This then flows to the Tanitewhiora, Mangatawhiri then Waikato Rivers.

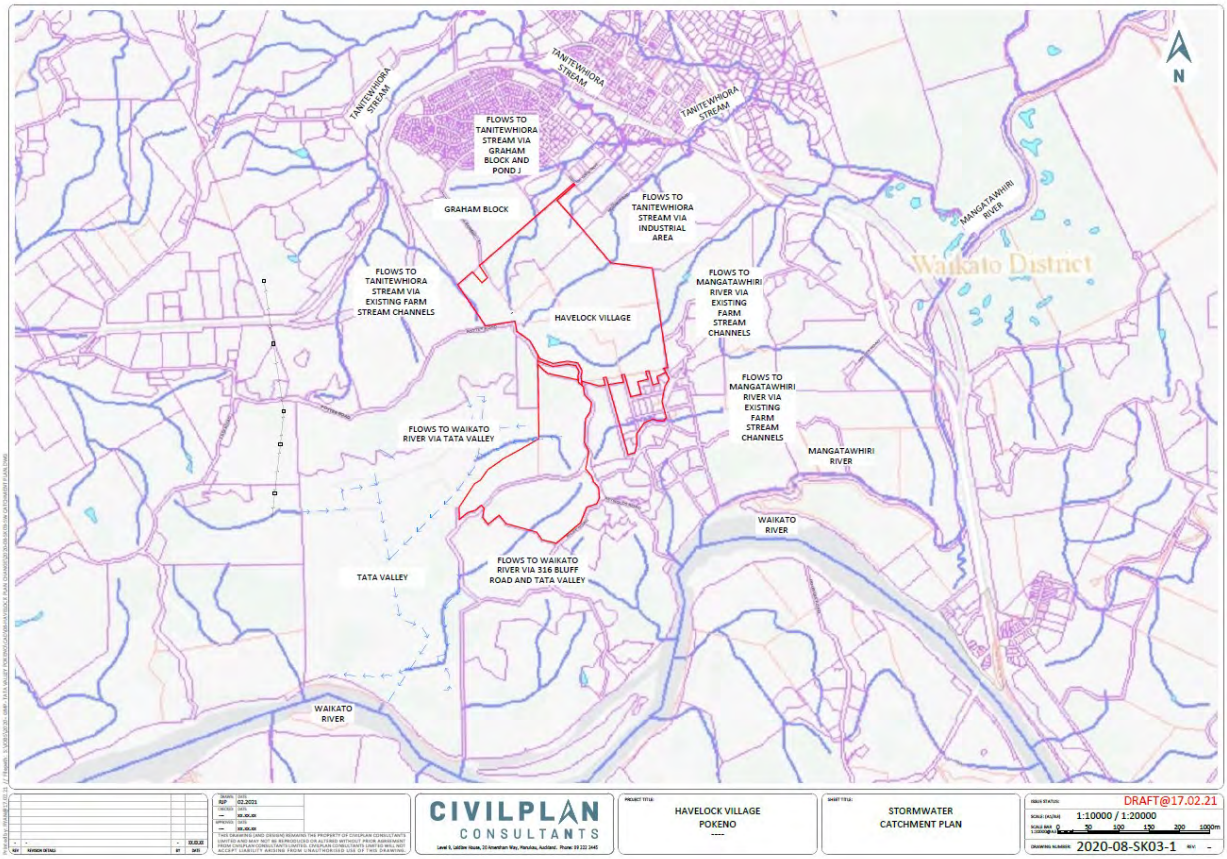


Figure 3 – Existing stormwater discharge locations.

8.12 Stormwater management to address both quality and quantity, would be required at the time of subdivision and development, and would be based on low impact design based as required by the Waikato Stormwater Management Guidelines and Waikato District Council requirements as outlined in current versions of the following documents:

(a) Waikato Regional Council TR2020/06– Waikato Stormwater Runoff Modelling Guideline.

(b) Waikato Regional Council TR2020/07 – Waikato Stormwater Management Guideline.

(c) Waikato Local Authority Shared Services Regional Infrastructure Technical Specifications (RITS) – Stormwater

8.13 Preliminary stormwater design, for the purpose of testing the proposed zoning and structure plan, is outlined in the sections below and indicative devices located offline to streams are shown in Figure 4. The Precinct Plan incorporates riparian margins (Environmental Protection Areas) running along

the main gullys to allow for stream channel restoration and replanting of native vegetation. The streams would be protected from erosion by the provision of stormwater treatment and extended detention, although further investigation is required at the resource consent stage to determine the feasible level of stormwater retention (refer to paragraph 8.15).

8.14 Detailed design of the development would ensure fish passage is maintained along the streams and in any culverts, and the WRC Low Impact Design Scoring Matrix will be used – preliminary scoring for the concepts has indicated that the site development has potential to score 18, a few points higher than the minimum required 15.

8.15 Geotechnical investigation (Insitu testing such as falling head percolation method) is required at resource consent stage to determine how much retention by soakage can be provided. The clay soils which cover most of the Site make this difficult, but part of the Site also has basalt rock outcrops. The Site is steep in places and any infiltration soakage into the ground will need to be in accordance with geotechnical advice addressing slope stability. Usually infiltration would be discouraged for slope stability reasons on slopes showing signs of instability, or steeper than 1(v) in 4(h). This would be designed in detail with the Geotechnical Engineer at resource consent stage.

8.16 Stormwater from roofs, consistent with Council's stormwater guidance, would likely be managed by rain tanks providing non-potable reuse and extended detention.

8.17 Stormwater from paved areas would likely be managed by rain gardens in lots and/or roads providing quality treatment and detention.

8.18 Peak Stormwater flows up to the 100-year plus climate change storm event can be attenuated to no more than pre-development flows, ensuring downstream properties and infrastructure are not negatively affected (i.e. downstream flooding of streams, pipes, roads and bridges is not increased from the existing condition). The Site's upper catchment location means attenuation of flow rates to pre development levels will prevent any flooding downstream in events up to and including the 100 year plus climate change event. Overland flow would be captured on site via roads and dedicated overland flow paths discharging into the attenuation devices before discharging into the stream / gully network at pre development flow rates.

8.19 During the development of the downstream industrial area, these sites have allowed for the Site's upstream runoff to pass through the Site at pre development (rural) flow rates. This sets the baseline for the Site's discharge rates.

8.20 Attenuation storage would likely occur via at source devices (basins/wetlands/rain gardens and/or tanks) or in larger communal (Council owned and operated) devices located offline to streams, at the head of gullies for example. Discharge from all devices would be orifice controlled consistent with Council's stormwater guidance.

8.21 To be consistent with the PWDP Residential Zone standards for lot size and coverage, a minimum 450 m² lot size with 40% building coverage (180m^2), and 70% total impervious area (315m^2) has been modelled in HEC-HMS [7]to confirm the feasibility of this option and provide indicative device sizing. The calculations show:

(a) For roof areas, a required total tank volume of 12 m³, including 5.6 m³ for reuse and extended detention.

(b) For paved areas, 6.3 m³ total storage is required, which can be provided by an 18 m² rain garden.

8.22 Specific implementation of any stormwater management strategy including detailed design to match each stage of development can be provided at resource consenting stage, as would be necessary to obtain the relevant regional consent requirements. In my experience in land development this is typical practice. At this stage I am confident that suitable solutions can be achieved at resource consent stage in order to support the proposed rezoning of the land.

8.23 In conclusion, all stormwater treatment devices and infrastructure can be installed on-site to mitigate effects of development. I expect that no offsite works or infrastructure will be required and there will be no downstream effects.

[7] The US Army Corps of Engineers "Hydrologic Engineering Center Hydrologic Modelling System" (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing.

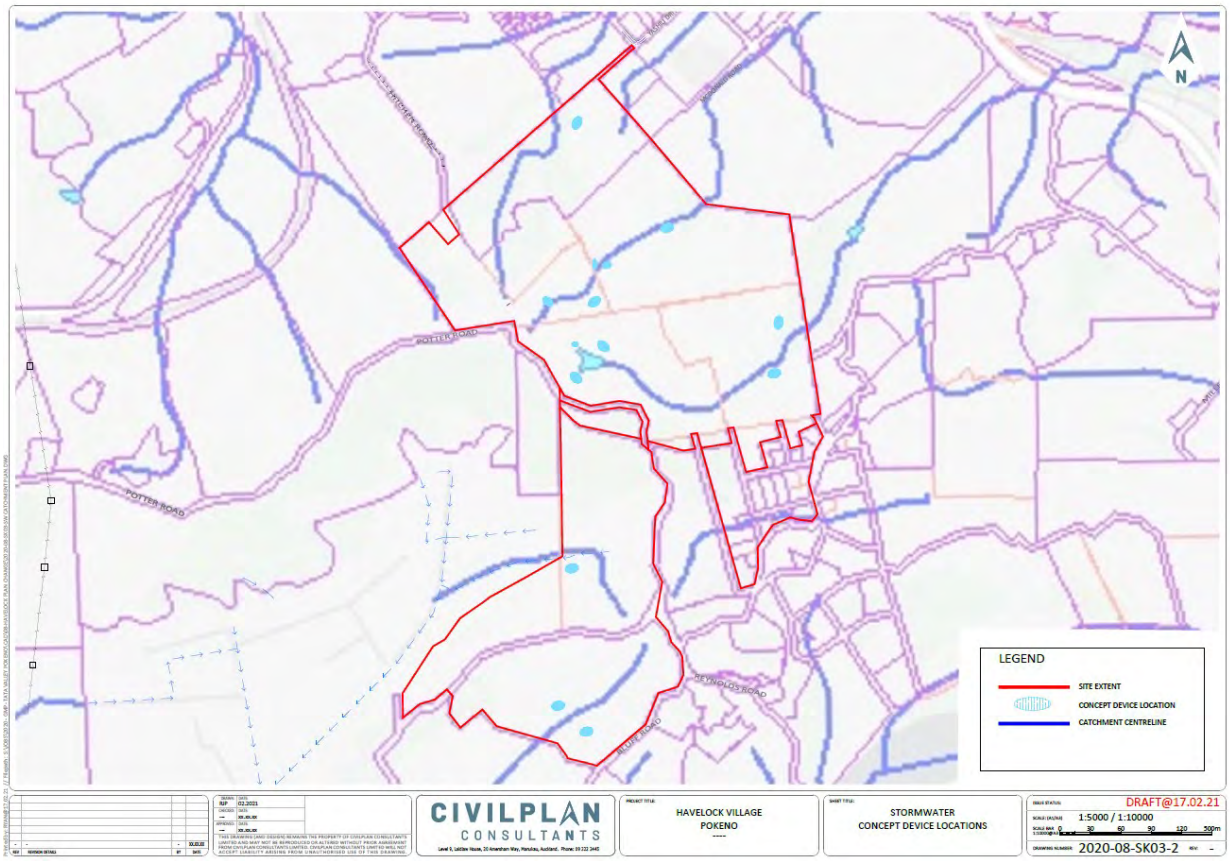


Figure 4 – Indicative communal stormwater devices based on concept design.

Appendix B

3.12 I consider it is technically and practically feasible to develop the land and manage stormwater within the HVL land holdings so as not to increase peak flow rates at the HVL boundaries or downstream, and be in line with the current SCMP. Mr McGregor also agreed this is technically feasible. Therefore, in my opinion the completion of the SCMP works is unrelated to whether the HVL land should be rezoned as the management of stormwater from Havelock does not rely on completion of the SCMP works.

3.13 The completion of the SCMP works is an issue needing resolution separate to and regardless of the rezoning outcome. I also consider that resource consent processes for development within the HVL land can address the implications (if any) of the failure to complete these works on the management of stormwater from the Havelock Site, including in the absence of a Council-led catchment management plan.

3.14 The section 42A report records the concerns raised by Mr McGregor at paragraph 377. The report writer, Mr Mead, considers that the implications of the incomplete works for development of the HVL site can be assessed at the time of resource consent. This is consistent with my opinion.

Incomplete stormwater works on Hynds Land

3.15 Paragraphs 3.17-3.28 of Mr McGregor's evidence explains additional incomplete works in Hynds and Synlait land and is very similar to his concern about other incomplete stormwater works explained above.

3.16 He notes that certain stormwater works, called Pipeline A, are incomplete and in private (Hynds) ownership due to works ceasing on account of a misunderstanding of how the pipeline cost is to be reimbursed (discussions to establish a Developer's Agreement with WDC are ongoing).

3.17 Mr McGregor considers that:

(a) Pipeline A is required to be extended to service the Synlait and upstream HVL land, to provide connection to both land holdings. This line also requires vesting to WDC.

(b) That the HVL site needs to connect to Pipeline A directly.

(c) Pipeline A is adequately sized to cater for catchments to remain in their current state under the Operative District Plan (which includes 32ha of HVL land currently in pasture).

(d) Further consideration is required regarding to the continued safe conveyance of flows through the Synlait site to McDonald Road and Pipeline A, and

(e) No identification of existing 1 in 100-year flow paths or their ability to cater for existing flooding has been provided, and no 1% AEP flood path is provided for the HVL / Synlait land without Pipeline A being completed.

Response

3.18 I agree with and am of the same opinion of Mr McGregor with regards 3.12 a) – d) above. These are all technical requirements for the successful completion of Pipeline A as originally intended.

3.19 I also agree that discussions to establish a Developer's Agreement with WDC need to be concluded and the works completed so that the system can operate as intended.

3.20 I do not agree with the statement in paragraph 3.17 e) above. The landform, infrastructure, roading and channels currently on site allow for the safe conveyance of 1% AEP overland flows from HVL land through to the Tanitewhiora Stream. This is shown on drawings 2020-08-SK05-1 and 2 in the Appendices and conveyed as follows:

(a) Cut off channels running within Yashili's, Synlait's and Hynd's properties which directs water to McDonald Road, Pipeline A, and then to the Tanitewhiora stream.

(b) Water passing via McDonald Road itself to the sag to the east of the McDonald Road roundabout, which then flows into Pipeline A.

3.21 As required by the WDC RITS Section 4.1.8, all stormwater systems shall provide for the management of stormwater runoff from within the land being developed together with any runoff from upstream catchments. WDC, Yashili, Hynds and Synlait are required to manage as a minimum the upstream predevelopment flows entering their site, pass it through their site and discharge it downstream. This is currently being achieved in the temporary case with private channels and road overland flow without Pipeline A being completed. Figure 3 (drawing 2020-08-SK05-1 in the Appendix) illustrates the current situation. There are also a series of photographs in the Appendix illustrating how overland flow currently passes from HVL land to the Tanitewhiora stream via Synlait Land, publicly vested McDonald Road, and Hynds Land/partially completed Pipeline A. With the preservation of the status quo, this would also be a feasible route if HVL was developed with the proposed stormwater strategy.

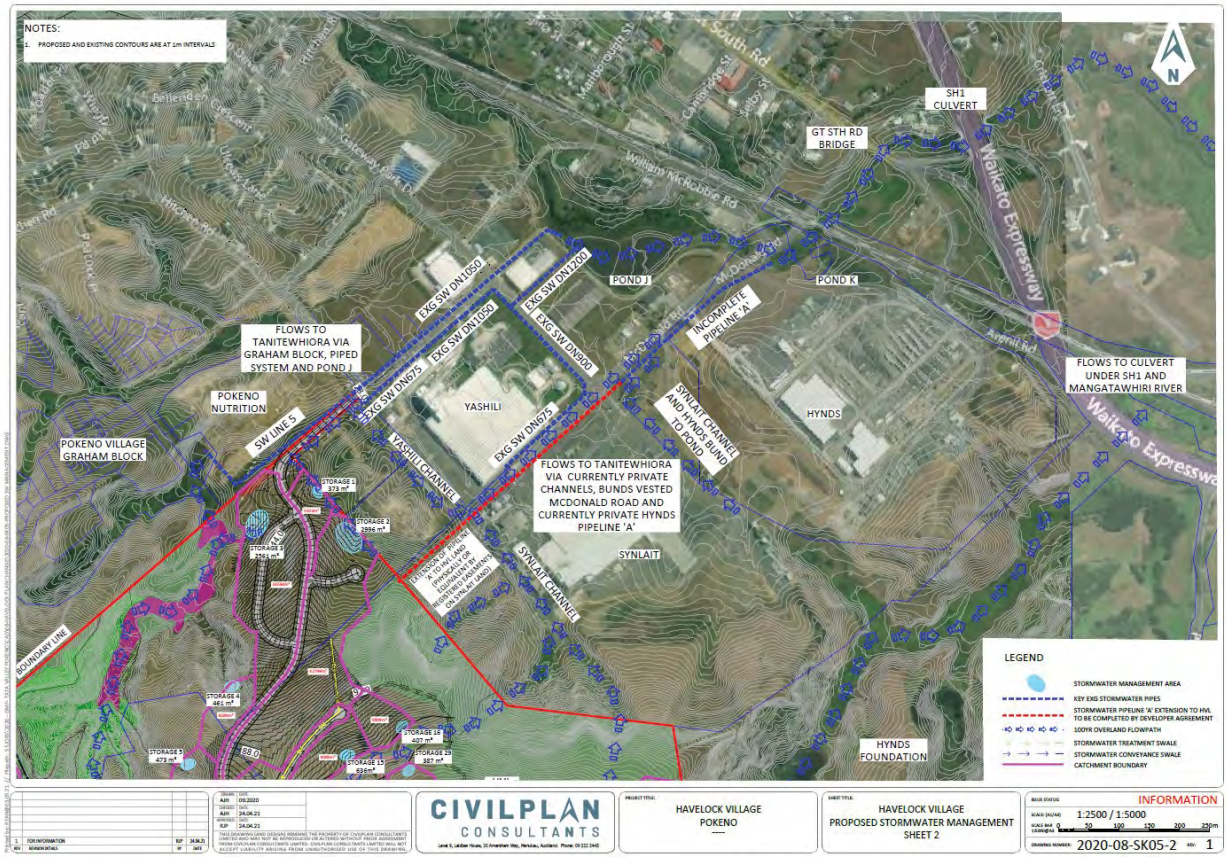


Figure 3 – Overland Flow Paths from 2020-08-SK05-1.

3.22 Predevelopment peak flows discharging into the downstream sites (Yashili, Synlait, Graham Block, Pokeno Nutritional, Hynds) from the HVL land will not change due to the proposed attenuation measures within the HVL land, at the top of the catchment. As noted in Mr McGregor's evidence, undersized culverts currently produce some issues further down the external catchment at SH1, but are not related to HVL in the pre or post development cases. This can be verified with catchment modelling at the resource consent stage and should not prevent the HVL land being rezoned.

3.23 Plans 2020-08-SK05-1 and 2 in the Appendix identify all 1 in 100-year flows paths from the HVL site. The piped networks and flow paths have been sized to cater for the predevelopment run off from HVL as per the WDC RITS requirements. To verify flows down McDonald Road, a calculation in the Appendix has been completed that shows that the catchment above McDonald Road generates 5.5m^3/s of predevelopment run off in the 1 in 100 year plus climate change event.

3.24 In the case where all pipes and inlets are 100% blocked (a common test for secondary overland flow path design), the Synlait western channel would overtop and flow would enter the top of McDonald Road via the Synlait site. McDonald Road is able to pass 5.6m^3/s completely within the public road reserve, without crossing boundaries or the

need for privately held ponds and ditches. This occurs from the start of Synlait's gated entrance, flowing east until the McDonald Road sag adjacent to the Hynds land. The private ditches and ponds in Synlait Land provide additional storage for the catchment and would manage Synlait's own flows, but the calculation shows they are not required to pass HVL predevelopment flows.

3.25 At the McDonald Road sag the road flattens to 0.5% either side and this is where Hynds currently takes and expects to take the runoff from the road and into Pipeline A.

3.26 This demonstrates that the existing arrangement of roads, private accessways, channels, ditches and both completed and uncompleted pipes can remain as the status quo regardless of whether HVL is developed without exacerbating flooding downstream. The lack of some completed infrastructure (ie Pipeline A) is not necessary to be in place for the HVL land to be developed, although in my opinion should be in place as soon as possible to honour the original developer's agreement.

3.27 As noted above the reporting officer has commented on this lack of certain infrastructure at paragraph 377 and agrees this issue can be addressed at resource consent stage. This is consistent with my opinion.

Stormwater should be considered on a catchment wide basis prior to rezoning

3.28 In Paragraph 4.10-4.18 Mr McGregor considers that:

(a) Development of the nature proposed by the submitters is technically feasible from a stormwater perspective.

(b) Although it is common to provide a stormwater assessment as part of a particular resource consent, he considers in this case the catchment has specific risks (large scale, significant downstream development and absence of secondary flow path connectivity), so should be considered on a catchment wide basis, and prior to rezoning being given.

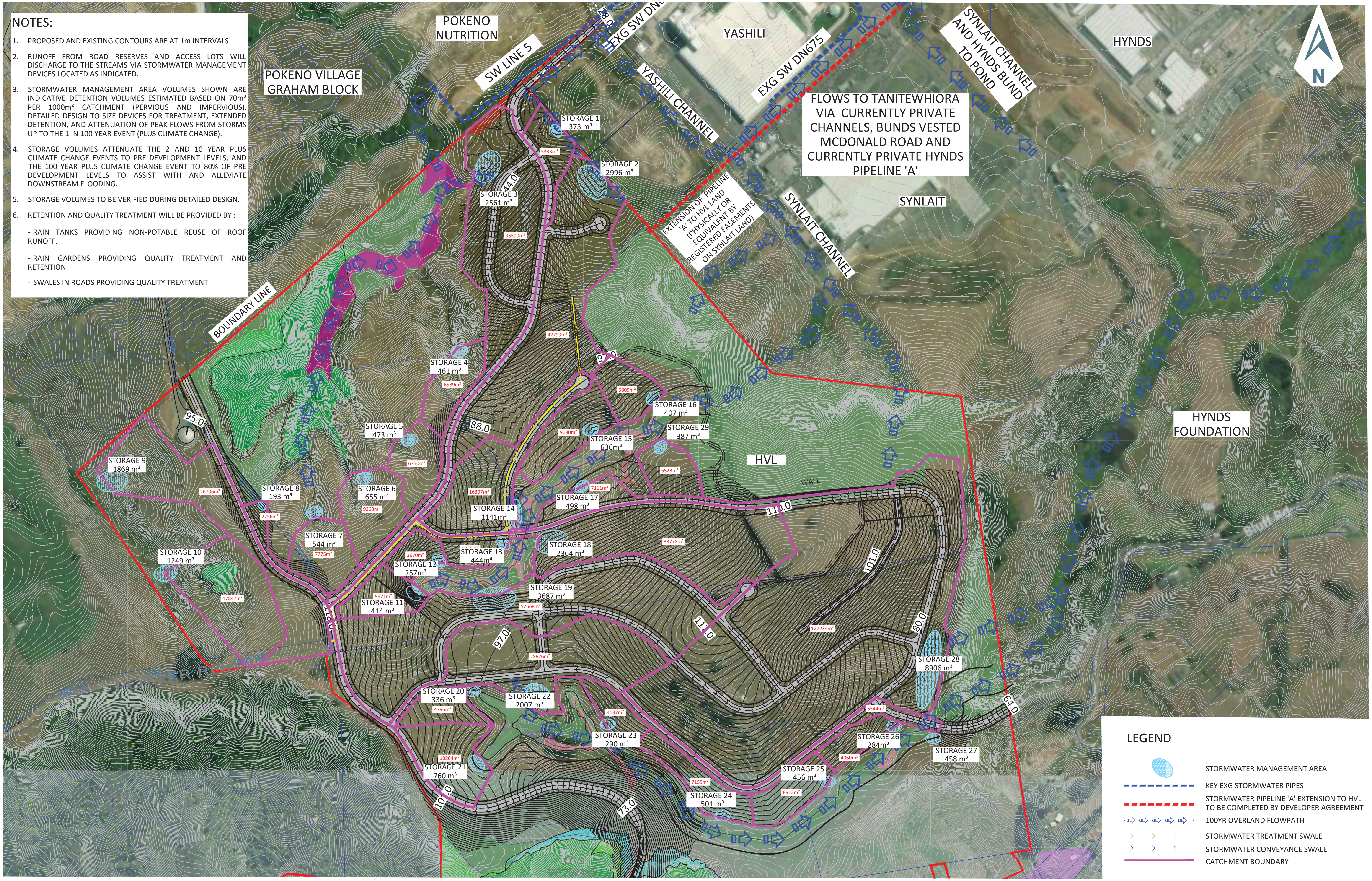
Response

3.29 I discuss above at paragraphs 3.8 to 3.14 how the upstream land identified as 'rural zoning' in the SCMP can be developed and still be in line with the current SCMP strategy.

3.30 I agree with the suggestion that for appropriate stormwater management, controls should be considered on a catchment wide basis. This is useful to understand whether the timing and volume of stormwater discharges is managed appropriately, and to

NOTES:

1. PROPOSED AND EXISTING CONTOURS ARE AT 1m INTERVALS
2. RUNOFF FROM ROAD RESERVES AND ACCESS LOTS WILL DISCHARGE TO THE STREAMS VIA STORMWATER MANAGEMENT DEVICES LOCATED AS INDICATED.
3. STORMWATER MANAGEMENT AREA VOLUMES SHOWN ARE INDICATIVE DETENTION VOLUMES ESTIMATED BASED ON $70m^3$ PER $1000m^2$ CATCHMENT (PERVIOUS AND IMPERVIOUS). DETAILED DESIGN TO SIZE DEVICES FOR TREATMENT, EXTENDED DETENTION, AND ATTENUATION OF PEAK FLOWS FROM STORMS UP TO THE 1 IN 100 YEAR EVENT (PLUS CLIMATE CHANGE).
4. STORAGE VOLUMES ATTENUATE THE 2 AND 10 YEAR PLUS CLIMATE CHANGE EVENTS TO PRE DEVELOPMENT LEVELS, AND THE 100 YEAR PLUS CLIMATE CHANGE EVENT TO 80% OF PRE DEVELOPMENT LEVELS TO ASSIST WITH AND ALLEVIATE DOWNSTREAM FLOODING.
5. STORAGE VOLUMES TO BE VERIFIED DURING DETAILED DESIGN.
6. RETENTION AND QUALITY TREATMENT WILL BE PROVIDED BY :
   - RAIN TANKS PROVIDING NON-POTABLE REUSE OF ROOF RUNOFF.
   - RAIN GARDENS PROVIDING QUALITY TREATMENT AND RETENTION.
   - SWALES IN ROADS PROVIDING QUALITY TREATMENT



POKENO NUTRITION
POKENO VILLAGE GRAHAM BLOCK
SW LINE 5
EXG SW DN675
YASHILI
YASHILI CHANNEL
SYNLAIT CHANNEL AND HYNDS BUND TO POND
HYNDS
FLOWS TO TANITEWHIORA VIA CURRENTLY PRIVATE CHANNELS, BUNDS VESTED MCDONALD ROAD AND CURRENTLY PRIVATE HYNDS PIPELINE 'A'
SYNLAIT
SYNLAIT CHANNEL
EXTENSION OF PIPELINE 'A' TO HVL LAND (PHYSICALLY OR EQUIVALENT BY REGISTERED EASEMENTS ON SYNLAIT LAND)
BOUNDARY LINE
HVL
HYNDS FOUNDATION
STORAGE 1 373 m³
STORAGE 2 2996 m³
STORAGE 3 2561 m³
STORAGE 4 461 m³
STORAGE 5 473 m³
STORAGE 6 655 m³
STORAGE 7 544 m³
STORAGE 8 193 m³
STORAGE 9 1869 m³
STORAGE 10 1249 m³
STORAGE 11 414 m³
STORAGE 12 257m³
STORAGE 13 444m³
STORAGE 14 1141m³
STORAGE 15 636m³
STORAGE 16 407 m³
STORAGE 17 498 m³
STORAGE 18 2364 m³
STORAGE 19 3687 m³
STORAGE 20 336 m³
STORAGE 21 760 m³
STORAGE 22 2007 m³
STORAGE 23 290 m³
STORAGE 24 501 m³
STORAGE 25 456 m³
STORAGE 26 284m³
STORAGE 27 458 m³
STORAGE 28 8906 m³
STORAGE 29 387 m³

LEGEND

- STORMWATER MANAGEMENT AREA
- KEY EXG STORMWATER PIPES
- STORMWATER PIPELINE 'A' EXTENSION TO HVL TO BE COMPLETED BY DEVELOPER AGREEMENT
- 100YR OVERLAND FLOWPATH
- STORMWATER TREATMENT SWALE
- STORMWATER CONVEYANCE SWALE
- CATCHMENT BOUNDARY

REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	24.04.21

DRAWN: AJH	DATE: 09.2020	
CHECKED: AJH	DATE: 24.04.21	
APPROVED: RJP	DATE: 24.04.21	

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE: HAVELOCK VILLAGE POKENO ----

SHEET TITLE: HAVELOCK VILLAGE PROPOSED STORMWATER MANAGEMENT SHEET 1

ISSUE STATUS: INFORMATION

SCALE: (A1/A3) 1:2500 / 1:5000

SCALE BAR 1:5000@A3 0 50 100 150 200 250m

DRAWING NUMBER: 2020-08-SK05-1 REV: 1

NOTES:

1. PROPOSED AND EXISTING CONTOURS ARE AT 1m INTERVALS

N

SH1 CULVERT

GT STH RD BRIDGE

Waikato Expressway

FLOWS TO CULVERT UNDER SH1 AND MANGATAWHIRI RIVER

Waikato Expressway

POND J

POND K

EXG SW DN1050

EXG SW DN1200

EXG SW DN1050

EXG SW DN900

EXG SW DN675

FLOWS TO TANITEWHIORA VIA GRAHAM BLOCK, PIPED SYSTEM AND POND J

INCOMPLETE PIPELINE 'A'

POKENO NUTRITION

SW LINE 5

YASHILI

EXG SW DN675

YASHILI CHANNEL

SYNLAIT CHANNEL AND HYNDS BUND TO POND

HYNDS

FLOWS TO TANITEWHIORA VIA CURRENTLY PRIVATE CHANNELS, BUNDS VESTED MCDONALD ROAD AND CURRENTLY PRIVATE HYNDS PIPELINE 'A'

POKENO VILLAGE GRAHAM BLOCK

STORAGE 1
373 m³

STORAGE 2
2996 m³

STORAGE 3
2561 m³

STORAGE 4
461 m³

STORAGE 5
473 m³

STORAGE 15
636m³

STORAGE 16
407 m³

STORAGE 29
387 m³

5333m²

36590m²

42799m²

6589m²

5809m²

9080m²

44.0

97.0

88.0

EXTENSION OF PIPELINE 'A' TO HVL LAND (PHYSICALLY OR EQUIVALENT BY REGISTERED EASEMENTS ON SYNLAIT LAND)

SYNLAIT

SYNLAIT CHANNEL

BOUNDARY LINE

HYNDS FOUNDATION

Bellenden Crescent

Gateway Park Dr

Hitchen Rd

Peacockes Rd

Wesleys Lane

William McRobbie Rd

McDonald Rd

Averill Rd

Marlborough St

Cambridge St

Selby St

South Rd

LEGEND

- STORMWATER MANAGEMENT AREA
- KEY EXG STORMWATER PIPES
- STORMWATER PIPELINE 'A' EXTENSION TO HVL TO BE COMPLETED BY DEVELOPER AGREEMENT
- 100YR OVERLAND FLOWPATH
- STORMWATER TREATMENT SWALE
- STORMWATER CONVEYANCE SWALE
- CATCHMENT BOUNDARY

REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	24.04.21

DRAWN: AJH	DATE: 09.2020	
CHECKED: AJH	DATE: 24.04.21	
APPROVED: RJP	DATE: 24.04.21	

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER MANAGEMENT
SHEET 2

ISSUE STATUS: INFORMATION

SCALE: (A1/A3) 1:2500 / 1:5000

SCALE BAR 1:5000@A3 0 50 100 150 200 250m

DRAWING NUMBER: 2020-08-SK05-2 REV: 1

CIVILPLAN CONSULTANTS

McDONALD RD OLFP CAPACITY CALCULATION (MANNINGS FLOW)

CLIENT:	GMP	
PROJECT:	Havelock Village	
JOB NO:	2020	
DESIGNER:	RJP	
DATE:	01.05.21	
REVISION:	1	

DESIGN RAINFALL (assumes 10 minute time of concentration)

Climate Change Allowance:	Waikato TR2018/02		
Design Storm:	100	yr ARI	
10 min peak rainfall:	149	mm/hr	
Climate Change:	16.8%		
10min Peak Rain + CC	174.03	mm/hr	
Peak rainfall intensity (I)	0.000048	m/s	

CATCHMENT INFORMATION:

Runoff Coefficient (C)	0.3		(average 'C')
Area (A)	377,100	m^2	Upstream rural
Expected Flow (Q=CIA)	5.5	m^3/s	assumes pipes blocked

FLOWPATH DIMENSIONS:

Depth (d)	0.10	m	on footpath
Cross Sectional Area (A)	2.711	m^2	
Wetted Perimeter (P)	22.248	m	
Hydraulic radius R=A/P	0.122	m	
Slope (S)	0.023	m/m	
Roughness (n)	0.018		GRASS LAWN = 0.027 ROAD ASPHALT = 0.020 CONCRETE = 0.015

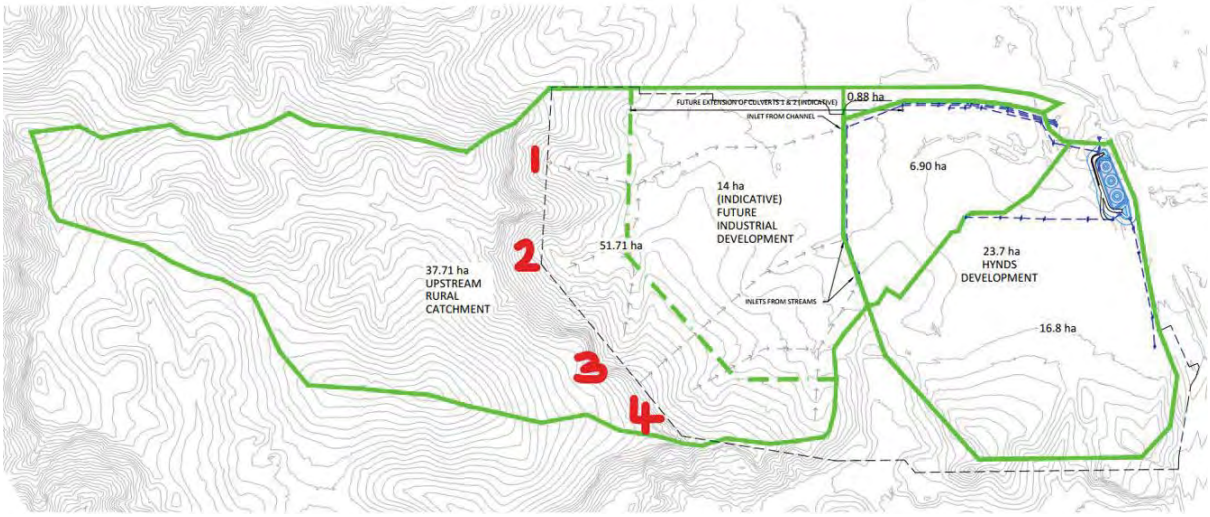
CAPACITY OF FLOWPATH USING MANNINGS EQUATION:

$$Q = \frac{AR^{2/3}S^{1/2}}{n}$$

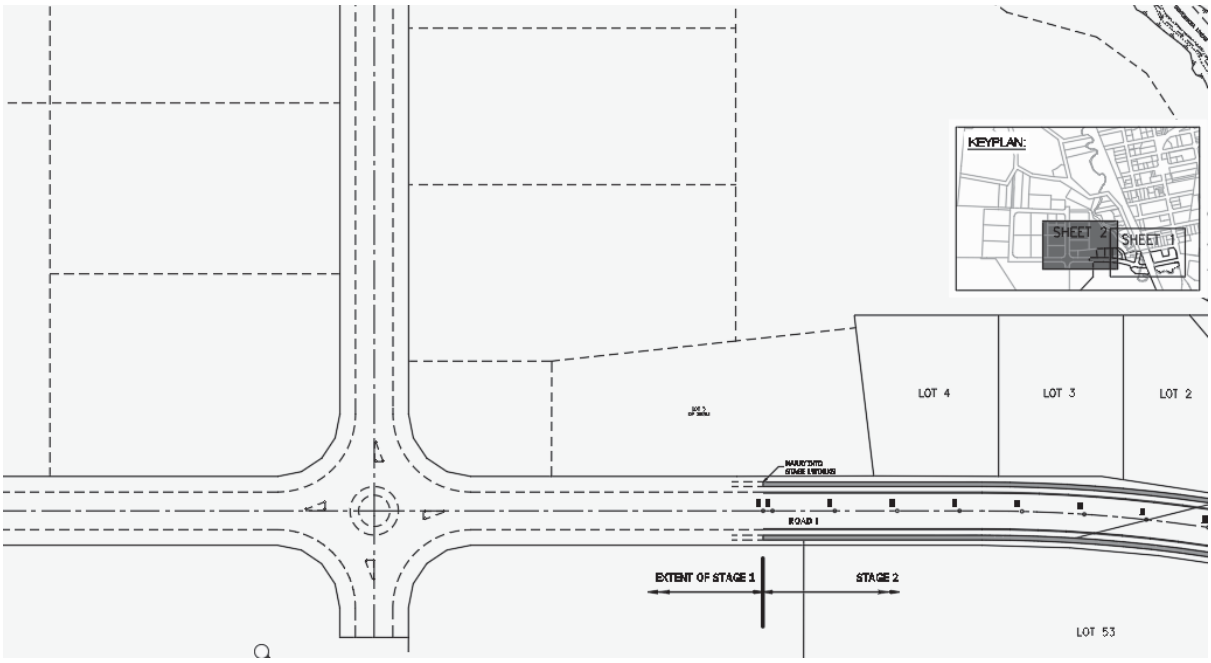
=	5.6	m^3/s
% of required capacity	103%	
Capacity	ADEQUATE	
Velocity Check V=Q/A =	2.07	
V*d	0.21	m/s
Pedestrian Safety Check V*d<0.4 =	OK	
Vehicle Safety Check V*d<0.6 =	OK	

McDonald Road Overland Flowpath Calculation

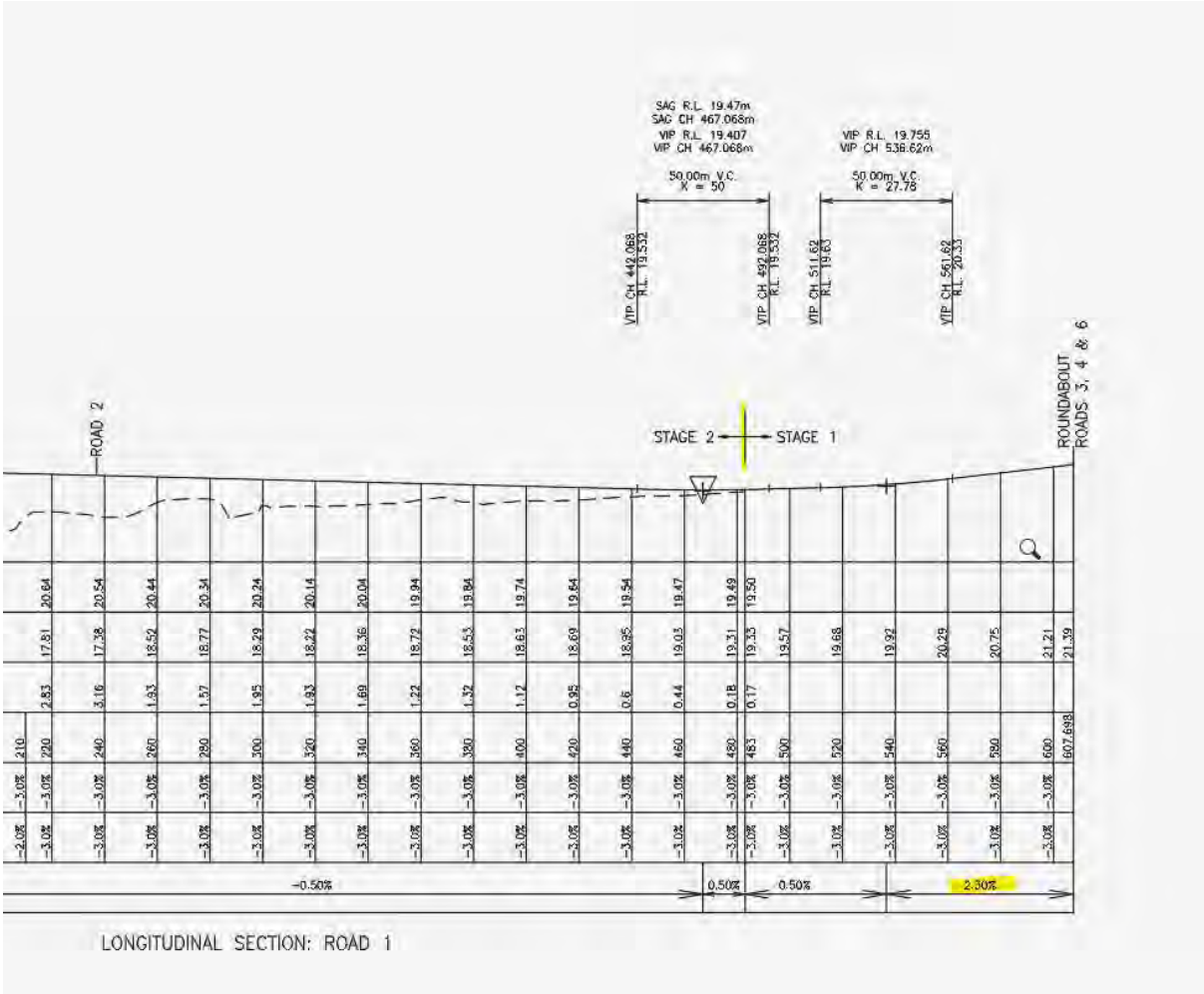
Upstream catchment = 37.71ha, pasture (C=0.3)



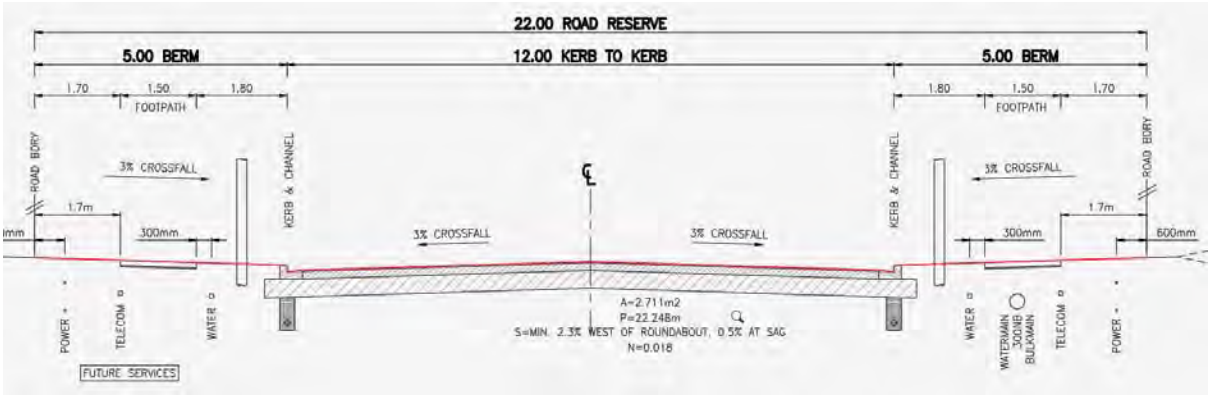
McDonald Road adjacent to Synalit (west of roundabout) is Road 1 Stage 1



Gradient is minimum of 2.3%. Approaching sag at Stage 1/2 boundary is 0.5%, and spills into Hynds land where Pipeline A picks up flow from McDonald road.



Road cross section for calculation:



Overland flowpath site photos from HVL to Tanitewhiora Stream - 2 May 2021

Photo 1 – Looking south. Synlait Channel to inlet piped under Synlait site to ditch in Synlait site parallel to McDonald Road. HVL to the right.

Photo 2 – Photo taken looking east to McDonald Road. In the case of all pipes and inlets blocked, the Synlait channel in Photo 1 would overtop and overland flow would travel in direction of arrow on Synlait site.

Photo 3 - overland flow would travel in direction of arrows on Synlait site, entering McDonald Road or in events larger than Q100 (or for flows from Synlait land itself), into the ditch on Synlait land.

Photo 4 - overland flow would travel in direction of arrows on Synlait site, entering McDonald Road or in events larger than Q100 (or for flows from Synlait land itself), into the ditch on Synlait land.

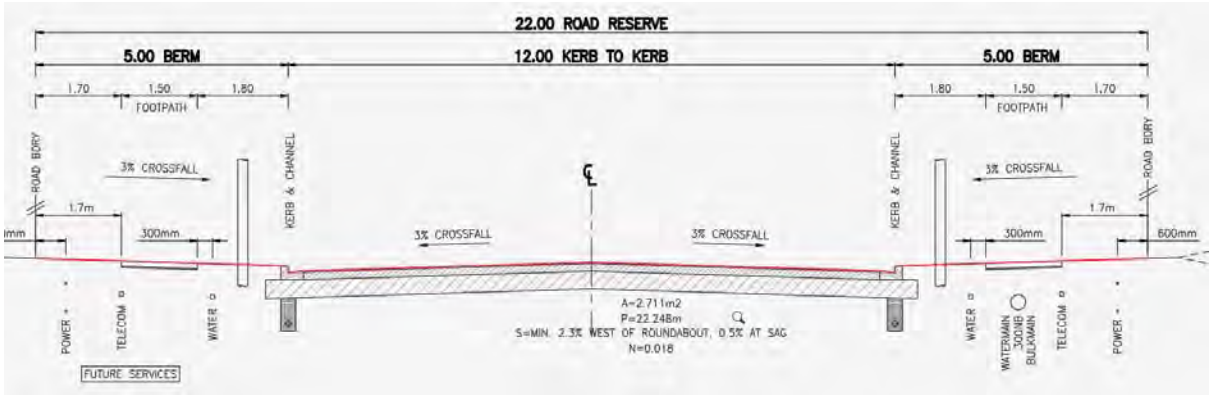


Photo 5 - overland flow down McDonald Road. Road cross section is shown, with a Q capacity of 5.6m3/s (without considering ponds or ditches). Q100 from HVL land is 5.5m3/s so all flow can pass down road without the need for ditches and ponds. The ditches and ponds provide additional storage for the catchment but are not required to pass HVL pre development flows.

Photo 6 – overland flow enters Hynds site at the road sag.

Photo 7 – overland flow from McDonald Road enters the partially complete DN1350 Pipeline A at the road sag/low point

Photo 8 – overland flow discharges to the Tanitewhiora Stream. Completed McDonald Road culvert to the right.