From: Philip Barrett
Sent: 18 Oct 2019 16:42:51 +1300
To: Cameron Aplin
Subject: Singleton Subdivision Revised Flood report
Attachments: S92 Amended Final Report-August2019- Culvert flooding scenario.pdf, M13246 Scheme Plan 18.10.2019.pdf

Hi Cam,

I have attached the updated Flood Hazard report with addendum in reply to the s92 request. This goes hand in hand with the SW Mgt report that will be ready Monday. I will send the SW Mgt Plan soon as it is received. I assume beca will want to see both the updated flood analysis and SW mgt plan together.

I have attached an updated subdivision Sheet 1 as well that was amend to support the SW Mgt Plan.

Kind Regards

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land & engineering surveyors

GOLOVIN

FLOODPLAIN ANALYSIS

635 Whatawhata Road, Hamilton

August 2019

Graham and Sharon Singleton

Prepared by Dr Steven Joynes

FLOOD LEVEL ANALYSIS

Contents

Person assigned to manage the Project & Report

Name Dr Steven Joynes

Organisation **GOLOVIN**

Distribution List

Name	Project Designation	Organisation
Dr Steven Joynes	Modeller	Golovin
Graham & Sharon Singleton	Client	
Bernard Brown	Environmental Planner	Bernard Brown & Associates

Revisions

Version	Date	Comment
1	May 2017	Original
2	October 2018	Typographical amendments
3	This report	Addendum added concerning culvert blockage

Prepared by

Dr Steven Joynes

1 INTRODUCTION

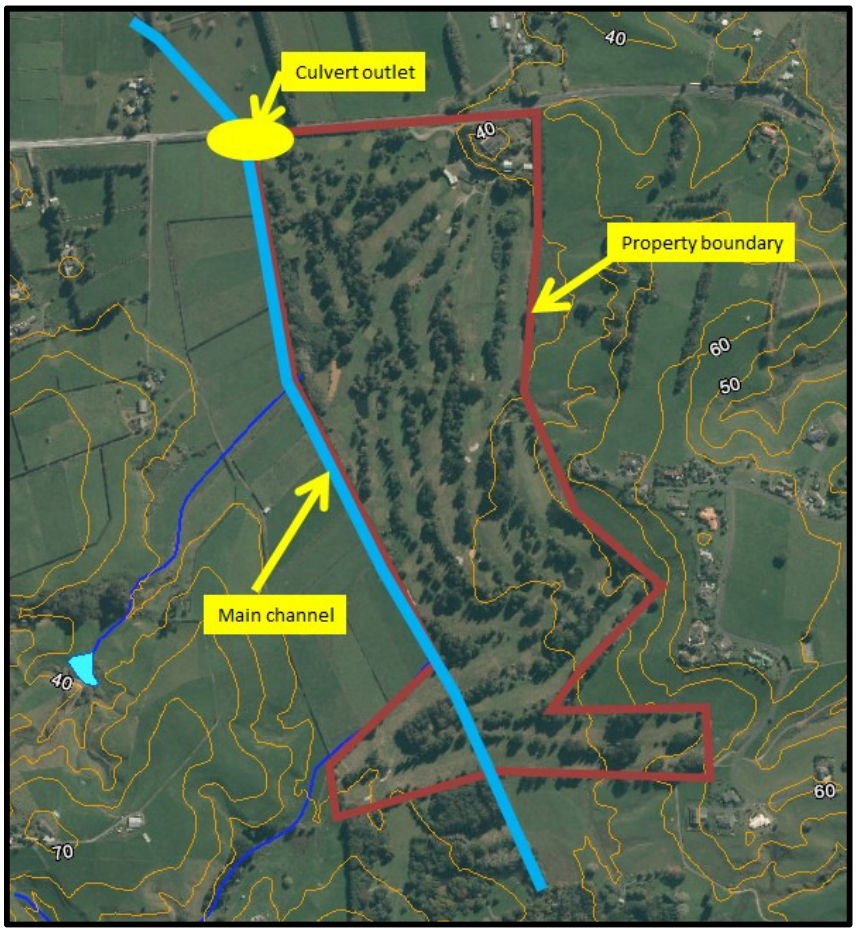
1.1 Statement of Issues

The client wishes build a number of dwellings on the former golf course. The land is prone to flooding due to its location and has a history of low-level ponding. The land is part of the catchment of Ohote Stream that is the eventual tributary of the Waipa River. It legal description is LOTS 1 2 DPS 12627 BLK I HAMILTON SD and measures just over 45 ha.

The flood levels need to be understood because the property has a number of potential house sites available. This report will determine minimum floor levels.

Figure 1.1 shows the property boundary. It also shows the main drainage route on the western boundary and the outlet location underneath the State Highway.

Figure 1.1 – Property location



1.2 Proposed Strategy

The large catchment creates a reasonable sized floodplain. The hydrology will be calculated using the methodology required by Hamilton City Council. A hydraulic model will be used to calculate the floodplain levels based on LiDAR contours available and some site specific measurements. The 100-year storm will be analysed.

1.3 Target audience

The quality, quantity and tenure of the report should consider the following audience.

a) Waikato Regional Council engineering staff,
b) Waikato District Council engineering staff.

1.4 Previous Study

There is no known flood study of the catchment.

1.5 Previous flooding

The severe storm in April 2017 flooded the lower parts of the property at the culvert. Video evidence showed the peak flood level reached RL23m, about 1m above the invert of the culvert. The extent of flooding suggested no greater flood level than RL23.2m in the flooded area upstream of the culvert. The Waingaro rainfall gauge suggested a 20-year return period for a 12 hour storm. Therefore a 100-year flood level would be in the vicinity of RL24m and not overtop the road.

1.6 Sources of data

Table 1.1 – Source of Data

Attribute	**Organisation**
Catchment plans & contours	Waikato Regional Council Maps
Cross-section extraction	LiDAR plots from McCracken Surveys Ltd
Flow & WL data	none

1.7 Reference Technical Documents

- Hamilton City Council Infrastructure Technical Specifications.

Document Set ID: 2509686
Version: 1, Version Date: 21/02/2020

2 HYDROLOGY

2.1 Methodology

The analysis is storage driven due to the impedance of the culvert at the outlet. Therefore it is important to do a dynamic analysis of the system, not a steady-state peak flow analysis. The analysis was done using the following steps:

1. Delineate the catchment.
2. Use HEC-HMS to generate flow hydrographs.
3. Model peak flood levels using HEC-RAS

2.2 Rainfall Data

The rainfall depth is prescribed in the HCC IFS. The 100-year development scenario is given in Table 4-9 of that manual. The total rain depth is 169.9mm.

2.3 Catchment Size

The catchment has been broken into four subcatchments which allows for the gradual input of flows. The areas are given in Figure 2.1.

Figure 2.1 – Catchment boundaries and areas

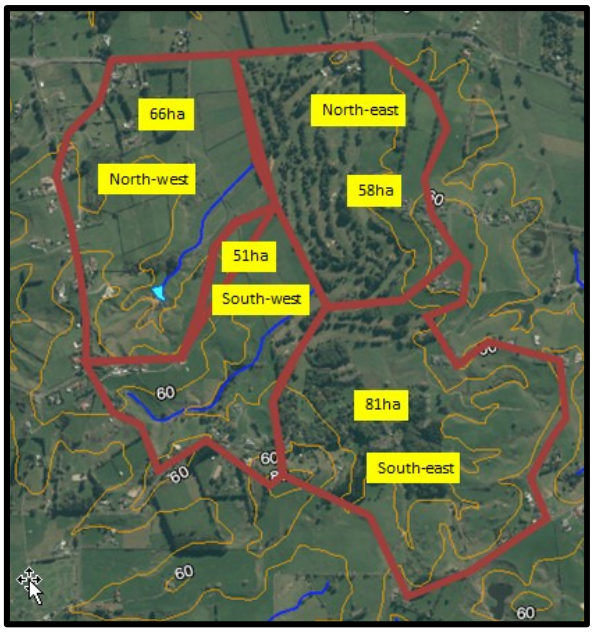


Table 2.1 gives data and calculation of the subcatchment time of concentrations using the Ramser-Kirpich method. They were all rounded up to a minimum of 20 minutes.

Table 2.1 – Time of concentrations

	North-west	**North-east**	**South-west**	**South-east**
Length (m)	1343	832	1225	1080
H (m)	47	37	57	57
Slope %	3.5	4.4	4.7	5.3
Tc	**18**	**11**	**15**	**13**

2.4 HEC-HMS modelling

A HEC-HMS model was built to generate hydrographs. Figure 2.2 shows the simple layout and the rainfall hyetograph. Figure 2.3 shows the run-off hydrograph for the north-west subcatchment. Table 2.2 gives the peak flows.

Figure 2.2 – HEC-HMS Model

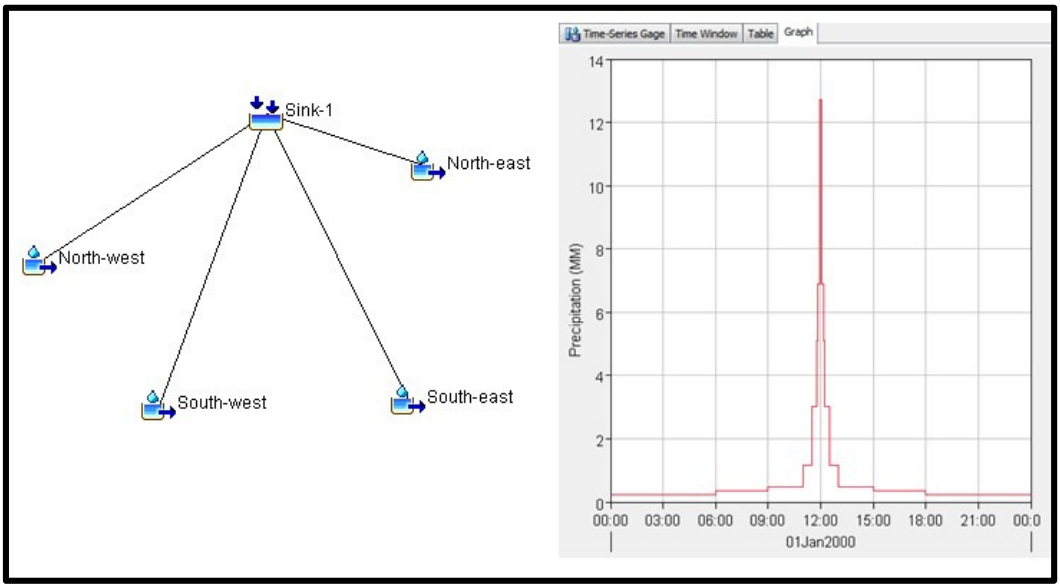


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Figure 2.3 – Flow hydrograph, 100-year storm for north-west subcatchment

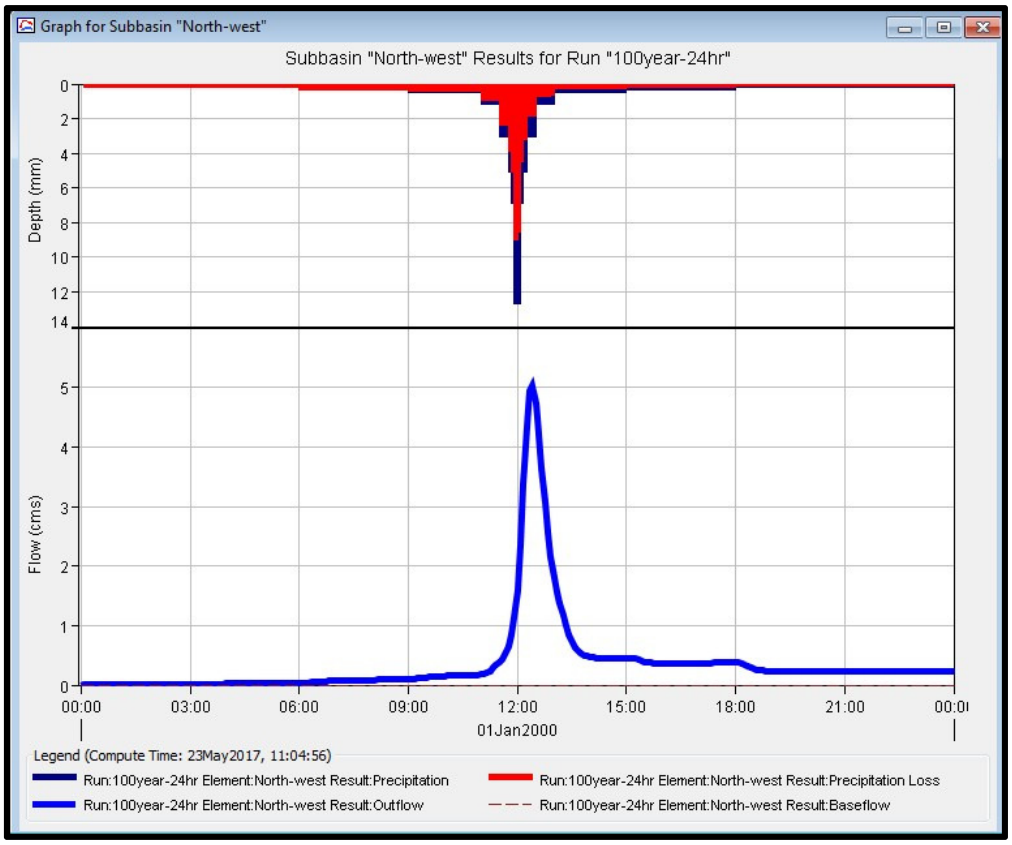


Table 2.2 – Peak flows for 24-hour, 100-year storm

	North-west	**North-east**	**South-west**	**South-east**
Q (m^3/s)	5.0	4.4	3.9	6.2

In theory, without impedance, the peak flow at the outlet will be about 19.5m^3/s. These four hydrographs can be applied to the hydraulic model.

3 HYDRAULIC ANALYSIS

3.1 Model Layout

HEC-RAS software was used to generate flood levels. The setup is shown in Figure 3.1. The cross-sections have been extrapolated from the LiDAR 0.5m contours. The cross-sections were specific chosen to reflect restrictions in flows between contours and the structures. A 1m deep 1m wide drain was added for the whole length. The culvert under the State Highway is 1.5m square at an invert of RL22m. The floodplain bed roughness has been set to Manning's n = 0.05, a compromise between a good flowing main channel, shrubs on the edge of the stream and open grass paddocks.

Figure 3.1 – HEC-RAS model set up

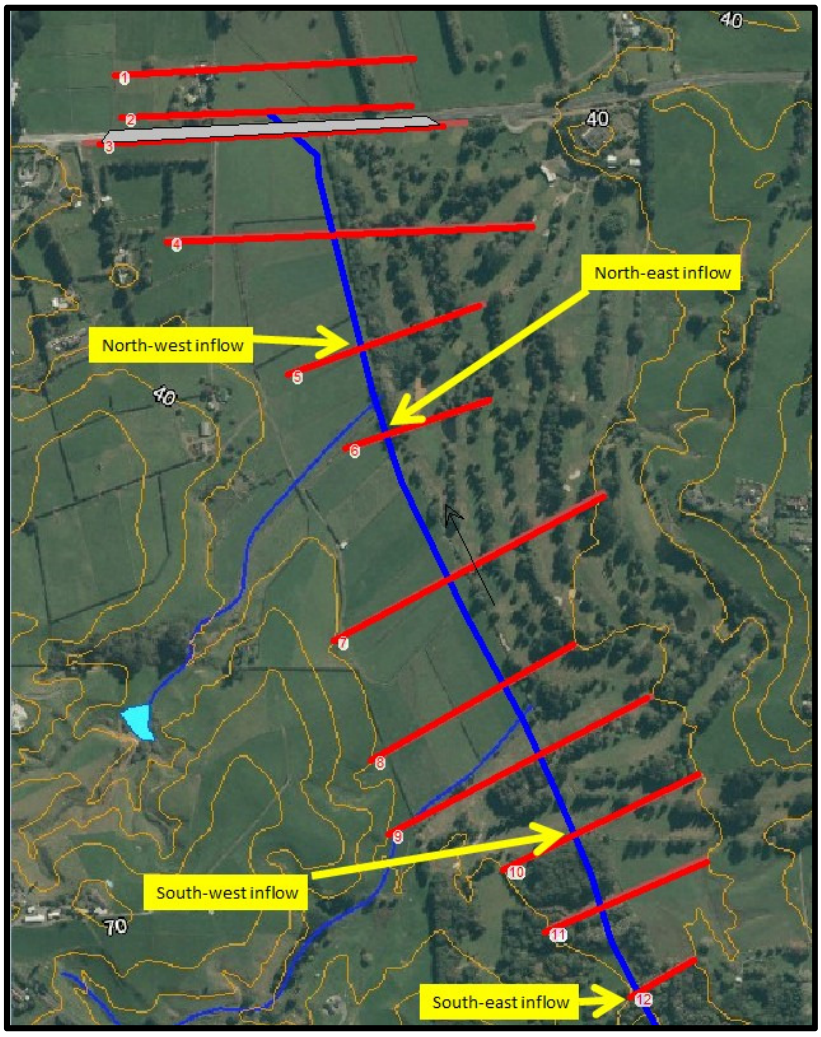
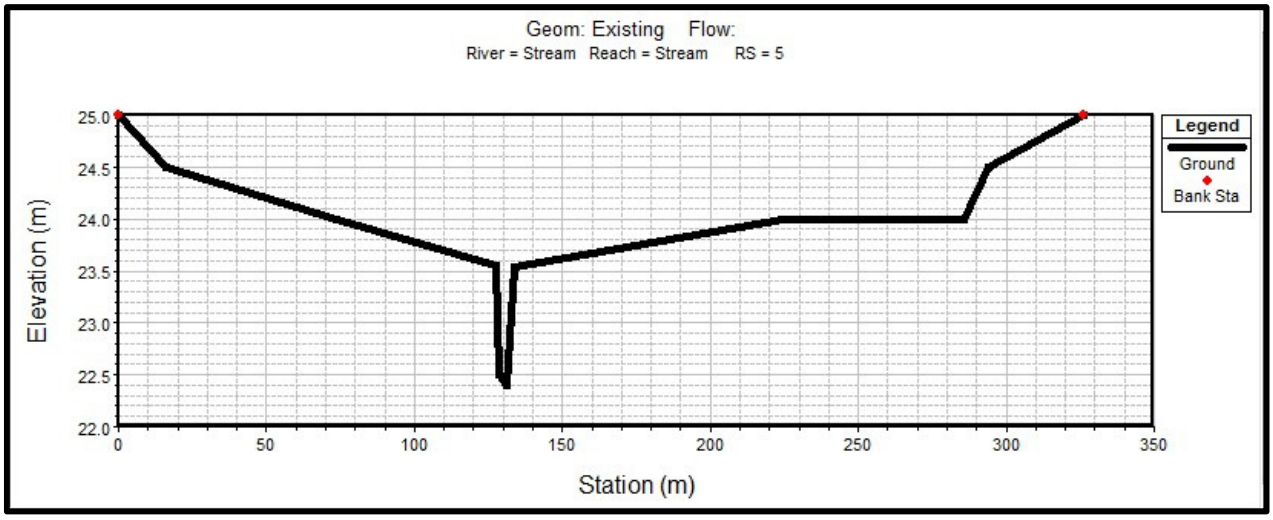


Figure 3.2 shows the cross-section at RS5 at the point of inflow for the north-west subcatchment.

Figure 3.2 – Cross-section RS5



3.2 Downstream boundary control

The downstream boundary is a wide open floodplain if relatively unrestricted flows. Instead of using a fixed boundary a normal flow boundary was used. This had a grade of 0.1%.

3.3 Floodplain profile

Figure 3.3 shows the hydraulic grade-line for the whole reach. There is a uniform flow until RS5 where the effect of the culvert creates a flat hydraulic grade. The peak level at the culvert is RL24.0m. This is close to that predicted based on the April 2017 storm.

Figure 3.4 shows the flow and water level hydrographs of RS5 and RS3. RS5 was chosen because it represents the highest flows where all subcatchments are contributing. RS3 is just upstream of the culvert. It is shown that the culvert reduces the floodplain flow (green-dashed line) from about 11m^3/s to 4m^3/s. The duration of the flows are affected as well with the culvert discharging over a good 12 hours compared to just 1-2 hours upstream. All this is expected due to the attenuation of the floodwaters.

Figure 3.3 – Hydraulic grade-line for the 100- and 10-year flows

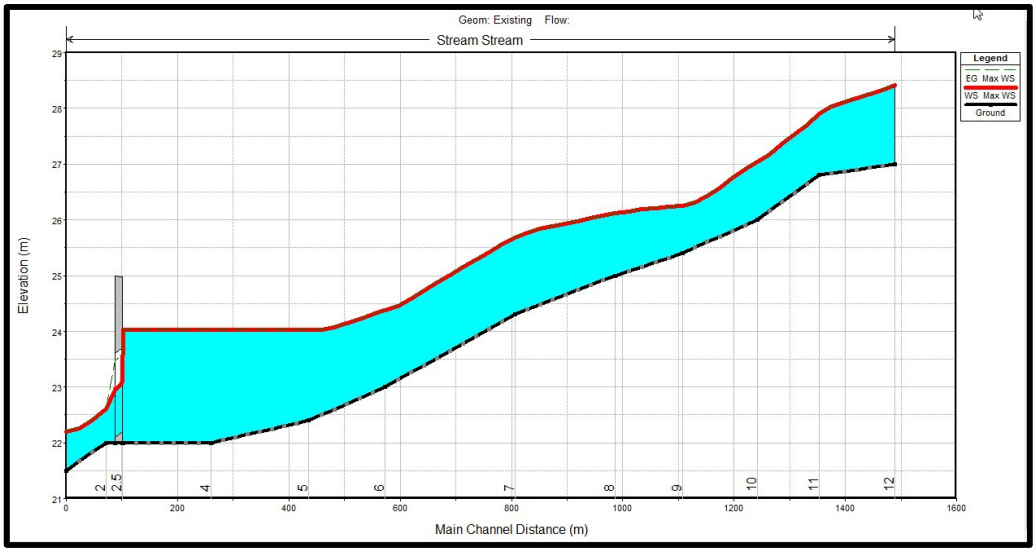
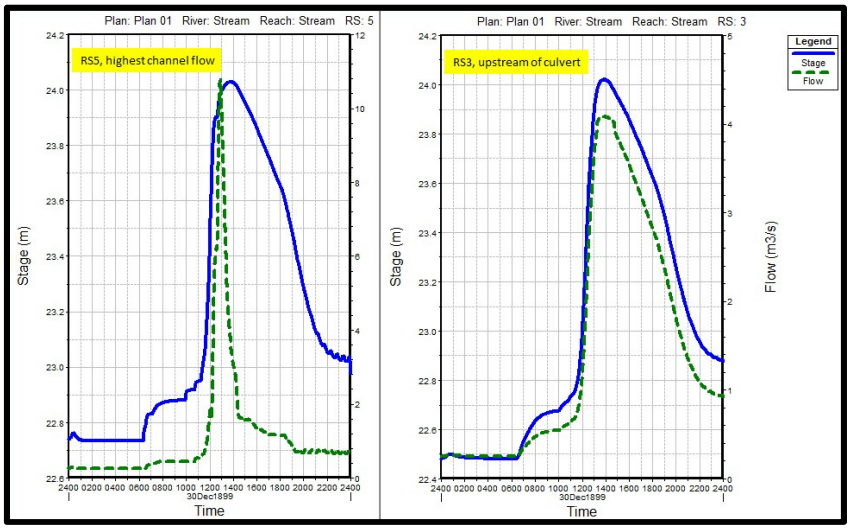


Figure 3.4 – Hydraulic grade-line for the 100- and 10-year flows



3.4 Floodplain and finished floor levels

Figure 3.5 overlays the estimated floodplain onto the aerial photograph. The 100-year flood level is given at each of the modelled cross-sections where a building site is proposed. Additionally the lettered orange labels show the approximate building site locations. *It should be noted the edge of the floodplain is indicative to create an impression only. It is only for the client's property. The proposed building sites are approximate based on a concept plan by Bernard Brown Associates.* Table 3.1 summarises the details required for the building sites. It is clear that sites A, C and G need to be surveyed in. The others appear to be well above floodplain.

Figure 3.5 – Floodplain, flood levels and building site locations

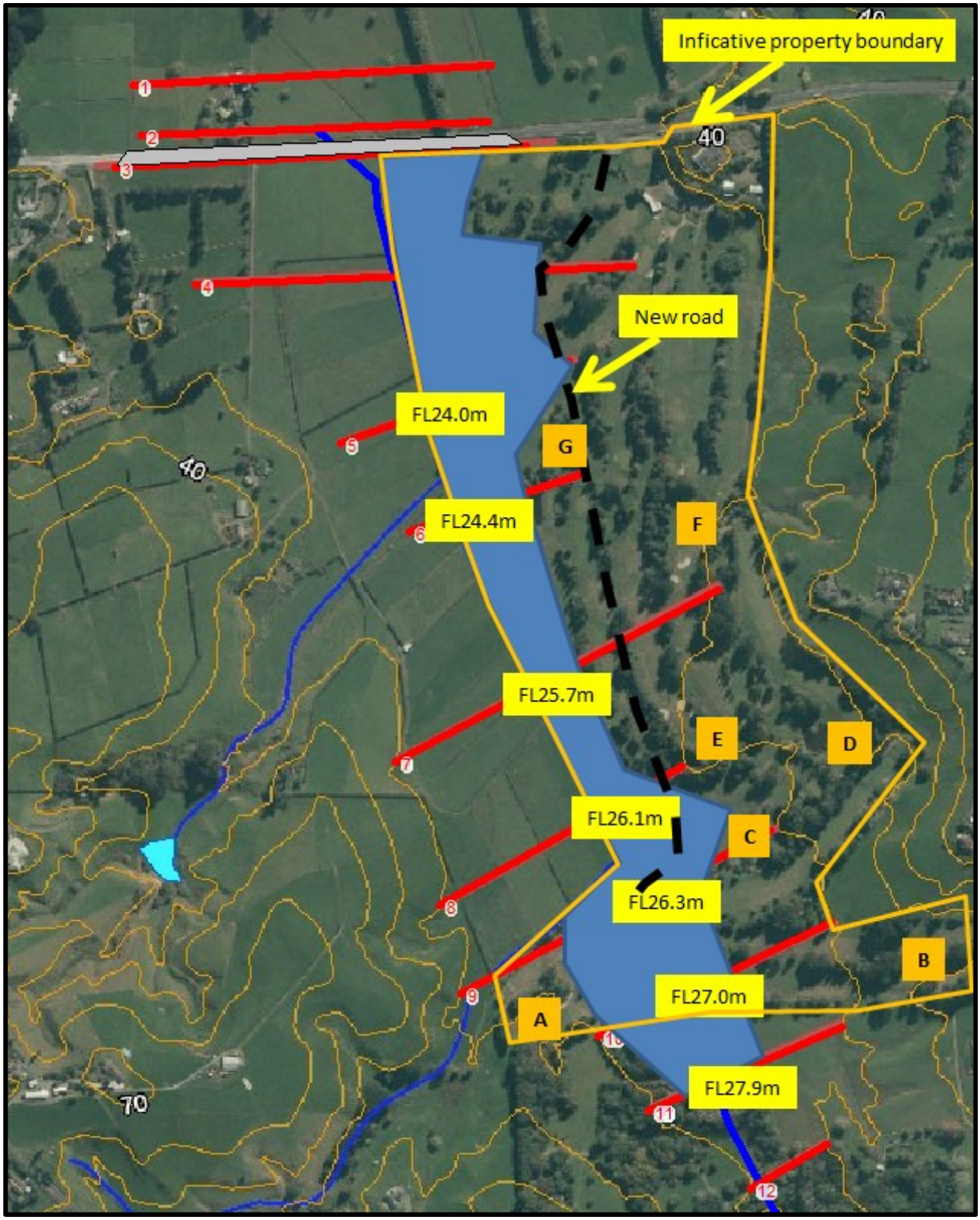


Table 3.1 – Minimum finished floor levels

Site	Estimated flood level RL(m)	Minimum finished floor level RL(m)	Estimated ground level RL(m)	Comment
A	26.6	27.1	27.0	Survey check
B	27.5	28.0	34.0	Well away from floodplain
C	26.3	26.8	28.0	Survey check
D	26.2	26.7	35.0	Well away from floodplain
E	26.1	26.6	32.0	Well away from floodplain
F	25.0	25.5	29.0	Well away from floodplain
G	24.3	24.8	24.0	Survey check

4 SUMMARY

Flood modelling has been undertaken to calculate the 100-year flood levels for the whole property along the drainage channel.

Utilising HEC-HMS, four hydrographs were generated and input into a hydraulic model. The model included the state highway culvert which attenuated the flows from 11m^3/s to 4m^3/s.

The ponded level at the culvert was close to that estimated based on the experience of the 20-year flood in April 2017.

Table 3.1 provides details of finished floor levels for each of the proposed building sites.

5 ADDENDUM

This addendum was added. It based on a Section 32 request from Waikato District Council. It reads

Steven to consider
3(b) above - Specifically we need to understand the flooding effect of the culvert under the road being blocked, however unlikely, on the proposed building platforms. What would the wastewater field levels look like now and any change should the culvert block. I have attached the latest signed plans that show RL levels of building platforms suggested in your report to be confirmed. Please review and revise your report.

There are 3 items within this statement

1. Effect of culvert blockage
2. New building platforms and/or locations
3. The wastewater fields locations based on flood levels

5.1 Effect of culvert blockage

The Council have no criteria of blockage when examining flood risk. The two references to determine blockage are The Auckland Council's *COP for Land and Subdivision – Stormwater Chapter 4, Version 2.0*. It states

g) A secondary flow path shall be kept unobstructed at all times. The secondary flow path design shall assume the total blockage of the culvert in cases where it is less than 1500mm in diameter, and 50% blockage of the culvert where it is greater than or equal to 1500mm in diameter.

The Australian Rainfall and Run-off (ARR Project11 Stage3 Blockage guidelines February 2015) has a more detailed analysis based on a number of risk factors. The risk is Low based on a low-low-low criteria for

Debris Availability
Well maintained rural lands and paddocks with minimal outbuildings or stored materials in

the source area.

1. Streams with moderate to flat slopes and stable bed and banks.
2. Arid areas where vegetation is deep rooted and soils are resistant to scour.
3. Urban areas that are well maintained with limited debris present in the source area

Debris Mobility

1. Low rainfall intensities and large, flat source areas.
2. Receiving streams infrequently overtops their banks.
3. Main debris source areas well away from streams

Debris Transportability

1. Flat bed slopes (< 1%).and/or low stream velocity (V<1m/sec)
2. Shallow depth relative to vertical debris dimension (D < 0.5L10)
3. Narrow stream relative to horizontal debris dimension (W<L10)
4. Stream meanders with frequent constrictions/snag points.
5. Low temporal variability in maximum stream flows

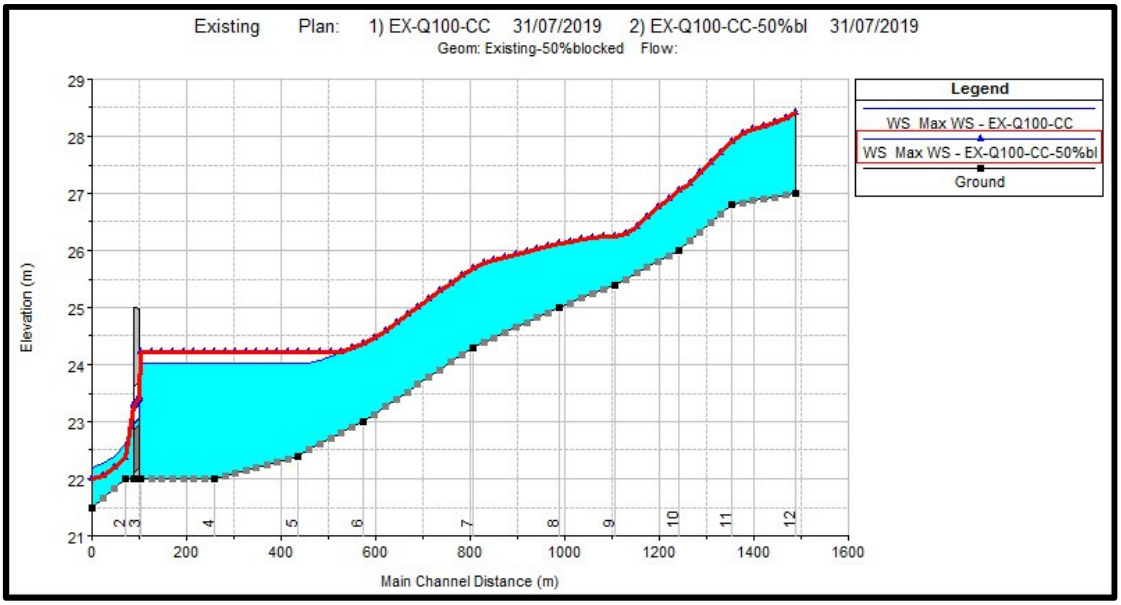
The analysis indicates that for a 100-year event the blockage for the inlet and sediment is 0%.

Therefore taking the worst-case of the two methods the 1.5m square culvert is an equivalent 1.7m barrel and the Auckland method might suggest 50% blockage.

The hydraulic model was re-run with the 100-year storm and the bottom 0.75m of the culvert blocked.

Figure 5.1 shows the hydraulic profiles along the reach comparing the non-blocked and 50% blocked. The 50% blockage effects cross-sections up to RS6. The increase in water level at the culvert is 0.2m. The flow is decreased from 4.1m^3/s to 1.6m^3/s.an almost 61% capacity loss.

Figure 5.1 – Hydraulic grade-line comparing a 50% blockage



5.2 Minimum finished floor levels

Table 5.1 gives the minimum finished floor levels and have been adjusted when the culvert blockage impacts flood levels. Based on the estimated ground levels the new dwellings are above the freeboard requirement of 500mm even when the culvert is 50% blocked.

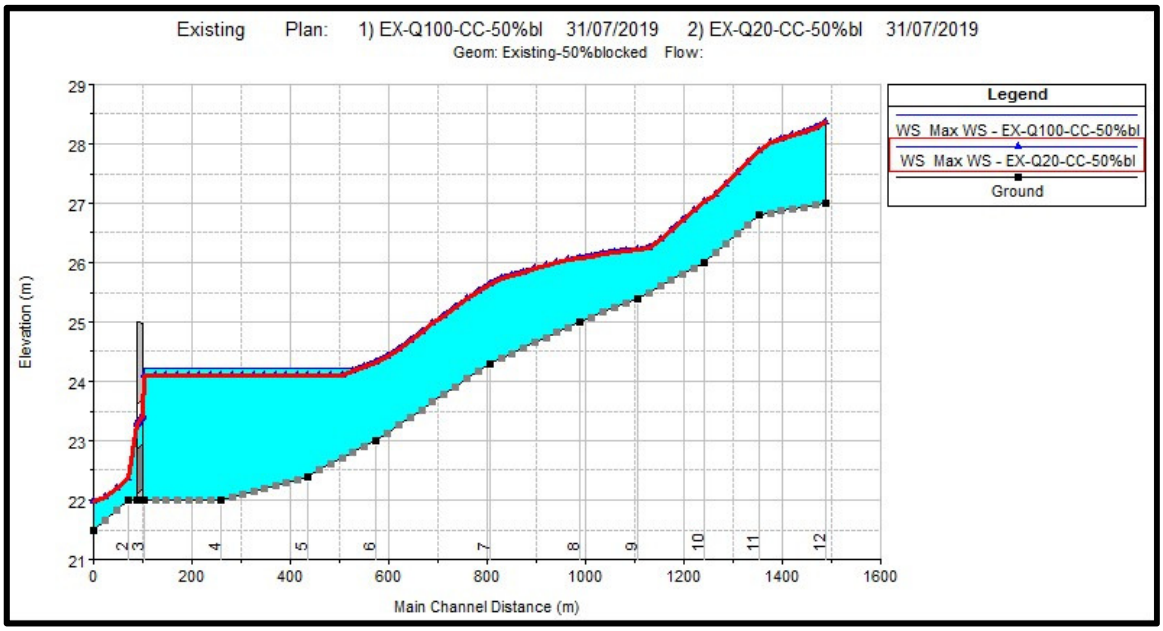
Table 5.1 – Minimum finished floor levels

Lot number	Former site number	Model RS	Estimated flood level RL(m)	Minimum finished floor level RL(m)	Estimated ground level RL(m)
1	G	6	24.4	24.9	24
2	F	7	25.7	26.2	29
3	E	8	26.1	26.6	32
4	New	7	25.7	26.2	30
5	C	9	26.3	26.8	28
6	B	11	27.9	28.4	34
7	A	9	26.3	26.8	27
8	New	4	24.2	24.5	40
9	New	4	24.2	24.5	28
10	D	8 & 9	26.2	26.7	35

5.3 Wastewater fields

The Council provide no guidance on wastewater field flood level thresholds. Auckland Council require all wastewater fields to be above the 20-year flows. Figure 5.2 compares the 100-year and 20-year flows when the culvert is 50% blocked. There is a small drop of 100-200mm at the various locations. This low value is due to the wide nature of the floodplain. Therefore the wastewater field levels should be based on the flood levels in Table 5.1 at each Lot.

Figure 5.2 – Comparison of 100-year and 20-year storms , 50% culvert blockage



5.4 Addendum Summary

The 50% culvert blockage scenario was tested. The blockage caused the water level to rise by about 200mm up to 500m upstream. This does not affect the Lot designation. The minimum floor level designations were checked and re-tabulated. The wastewater field location and levels can be based on the 100-year storm results as there is minimal difference to the 20-year storm.

M13246

Proposed Easements

Purpose	Shown	Burdened Land	Benefitted Land
Right of way & Right to convey Water, Electricity, Gas, Computer Media & Telecommunications & right to Drain Water & Sewage.	A	Lot 10 hereon	Lots 1 to 7 hereon
	B	Lot 10 hereon	Lots 3 to 7 hereon
	C	Lot 10 hereon	Lots 5 to 7 hereon
	D	Lot 10 hereon	Lot 6 hereon
	E	Lot 10 hereon	Lots 3 hereon
Right to convey Water	F	Lot 2 hereon	Lot 10 hereon
Right to covey Electricity	G	Lot 8 hereon	Lots 9 & 10 hereon

Key
P - Pond

Area within which buildings/structure dwellings can be constructed.

100-year Flooding Level

50% Culvert Blockage

Contours - Waikato Regional LIDAR Service 2007 (WRLS 2007). LIDAR data sourced from Environment Waikato . COPYRIGHT RESERVED.

Contour Interval
Major Contour = 5m
Minor Contour = 0.5m

Aerial Photo is collected in February 2018.

Note: The Building Envelope within the land shown is all the land excluding the building setbacks specified in the Waikato District Plan.

Note: Areas & dimensions are subject to survey.

Zone:	Rural Zone
Total Area:	45.6686 Ha.
Comprised in:	SA10B/683 & SA10B/682
Registered Owner(s):	G. & S. Singleton Heritage Ltd.

I, David Vernon McCracken,
Registered Professional Surveyor, do hereby certify that this plan has been prepared by me for a Resource Consent under the provisions of the Resource Management Act 1991 and should not be used for any other purpose.

Registered Professional Surveyor _____ Date _____

Amendments

No	Activity	Date
1	Amend 100-year Flooding Line	02/10/2019
	& 50% Culvert Blockage Extent	

cheal

McCRACKENSURVEYS 2002
land & engineering surveyors

Proposed Subdivision of Lots 1 & 2 DPS 12627
635 Whatawhata Road, Dinsdale.

Prepared for: G. & S. Singleton Heritage Ltd.			Sheet 1
Drawn HC	Checked	Scales	Series of 8
Traced	Date Sep. 2019	1:4000 A2	File Ref M13246