STORMWATER MODELLING REPORT

FOR

PROPOSED WARKWORTH SOUTH PLAN CHANGE AREA



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- A 100 YEAR FLOW HYDROGRAPH
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- C PRELIMINARY PRE & POST DEVELOPMENT FLOOD EXTENT PLAN
- D TP 108 CALCULATIONS AND TIME OF CONCENTRATION CALCLATIONS
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1 INTRODUCTION

1.1 PROJECT

Maven Associates have been engaged to assist in the development of a plan change application including determining setting baseline scenarios for predevelopment scenarios in various storm events and assessing the effects of development specific to the proposed plan change area (PCA) at 1711 & 1723 State Highway 1, Warkworth. Figure 1.1 shows the study area.

The objective of this report is to provide a preliminary analysis of the overland flowpaths in terms of peak flows and water level constraints. This will enable the assessment of mitigation measures required to ensure the proposal does not result in any adverse effect on the downstream properties. The analysis will be for a range of annual return period storms and include rainfall increases due to climate change.



Figure 1.1 – Catchment Delineation



1.2 PREVIOUS STUDY

A Rapid Flood Hazard Assessment was undertaken by DHI in 2009. This was done on a 10m grid. This assessment did not include either climate change or land development changes.

1.3 PROPOSED STRATEGY

A 2D model will be used in the area around the Scheme Plan boundary. This will enable the identification of all overland flowpaths. The upper catchment area will be modelled as individual catchments to provide boundary inflows. All analyses will be done using TP108, HEC-HMS and HEC-RAS in accordance with guidelines of the Auckland Council Stormwater Code of Practice.

1.4 SCENARIOS MODELLED

Table 1.1 shows the scenarios modelled. Scenarios will indicate the difference between today's existing flow environment and the future.

Scenario	Return period	Land-use	Rainfall
1	100-year	Existing	Existing - historical
2	100-year	Existing	Climate change
3	100-year	Developed	Climate change
4	50-year	Developed	Climate change
5	20-year	Developed	Climate change
7	10-year	Developed	Climate change

Table 1.1 – Scenarios modelled

1.5 SOURCES OF DATA

Attribute	Organisation
Catchment Plans	Auckland Council Geomaps
Contours	LINZ DEM 1m. The Terrain datum is New Zealand Vertical Datum. LiDAR/Site Survey by Parrallax Ltd. LiDAR/Site Survey by Maven Associates.
Flow & WL data	Healthywaters
Flood level evidence	None

Table 1.2 – Source of Data



1.6 REFERENCE TECHNICAL DOCUMENTS

- AUCKLAND COUNCIL CODE OF PRACTICE FOR LAND DEVELOPMENT AND SUBDIVISION. CHAPTER4 STORMWATER, VERSION 3.00
- ACCEPTABLE SOLUTIONS AND VERIFIABLE METHODS, DOCUMENT E1 SURFACE WATER, MINISTRYOF BUSINESS, INNOVATION AND EMPLOYMENT,
- AUCKLAND COUNCIL TP108



2 HYDROLOGICAL MODELLING WITH HEC-HMS

2.1 METHODOLOGY

The analysis was done using the following steps:

- 1. Delineate the catchments,
- 2. Use Tp108 to calculate parameters,
- 3. Use HEC-HMS to create a rainfall hyetograph and flow hydrographs,

2.2 RAINFALL DATA

TP108 gives the following rainfall depths which are then adjusted for climate change as shown in Table 2.2. Climate change factor have been applied in accordance with Auckland Council code of practice (Version 3) assuming a 2.1°C increase in temperature as shown below;

Annual Exceedance probability exceedance	Percentage Increase in 24-hour design rainfall depth due to future climate change*
50%	9.0%
10%	13.2%
5%	15.1%
2%	16.8%
1%	16.8%

* Assuming 2.1°C increase in temperature

Table 2.1 - Climate change factors

In accordance with TP108 section 2.3 an areal reduction factor (ARF) has been applies as the catchment has an area above 10 km2. ARF adjusted rainfalls are also shown in table 2.2. An ARF factor of 0.92 was used per TP108 table 2.2.

	TP108	Climate change	ARF adjusted
2-year	112	122	112
10-year	170	192	176
20-year	208	239	220
50-year	238	278	256
100-year	270	315	290

Table 2.2 – Rain depths



2.3 CATCHMENT SIZE

Figure 2.1 shows the catchment area modelled. Naming conventions of the subcatchments have been split between upstream and downstream of the PCA. The upper catchments are named upstream A to F and downstream catchments, downstream A to H. The yellow area (including the red boundary) is the 2D grid with the excess *Rain*. The catchment outflow of the Mahurangi River is at the northern edge. The Scheme Plan boundary is blue. The total area is 49km².

2.4 LAND-USE AND SOILS

The soil is assumed to be Group C with a curve number of 74. The land cover for the existing scenario has been obtained via delineation of impervious areas shown on the Auckland Council GIS aerial. The land-use is predominantly Rural-production and Rural-coastal with a small area of conservation, according to the AUP, see Figure 2.2. For the proposed scenario, the MPD (maximum probable development) of the proposed zoning has been used as well as MPD for the yellow designated FutureUrban. The FutureUrban zoning included in the developed scenarios assumes an average impervious area of 60%. The combined curve numbers and initial abstractions have been calculated according to TP108 and may be found in appendix D based on existing and developed land-use. Only catchments *Rain* and upstream catchment *F* will have a change in impervious area.

The full TP108 details to calculate the peak flows and times of concentration may be found in Appendix D. The total catchment area and the time of concentration suggests an area reduction factor of 0.92. This has been applied to the rainfall as per Table 2.2. This data can now be inserted into a HEC-HMS model.





Figure 2.1 – Catchment Boundary





		Upstream of PCA					Downstream of PCA									
	Impervious %	Rain	Α	В	С	D	E	F	Α	В	С	D	E	F	G	Н
Total		485	334	412	292	510	573	304	585	849	24	284	72	22	128	49
Rural / Vegetated area	1%	471	331	405	291	481	572	302	581	845	12	276	27	22	15	10
Urban MPD	60%	0	0	0	0	0	0	0	0	0	12	5	0	0	113	39
Open Space - Conservation	1%	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transort Corridor	90%	13	3	7	1	0	0	2	4	4	0	3	0	0	0	0
Residential - Large Lot	35%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Single House	60%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Mixed Housing Urban	60%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Terrace & Apartment	70%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Business - Local Centre Zone	100%	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0
Impervious		16.42	6.01	10.35	3.81	4.81	5.72	4.82	9.41	12.05	7.32	8.46	45.27	0.22	67.71	23.60
Pervious		468.91	327.76	401.82	287.75	505.27	567.57	299.11	575.13	836.71	16.25	275.40	26.88	21.57	59.89	25.57

Figure 2.3 – Existing land use calculations



	Upstream of PCA					Downstream of PCA										
	Impervious %	Rain	Α	В	С	D	E	F	Α	В	С	D	E	F	G	Η
Total		485	334	412	292	510	573	304	585	849	24	284	72	22	128	49
Rural / Vegetated area	1%	51	331	405	291	481	572	285	581	845	12	276	27	22	15	10
Urban MPD to	60%	276	0	0	0	0	0	17	0	0	12	5	0	0	113	39
Open Space - Conservation	1%	5.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transort Corridor	90%	13.0	3	7	1	0	0	2	4	4	0	3	0	0	0	0
Residential - Large Lot	35%	13.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Single House	60%	22.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Mixed Housing Urban	60%	74.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential - Terrace & Apartment	70%	25.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Business - Local Centre Zone	100%	3.4	0	0	0	0	0	0	0	0	0	0	45	0	0	0
Impervious		261.76	6.01	10.35	3.81	4.81	5.72	15.10	9.41	12.05	7.32	8.46	45.27	0.22	67.71	23.60
Pervious		223.57	327.76	401.82	287.75	505.27	567.57	288.83	575.13	836.71	16.25	275.40	26.88	21.57	59.89	25.57

Figure 2.4 – Developed land use calculations

2.5 HEC-HMS MODEL

The data was then transferred to HEC-HMS. Figure 2.5 shows the model set-up. Calculations for the time of concentration of the reaches may be found in Appendix D. The reaches between junctions have been incorporated respectively to **det** the time it would take to arrive at the downstream connection.



Figure 2.5 – HEC-HMS model set-up







Figure 2.6 – Rainfall excess, 100-year, climate change, developed



Figure 2.7 shows the hydrograph for scheme inflow for the 100-year storm with climate change rain and developed.

Figure 2.7 – Flow hydrograph, 100-year, climate change, developed



2.5.1 Effects of climate change

Figure 2.8 shows the global summary of the existing catchment flows against those that are expected to occur due to climate change and development. The scheme inflow has increased from 224m³/s to 273m³/s. Most of the 49m³/s increase is due to climate change. The volume increase is almost 0.91 million m³.

At the scheme outflow the changes are $347m^3$ /s to $421m^3$ /s. Thus, the catchment is expected to yield $74m^3$ /s, (this entire increase is due to climate change as explained in section 2.5.2). This increase is 17%. The volume increase is 1.6 million m³.



Figure 2.8 – Global summary of flows and volumes for the 100-year storm (historical rain, existing land-use vs climate change rain and existing land-use vs. historical rain, proposed land-use vs climate changed rain and developed)

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👹 Global Summary Result	s for Run "Existing-Q100-	existing 3"		- 🗆 ×						
	Project: Warkworth So	outh Simulation Run: E	xisting-Q100-existing 3							
Start of Run:01Jan2000, 00:00Basin Model:Existing Land-UseEnd of Run:02Jan2000, 00:00Meteorologic Model:100yr-existing-existing-landCompute Time:04Apr2023, 11:34:28Control Specifications:24hr (Maven)										
Show Elements: All El	ements \vee	Volume Units: 🔿 MM 🤅) 1000 M3	Sorting: Alphabetic $ \smallsetminus $						
Hydrologic	Drainage Area	Peak Discharge	Time of Peak	Volume						
Element	(KM2)	(M3/S)		(1000 M3)						
A Downstream	5.8454	55.71354	01Jan2000, 13:50	999.18175						
A Upstream	3.3380	36.86217	01Jan2000, 13:20	576.96580						
B Downstream	8.4876	91.34174	01Jan2000, 13:25	1462.51227						
B Upstream	4.1220	46.67449	01Jan2000, 13:20	715.49697						
C Downstream	0.2357	5.01350	01Jan2000, 12:25	46.24902						
C Upstream	2.9156	35.38431	01Jan2000, 13:10	506.20497						
D Downstream	2.8386	36.46248	01Jan2000, 13:00	496.99865						
D Upstream	5.1008	56.15127	01Jan2000, 13:20	878.69326						
E Downstream	0.7215	16.17126	01Jan2000, 12:25	156.27172						
E Upstream	5.7329	58.75500	01Jan2000, 13:35	982.55892						
F Downstream	0.2179	4.58160	01Jan2000, 12:20	38.57723						
F Upstream	3.0393	38.64703	01Jan2000, 13:00	529.75106						
G Downstream	1.2760	25.09295	01Jan2000, 12:30	267.38809						
H Downstream	0.4917	11.32758	01Jan2000, 12:20	101.86108						
Junction - ABE	21.2093	208.34781	01Jan2000, 13:55	3628.33498						
Junction-AB	14.3330	132.15756	01Jan2000, 14:50	2411.57944						
Junction-CD	8.0164	90.79421	01Jan2000, 13:15	1384.89822						
Junction-CD ds	46.5092	354.71174	01Jan2000, 16:05	7668.43491						
Junction-EFG	48.7246	359.38568	01Jan2000, 16:45	8008.70568						
Outlet	49.2163	360.41859	01Jan2000, 17:25	7969.16268						
Rain	4.8533	54.41783	01Jan2000, 13:20	844.55754						
Reach-1	21.2093	208.07416	01Jan2000, 14:45	3564.45241						
Reach-2	8.0164	90.70163	01Jan2000, 14:20	1353.31328						
Reach-3	8.4876	91.30646	01Jan2000, 15:00	1412.39769						
Reach-4	24.2486	224.27160	01Jan2000, 15:55	3978.68919						
Reach-5	43.4349	346.41930	01Jan2000, 16:10	7125.18723						
Reach-6	46.5092	354.68892	01Jan2000, 16:45	7546.46865						
Reach-7	48.7246	359.38568	01Jan2000, 17:25	7867.30160						
Scheme Inflow	24.2486	224.27160	01Jan2000, 14:40	4094.20347						
Scheme Outflow	43.4349	346.50079	01Jan2000, 15:30	7234.82617						



🐉 Global Summary Resu	lts for Run "Existing-Q100-	existing-CC 3"		- 0
	Project: Warkworth Sou	th Simulation Run: Ex	isting-Q100-existing-CC	3
Start of End of Comput	f Run: 01Jan2000, 00:0 Run: 02Jan2000, 00:0 te Time:04Apr2023, 11:2	0 Basin Model: 0 Meteorologic M 5:23 Control Specifi	Existing Land-Us lodel: 100yr-CC-existing cations:24hr (Maven)	e g-land-use
Show Elements: All E	elements V		J 1000 M3	Sorung: Apriabelic
Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
A Downstream	5.8454	67.89074	01Jan2000, 13:50	1220.76543
A Upstream	3.3380	44.93661	01Jan2000, 13:20	704.70863
B Downstream	8.4876	111.35746	01Jan2000, 13:25	1786.68282
B Upstream	4.1220	56.84513	01Jan2000, 13:20	873.60158
C Downstream	0.2357	6.01131	01Jan2000, 12:25	55.75929
C Upstream	2.9156	43.11220	01Jan2000, 13:10	618.28270
D Downstream	2.8386	44.41328	01Jan2000, 13:00	606.60934
D Upstream	5.1008	68.48363	01Jan2000, 13:20	1073.67741
E Downstream	0.7215	19.12037	01Jan2000, 12:25	186.00455
E Upstream	5.7329	71.63279	01Jan2000, 13:35	1200.75451
F Downstream	0.2179	5.57805	01Jan2000, 12:20	47.09980
F Upstream	3.0393	47.10883	01Jan2000, 13:00	646.89674
G Downstream	1.2760	29.80892	01Jan2000, 12:30	319.54365
H Downstream	0.4917	13.48195	01Jan2000, 12:20	121.97268
Junction - ABE	21.2093	253.81225	01Jan2000, 13:55	4433.46367
Junction-AB	14.3330	160.93311	01Jan2000, 14:45	2947.84554
Junction-CD	8.0164	110.71134	01Jan2000, 13:15	1691.96012
Junction-CD ds	46.5092	431.66357	01Jan2000, 16:05	9377.50515
Junction-EFG	48.7246	437.12556	01Jan2000, 16:45	9785.00179
Outlet	49.2163	438.34159	01Jan2000, 17:25	9738.70730
Rain	4.8533	66.26538	01Jan2000, 13:20	1030.78437
Reach-1	21.2093	253.46225	01Jan2000, 14:40	4357.48934
Reach-2	8.0164	110.56449	01Jan2000, 14:20	1654.39895
Reach-3	8.4876	111.29836	01Jan2000, 15:00	1727.08011
Reach-4	24.2486	273.06652	01Jan2000, 15:55	4866.95901
Reach-5	43.4349	421.57056	01Jan2000, 16:05	8715.13652
Reach-6	46.5092	431.59631	01Jan2000, 16:45	9232.35379
Reach-7	48.7246	437.12556	01Jan2000, 17:25	9616.73461
Scheme Inflow	24.2486	273.06652	01Jan2000, 14:40	5004.38608
Scheme Outflow	43.4349	421.69390	01Jan2000, 15:30	8845.58892



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	Proiect: Warkwort	h South Simulation Ru	n: Developed-O100	
Start of	Rup: 013202000 00:0	0 Pasia Madak	Developed Lond I	leo
End of F	Run: 01Jan2000,00:0	0 Basin Model: 0 Meteorologic M	odel· 100vr-existing-exi	use istina-land
Comput	e Time:05Apr2023, 15:2	6:21 Control Specific	ations:24hr (Maven)	Song-land
compac		onici opocini		
Show Elements: All Ele	ements 🗸	Volume Units: 🔘 MM 🔘) 1000 M3	Sorting: Alphabetic ~
Hydrologic	Drainage Area	Peak Discharge	Time of Peak	Volume
Element	(KM2)	(M3/S)		(1000 M3)
A Downstream	5.8454	55.71354	01Jan2000, 13:50	999.18175
A Upstream	3.3380	36.86217	01Jan2000, 13:20	576.96580
B Downstream	8.4876	91.34174	01Jan2000, 13:25	1462.51227
B Upstream	4.1220	46.67449	01Jan2000, 13:20	715.49697
C Downstream	0.2357	5.01350	01Jan2000, 12:25	46.24902
C Upstream	2.9156	35.38431	01Jan2000, 13:10	506.20497
D Downstream	2.8386	36.46248	01Jan2000, 13:00	496.99865
D Upstream	5.1008	56.15127	01Jan2000, 13:20	878.69326
E Downstream	0.7215	16.17126	01Jan2000, 12:25	156.27172
E Upstream	5.7329	58.75500	01Jan2000, 13:35	982.55892
F Downstream	0.2179	4.58160	01Jan2000, 12:20	38.57723
F Upstream	3.0393	39.32813	01Jan2000, 13:00	536.15710
G Downstream	1.2760	25.09295	01Jan2000, 12:30	267.38809
H Downstream	0.4917	11.32758	01Jan2000, 12:20	101.86108
Junction - ABE	21.2093	208.34781	01Jan2000, 13:55	3628.33498
Junction-AB	14.3330	132.15756	01Jan2000, 14:50	2411.57944
Junction-CD	8.0164	90.79421	01Jan2000, 13:15	1384.89822
Junction-CD ds	46.5092	354.24160	01Jan2000, 16:05	7835.33315
Junction-EFG ds	48.7246	358.90511	01Jan2000, 16:45	8174.93964
Outlet	49.2163	359.93801	01Jan2000, 17:25	8134.74845
Rain	4.8533	68.19996	01Jan2000, 13:10	1005.79512
Reach-1	21.2093	208.07416	01Jan2000, 14:45	3564.45241
Reach-2	8.0164	90.70163	01Jan2000, 14:20	1353.31328
Reach-3	8.4876	91.30646	01Jan2000, 15:00	1412.39769
Reach-4	24.2486	224.28327	01Jan2000, 15:55	3985.02675
Reach-5	43.4349	345.89698	01Jan2000, 16:10	7292.08547
Reach-6	46.5092	354.20834	01Jan2000, 16:45	7712.70260
Reach-7	48.7246	358.90511	01Jan2000, 17:25	8032.88737
Scheme Inflow	24.2486	224.28327	01Jan2000, 14:40	4100.60950
Scheme Outflow	43.4349	345.98777	01Jan2000, 15:30	7402.40131

Global Summary Results for Run "Developed-Q100"



 Project: Warkworth South
 Simulation Run: Developed-Q100-CC 2

 Start of Run:
 01Jan2000, 00:00
 Basin Model:
 Developed Land-Use

 End of Run:
 02Jan2000, 00:00
 Meteorologic Model:
 100yr-CC-developed-land-use

 Compute Time:04Apr2023, 11:34:07
 Control Specifications:24hr (Maven)

Show Elements: All Elements \lor

Global Summary Results for Run "Developed-Q100-CC 2"

Volume Units: O MM () 1000 M3

Sorting: Alphabetic 🗸

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
A Downstream	5.8454	67.89074	01Jan2000, 13:50	1220.76543
A Upstream	3.3380	44.93661	01Jan2000, 13:20	704.70863
B Downstream	8.4876	111.35746	01Jan2000, 13:25	1786.68282
B Upstream	4.1220	56.84513	01Jan2000, 13:20	873.60158
C Downstream	0.2357	6.01131	01Jan2000, 12:25	55.75929
C Upstream	2.9156	43.11220	01Jan2000, 13:10	618.28270
D Downstream	2.8386	44.41328	01Jan2000, 13:00	606.60934
D Upstream	5.1008	68.48363	01Jan2000, 13:20	1073.67741
E Downstream	0.7215	19.12037	01Jan2000, 12:25	186.00455
E Upstream	5.7329	71.63279	01Jan2000, 13:35	1200.75451
F Downstream	0.2179	5.57805	01Jan2000, 12:20	47.09980
F Upstream	3.0393	47.85160	01Jan2000, 13:00	653.82898
G Downstream	1.2760	29.80892	01Jan2000, 12:30	319.54365
H Downstream	0.4917	13.48195	01Jan2000, 12:20	121.97268
Junction - ABE	21.2093	253.81225	01Jan2000, 13:55	4433.46367
Junction-AB	14.3330	160.93311	01Jan2000, 14:45	2947.84554
Junction-CD	8.0164	110.71134	01Jan2000, 13:15	1691.96012
Junction-CD ds	46.5092	430.57852	01Jan2000, 16:05	9554.84443
Junction-EFG	48.7246	436.03322	01Jan2000, 16:45	9961.73207
Outlet	49.2163	437.24925	01Jan2000, 17:25	9914.85577
Rain	4.8533	80.98906	01Jan2000, 13:10	1201.88354
Reach-1	21.2093	253.46225	01Jan2000, 14:40	4357.48934
Reach-2	8.0164	110.56449	01Jan2000, 14:20	1654.39895
Reach-3	8.4876	111.29836	01Jan2000, 15:00	1727.08011
Reach-4	24.2486	273.05174	01Jan2000, 15:55	4873.82581
Reach-5	43.4349	420.48551	01Jan2000, 16:05	8892.47580
Reach-6	46.5092	430.50396	01Jan2000, 16:45	9409.08407
Reach-7	48.7246	436.03322	01Jan2000, 17:25	9792.88309
Scheme Inflow	24.2486	273.05174	01Jan2000, 14:40	5011.31833
Scheme Outflow	43.4349	420.57851	01Jan2000, 15:30	9023.55489

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2.5.3 Effects of the proposed development

A graph of the flows at the scheme outflow of the existing catchment flow with climate change against flow of the developed catchment with climate change can be found in the appendix A, the table below summaries the findings.

Rain event	Land-use	Climate change	Catchments A-F (m3/s)	Rain (m3/s)	Downstream Catchment A & B (m3/s) outflow	Scheme Outflow (m3/s)
100yr	Existing	No	224.3	54.4	132.2	346.5
100yr	Existing	Yes	273.1	66.3	160.9	421.7
100yr	Developed	No	224.6	68.2	132.2	344.2
100yr	Developed	Yes	273.1	81.0	160.9	420.6

Table 2.3 – Peak flow comparison, 100-year, climate change, existing vs developed

Table 2.3 shows that the peak flow for 100year storm events exiting the scheme area (Scheme outflow) decreases by $0.9m^{3}/s$, even though there is an increase in impervious area of the development. This is explained by the decrease in time of concentration of the developed Rain catchment, which results in the runoff from the catchment reaching the Scheme outflow before the runoff from the upstream catchments (A-F). As shown in figure 2.8, for the developed catchment, the 100year time of peak flow of the *Rain* catchment is 13:10 and for the upstream catchments, *A to F* (Reach 4) is 15:55. This demonstrates the peak flow from the *Rain* catchment exits the catchment boundary 2 hour 45 min prior to the arrival of upper catchment peak flow.

Downstream effects

Table 2.4 below shows the peak 100year stormwater events at the catchment junctions downstream of the site. Similarly to the effects described above the it is noted that the peak flows decrease as a result of the development. This is explained by the decrease in time of concentration of the developed Rain catchment, which results in the runoff from the catchment reaching the Scheme outflow before the runoff from the upstream catchments (A-F).

Rain event	Land-use	Climate change	Downstream Junction CD (m3/s)	Downstream Junction EFG (m3/s)	
100yr	Existing	No	354.7	359.4	
100yr	Existing	Yes	431.7	437.1	
100yr	Developed	No	352.3	358.9	
100yr	Developed	Yes	430.6	436.0	

Table 2.4 Peak 100yr flows at junctions downstream of the proposed development



2.5.3 Localised event scenario

A localised event scenario has been modelled which includes an Upstream PCA 2yr event and a 100yr event within the PCA (rain catchment) and downstream catchments of the PCA 100yr ARI for before and post development, no climate change. These runs are considered necessary to understand the effects of the development on the existing scenarios.



Figure 2.-9 Localised Event Scenario

Rain event	Land-use	Climate change	Scheme Outflow (m3 /s)	Downstream Junction CD (m3/s)	Downstream Junction EFG (m3/s)
100yr	Existing	No	212.6	222.8	227.6
100yr	Developed	No	212.4	222.6	227.4

Table 2.5 Peak 100yr flows at junctions downstream of the proposed development for a localised 100yr event scenario without climate change



Table 2.5 above shows the 100yr peak stormwater event for a localised 100yr event for the PCA area and downstream PCA area. Similarly to the effects described above the it is noted that the peak flows slightly decrease as a result of the development. This is explained by the decrease in time of concentration of the developed Rain catchment, which results in the runoff from the catchment reaching the Scheme outflow before the runoff from the upstream catchments (A-F).



3 HYDRAULIC MODELLING WITH HEC-RAS

3.1 METHODOLOGY

The analysis was done using the following steps:

- 1. Delineate the perimeter for the grid,
- 2. Create a grid and sub-grid areas,
- 3. Input flow hydrographs and other boundaries
- 4. Input structures,
- 5. Run scenarios.

3.2 HEC-RAS MODEL LAYOUT

HEC-RAS software was used to generate water levels throughout the catchment. A 2D model was developed using a combination of LINZ Terrain data and site-specific LiDAR and topographical survey. A Manning's n of 0.1 was used in the grid.A 5m x 5m grid was used. Figure 3.1 shows the grid and its boundary conditions. Appendix B shows culvert details used in the model.



Figure 3.1 – HEC-RAS model set-up 20



There are three boundaries. These are:

- Rain on grid as per figure 3.1.
- Main inflow for mahurangi river
- Downstream boundary using a normal depth method with a gradient of 0.002.

3.4 FLOODPLAIN COMPARISON

Figure 3.2 compares the Geomaps floodplain against the 100-year storm for developed land and climate change rainfall. The patterns are similar. The flow at critical pinch points in the north-east at the confluence have similar widths.

The only difference of note is in the central scheme area, area A. Geomaps shows more flooding while the new model is more defined in the channels due to a specific site survey of the stream being modelled. In general, the new model appears to replicate the Geomaps floodplain.



Figure 3.2 – Floodplain comparison – 100yr-storm



3.5 FLOW CHECK

All watercourse arrive at the point of confluence from the east making up about 332ha. The estimate TP108 graphical method 100-year peak flow is estimated at 47m³/s. This is the existing rainfall and land-use. The modelled peak flow at this point is 53m³/s. The model is higher than what TP108 estimates catchment run-off should be. However, the 2D terrain model uses a Manning's n of 0.1 which might be smoother than reality, but it also encourages higher flows. Importantly the model gives reasonable peak flows even though the finite volume method in HEC-RAS has pockets of water "stuck in hollows" inside the 5m grid. However, this does not affect the peak flow.

3.6 HYDRAULIC GRADE LINE

Figures 3.3 shows the HGL along the Mahurangi River on the west boundary of the scheme plan. The 100-year developed scenario ranges from RL32.4m to RL26.6m NZVD at a grade of 1 in 240. The range of water levels from 10-year to 100-year is about 1.3m.







Figure 3.3 – HGL– Mahurangi River boundary (NZVD)



Figure 3.4 shows the HGL along the main scheme stream from east of the SH1 culverts across to the confluence with the Mahurangi River. The SH1 Culverts will cause a pond that is 200m long and 135m wide.









3.7 FLOW HYDROGRAPHS

Figure 3.5 shows the flow hydrographs in the east-west stream just before the connection to the Mahurangi River. The existing 100-year storm without climate change flows (blue) is approximately equivalent to a 20-year storm with climate change flow (yellow) due to the development. And the existing 100-year storm with climate change is approximately equivalent to a 50-year storm post development.



Figure 3.5 – Flow hydrograph for east-west stream outlet

3.8 CHECK ON DOWNSTREAM LEVEL

The model grid stops at Woodcocks Road bridge. The road deck of the bridge has been surveyed to be RL23.75. The peak 1% AEP event with climate change flow level at this location has been calculated to be RL 22.17 and 22.16 for the existing and proposed scenario respectively.

The manning calculation may be found in appendix E. It is noted that the contours used for the mannings calculation have been obtained from Auckland Council Geomaps. As the Lidar contours indicate the water surface elevation (rather than the streambed) of the stream baseflow it is noted that the flow depth may be considered conservative. Therefore, the bridge is not impeding flow.

3.9 CULVERTS CAPACITY ASSESSMENT

Cross sections showing water surface elevations across the four culverts through SH 1 maybe found in appendix B.

Cross sections indicate the two northern culverts (names Culvert north and Culvert mid) are under capacity and are overtopped for all modelled storm events (10yr through to 100yr). The next adjacent culvert to the south (culvert south) is show to only overtop during a 100yr event for the developed scenario. The southern most culvert is shown to have sufficient capacity for the developed scenario. It is noted that the entire section of SH1 which is shown to be have under capacity culvert is proposed to be upgraded in the future by Auckland Transport once the road is eventually repurposed as an arterial road and the opening of Ara Tūhono – Pūhoi to Warkworth statehighway.

3.10 OUTFLOW VOLUME VALIDATION

HEC-RAS uses an Implicit Finite Volume Algorithm. The consequence of this is to have small volumes of water in the base of a cell that does not escape. A method to remove the potential holding back of water is to run the models with low flows in the initial stages to fill the hollows. The main storm run-off can then flow over the top. This is not a problem as long as there is volume continuity.

Figure 3.6 shows the volume generated in HEC-HMS for the existing land-use and 100-year historical rainfall. The volume is 4,942,000m³. Figure 3.7 shows the volume accumulated at the HEC-RAS downstream boundary after 36 hours of simulation. The volume is 4,908,000m³. This is an error of 0.0007% which is extremely small. The volume integrity is excellent.

Summary Results for Junction "Scheme Outflow" -					
Project: Warkworth South Simulation Run: Existing-Q100-existing 3 Junction: Scheme Outflow					
Start of Run:01Jan2000, 00:00Basin Model:Existing Land-UseEnd of Run:02Jan2000, 00:00Meteorologic Model:100yr-existing-existing-lanCompute Time:05Apr2023, 11:21:32Control Specifications:24hr (Maven)					
Volun	ie Units: 🔿 MM 💿 1000 M3				
Computed Results					
Peak Discharge:346.50079 (M3/S Volume: 7234.82617 (100) Date/Time of Peak) M3)	: Discharge:01Jan2000, 15:30			

Figure 3.6 – HEC-HMS volume of run-off





Figure 3.7 – HEC-RAS outflow boundary cumulative volume

3.11 HEALTHY WATERS MODELLING

Auckland Council HealthyWaters have supplied flow data of their modelling of the Warkworth catchment, for Mahurangi River. A comparison of this reports results and Healthywaters are summarised in the table below;

	XS 95 - SCHEME INFLOW (m3/s)					
	10	yr Develope	d CC	100yr Developed CC		
Scenario	Peak Time	Peak Flow	Water level	Peak Time	Peak Flow	Water level
Healthy waters	13:40	199	31.34	13:40	340	32.88
Maven 14:45 142 31.78		14:40	273	33.05		

	XS87 - SCHEME OUTFLOW (m3/s)						
	10	yr Develope	d CC	100yr Developed CC			
Scenario	Peak Time	Peak Flow	Water level	Peak Time	Peak Flow	Water Level	
Healthy waters	14:10	223	22.16	14:15	326	23.74	
Maven	15:10	151	22.12	15:15	285	23.89	

Figure 3.8 MPD Modelling results comparison to Healthy waters model

Two notable points of comparison of modelling results are the times of peak flows and the water levels. The peak flow times produced in the model are generally 1 hour later than that from the Healthywaters model. A comparison of the water levels show similar peak flood levels with a difference of upto to 0.32m. This discrepancy is likely a result of the difference in terrain model used. As the terrain used in this reports model uses a combination of site survey and drone data, it has a higher degree of accuracy in comparison to the Lidar survey used in the Healthwaters model.



APPENDIX A – 100YR YEAR FLOW HYDROGRAPH

Junction "Scheme Outflow" Results for Run "Existing-Q100-existing-CC 3"



Junction "Scheme Outflow" Results for Run "Developed-Q100-CC 2"





APPENDIX B – HEC RAS CULVERT DETAIL



Northern Culvert - Details

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File View	Options Help		Culvert Group: Culvert #1 💽 🖬 🖄 🖿
Connection:	Northern Culvert		Solution Criteria: Computed Flow Control 🔻
Description	Breach (plan data)		Shape: Box Span: 1.8 Rise: 1.21
Connections			
From:	2D Flow Area: Grid Set SA/2D Weir Length: 51.00		
To:	2D Flow Area: Grid Set SA/2D Centerline Length: 51.02		Chart #: 8 - flared wingwalls
Overflow Cor C Normal 2D	Equation Domain Centerline GIS Coords		Scale #: 1 - Wingwall flared 30 to 75 deg.
Structure Type	: Weir, Gates, Culverts, Outlet RC and Outlet TS Cut profile from terrain		Culvert Length: 26 Depth to use Bottom n: 0
Flap Gates:	No Flap Gates Clip Weir Profile to 2D Cells		Entrance Loss Coeff: 1 Depth Blocked: 0
Weir / Embakment	Northern Culvert		Exit Loss Coeff: 1 Upstream Invert Elev: 38.3
			Manning's n for Top: 0.013 Downstream Invert Elev: 38
Gate			Manning's n for Bottom: 0.013
1 IIII	41.0	Legend	Culvert Barrel Data Barrel #1
Culvert		Spillway	Barrel Centerline Stations #Barrels: 1 Length: 26.2
		Extend/Trim to Face Points	Barrel Name US Sta DS Sta GIS Sta ▲ X Y ▲ 1 Barrel#1 28 28 28 11 1748267.29 i968519.723
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Culvert mid - Details

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Connection: Culvert-mid Apply Data	Breach (plan data)	Solution Criteria: Computed Flow Control
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From: 2D Flow Area: Grid Set SA/2D	Weir Length: 122.97	
To: 2D Flow Area: Grid Set SA/2D	Centerline Length: 122.97	Charle (L. Coursels Rev Columb
Overflow Computation Method O Normal 2D Equation Domain Use Weir Equation	Centerline GIS Coords	Scale #: 1 - Square edge entrance with headwall
Structure Type: Weir, Gates, Culverts, Outlet RC and Outlet TS	Cut profile from terrain	Culvert Length: 20 Depth to use Bottom n: 0
Flap Gates: No Flap Gates	Clip Weir Profile to 2D Cells	Entrance Loss Coeff: 1 Depth Blocked: 0
Weir/enclasheed	Culvert-mid Legend Spilway Extend/Trim to Face Points HW Cell Min Elev TW Cell Min Elev Current Terrain 80 100 120 140	Exit Loss Coeff: 1 Upstream Invert Elev: 39.8 Manning's n for Top: 0.013 Downstream Invert Elev: 38.9 Manning's n for Bottom: 0.013 Downstream Invert Elev: 38.9 Culvert Barrel Data Barrel Centerline Stations # Barrels : 1 Barrel Name US Sta DS Sta GIS Sta 1 1 Barrel *1 71.5 71.5 1 748048.167 968268.798 2 748048.167 968284.229 3 4 4 4 5 Individual Barrel Centerlines Show on Map OK Cancel Help Select culvert to edit * * * *
	14.56, 40.35	5

Culvert south - Details

🐨 Connection Data Editor - Existing v2		- 🗆 🗙	Culvert Data Editor
File View Options Help			Culvert Group: Culvert #1 🔽 🖬
Connection: culvert-south			Solution Criteria: Computed Flow Control
Description	Breach (plan data)		Shape: Circular Span: 0.825 Diameter: 0.825
Connections Eromy 2D Flow Area: Grid Set SA/2D	Weir Length: 116.48		
To: 2D Flow Area: Grid Set SA/2D	Centerline Length: 116.48		
Overflow Computation Method			Chart #: 1 - Concrete Pipe Culvert
C Normal 2D Equation Domain © Use Weir Equation	Centerline GIS Coords		Scale #: 1 - Square edge entrance with headwall
Structure Type: Weir, Gates, Culverts, Outlet RC and Outlet TS	Cut profile from terrain		Culvert Length: 29 Depth to use Bottom n: 0
Flap Gates: No Flap Gates	Clip Weir Profile to 2D Cells		Entrance Loss Coeff: 1 Depth Blocked: 0
Weir / Embakment CL	ulvert-south	<u>^</u>	Exit Loss Coeff: 1 Upstream Invert Elev: 41.9
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		TW Cell Min Elev	3
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Culvert m south - Details

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Description	Breach (plan data)	Shape: Circular Span: 0.8 Diameter: 0.8
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From:	2D Flow Area: Grid Set SA/2D Weir Length: 37.10	
To:	2D Flow Area: Grid Set SA/2D Centerline Length: 37.13	Chart #: 1 - Concrete Pipe Culvert
Overflow O O Normal	D Equation Domain (Use Weir Equation Centerline GIS Coords	Scale #: 1 - Square edge entrance with headwall
Structure Ty	e: Weir, Gates, Culverts, Outlet RC and Outlet TS Cut profile from terrain	Culvert Length: 18 Depth to use Bottom n: 0
Flap Gates:	No Flap Gates Clip Weir Profile to 2D Cells	Entrance Loss Coeff: 1 Depth Blocked: 0
Embaskment	Southern m culv	▲ Exit Loss Coeff: 1 Upstream Invert Elev: 46.8 Manning's n for Top: 0.013 ① Downstream Invert Elev: 46.58
Gate		Manning's n for Bottom: 0.013
I H	51 Legend	Culvert Barrel GIS Data: Barrel#1
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Outlet	HW Cell Min Elev	2
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TS		5
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	Station (m)	<u>_</u>
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Northern Culvert (1800mm x 1200mm box)



Mid Culvert (1800mm circular)



Culvert South (825mm circular x 2)



Culvert m south (800mm circular)





APPENDIX C – Preliminary Pre & Post Development Flood Extent Plan

DATUM 28.00m					~~~~	1												/
EXISTING LEVELS	32.28	34.00	36.25	39.17	40.12	41.28	42.75	44.24	44.70	46.13	48.24	49.61	51.99	54.17	58.84	64.00	75.19	99.44
DESIGN LEVELS	32.28	34.00	36.25	39.17	40.12	41.28	42.75	44.24	44.70	46.13	48.24	49.61	51.99	54.17	58.84	64.00	75.19	99.44
CUT/FILL	0.00	0.00	0.00	0.00	0.00	00.0	0.00	0.00	0.00	0.00	00.0	0.00	00.0	0.00	00.0	0.00	00.0	0.00
CHAINAGE	0.00	250.00	500.00	750.00	1000.00	1250.00	1500.00	1750.00	2000.00	2250.00	2500.00	2750.00	3000.00	3250.00	3500.00	3750.00	4000.00	4175.47

Upstream A Longsection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3



Upstream B Longsection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

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EXISTING LEVELS	29.95	27.50	31.89	32.02	32.01	32.28
DESIGN LEVELS	29.95	27.50	31.89	32.02	32.01	32.28
CUT/FILL	0.00	0.00	00.0	0.00	00.0	0.00
CHAINAGE	0.00	250.00	500.00	750.00	00.000	186.53

Upstream Reach ABE to Inflow HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

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EXISTING LEVELS	32.28	34.00	36.25	38.23	37.17	38.27	39.08	40.57	41.67	42.07		
DESIGN LEVELS	32.28	34.00	36.25	38.23	37.17	38.27	39.08	40.57	41.67	42.07		
CUT/FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
CHAINAGE	0.00	250.00	500.00	750.00	1000.00	1250.00	1500.00	1750.00	2000.00	250.00	2500.00	2750.00

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DATUM 22.00m											••••••	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~							~					
EXISTING LEVELS					27.00	29.21	29.97	29.94	30.28	32.47	32.26	33.04	32.75	33.50	34.33	36.28	37.86	37.42	38.05	39.90	40.55	45.00	52.27	58.22
DESIGN LEVELS					27.00	29.21	29.97	29.94	30.28	32.47	32.26	33.04	32.75	33.50	34.33	36.28	37.86	37.42	38.05	39.90	40.55	45.00	52.27	58.22
CUT/FILL					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHAINAGE	0.00	00	00.062	500.00	750.00	00.000	1250.00	1500.00	1250.00	00.000	250.00	500.00	2750.00	00.000	3250.00	3500.00	8750.00	00.000	1250.00	1500.00	1250.00	200.00	5250.00	200.00

Downstream A LongsectionHORIZONTAL SCALE1:25000 @ A3VERTICAL SCALE1:5000 @ A3

DATUM 36.00m							<u></u>					
EXISTING LEVELS	40.68	42.00	43.75	45.80	48.87	49.50	53.82	56.49	62.25	94.33	148.64	288.82
DESIGN LEVELS	40.68	42.00	43.75	45.80	48.87	49.50	53.82	56.49	62.25	94.33	148.64	288.82
CUT/FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHAINAGE	0.00	500.00	000.000	500.00	2000.00	500.00	00.000	500.00	00.000	500.00	00.000	<u> </u>

Downstream B LongsectionHORIZONTAL SCALE1:25000 @ A3VERTICAL SCALE1:5000 @ A3





DATUM 8.00m	~		~~~~			\square
EXISTING LEVELS	11.10	12.01	15.07	15.32	25.65	27.77
DESIGN LEVELS	11.10	12.01	15.07	15.32	25.65	27.77
CUT/FILL	0.00	0.00	00.0	0.0	00.0	0.00
CHAINAGE	0.00	250.00	500.00	750.00	00.000	077.43
	0	250	200	750		100

Downstream C Longsection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

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DATUM 8.00m														
EXISTING LEVELS	11.10	15.39	16.50	18.89	20.21	21.24	23.25	26.41	29.58	31.42	32.24	33.74	43.47	79.73
DESIGN LEVELS	11.10	15.39	16.50	18.89	20.21	21.24	23.25	26.41	29.58	31.42	32.24	33.74	43.47	79.73
CUT/FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	000	0.00	0.00	0.00
CHAINAGE	0.00	250.00	500.00	750.00	1000.00	1250.00	1500.00	1750.00	2000.00	2250.00	2500.00	2750.00	300.00	3 <u>250.00</u> 3 <u>331.05</u>

Downstream D Longsection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

DATUM 6.00m		~~~	~~~~					$\left[\right]$
EXISTING LEVELS	8.98	11.99	10.36	18.24	26.47	34.17	44.66	57.08
DESIGN LEVELS	8.98	11.99	10.36	18.24	26.47	34.17	44.66	57.08
CUT/FILL	0.00	00.0	0.00	00.0	0.00	00.0	00.0	0.00
CHAINAGE	0.00	250.00	500.00	750.00	00.000	250.00	500.00	695.06

Downstream E Longsection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

 Co-ordinates in terms of NZ Geodetic Datum Eden 2000. Levels in terms of the Auckland Vertical Datum 1946. 	Mt
Eden 2000. Levels in terms of the Auckland Vertical Datum 1946.	
ventual Datum 1940.	
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A FOR INFORMATION YW 03/2 Rev Description By Date By Date Survey ## MMYYYYY Design ## MMYYYYY Drawn BY MMYYYY Checked ## #### Maven Associa 09 571 0050 info@maven.co.nz Maven Associa 09 571 0050 info@maven.co.nz S Owens Road, Epsom Auckland 1023	tes
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A FOR INFORMATION YW 03/2 Rev Description By Date By Date Survey ## MM/YYYY Design ## MM/YYYY Drawn BY MM/YYYY Checked ## #### Maven Associa 09 571 0050 info@maven.co.nz www.maven.co.nz 5 Owens Road, Epsom Auckland 1023 Project WARKWORTH SOUTH PLAN CHANGE FOR KA WAIMANIAWALD 9	tes
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DATUM 6.00m		~~~~		\sim	
EXISTING LEVELS	8.98	8.25	10.88	37.35	61.78
DESIGN LEVELS	8.98	8.25	10.88	37.35	61.78
CUT/FILL	0.00	0.00	0.00	0.00	0.00
CHAINAGE	00.0	250.00	500.00	750.00	86.80t

Downstream F Lonasection HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

DATUM 6.00m	_	1	~~~~~						<u> </u>		
EXISTING LEVELS	9.39	13.78	16.27	20.00	27.46	31.75	35.09	38.48	42.35	51.20	67.66
DESIGN LEVELS	9.39	13.78	16.27	20.00	27.46	31.75	35.09	38.48	42.35	51.20	67.66
CUT/FILL	0.00	0.00	00.0	00.0	0.00	00.0	0.00	0.00	00.0	0.00	0.00
CHAINAGE	0.00	250.00	500.00	750.00	00.000	250.00	500.00	750.00	00.000	250.00	500.00
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DATUM -4.00m					/		
EXISTING LEVELS	-0.75	3.75	3.58	5.25	18.08	43.07	69. <u>6</u> 9
DESIGN LEVELS	-0.75	3.75	3.58	5.25	18.08	43.07	69. <u>69</u>
CUT/FILL	0.00	0.00	0.00	0.00	0.00	0.00	<u>8.88</u>
CHAINAGE	0.00	250.00	500.00	750.00	1000.00	1250.00	1 <u>599.08</u>

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CUT/FILL	0.00	0.00	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	0.0
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Reach Scheme In to Scheme OutHORIZONTAL SCALE1:25000 @ A3VERTICAL SCALE1:5000 @ A3



Downstream Reach B to A Scheme Out HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

1. Co-ordinates in terms of NZ Geodetic Datum Mt Eden 2000. Levels in terms of the Auckland Vertical Datum 1946.         A       FOR INFORMATION         A       FOR INFORMATION         By       Date         By       Date         By       Date         Survey       ##         MA       FOR INFORMATION         YW       03/2023         Rev       Description         By       Date         Survey       ##         Maven Associates         09 571 0050         Info@maren.co.rz         Surven BY         Maven Associates         09 571 0050         Info@maren.co.rz         Surven Read, Epsom         Project         WARKWORTH SOUTH	1.	zs Co-or Eden Vertic	dinates in t 2000. Leve al Datum 1	erms of I els in terr 946.	NZ Ge	odetic I	Datum Mt kland
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Survey         ##         MM/YYYY           Design         ##         MM/YYYY           Drawn         BY         MM/YYYY           Checked         ##         #####           Maven Associates         09 571 0050           09 571 0050         info@maven.co.nz           MA         E         N           Maven Associates         09 571 0050           Info@maven.co.nz         5 Owens Road, Epsorn           Auckland 1023         Project           WARKWORTH SOUTH         SOUTH	1.01	Desc	R INFORMA	ΓΙΟΝ		YW	03/2023
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PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD	Surve Desig Drawn Chec Chec M Projet W PL K/ ST F/A	A A A A A A A A A A A A A A A A A A A	RINFORMATION		Date MM/YY MM/YY #### aven maven.o. maven.o. maven.o. maven.o. SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY YYY A Asss 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20	ociates
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING	Surve Desig Draw Chec M Projec W Projec K J FL ST FL	A A A A A A A A A A A A A A A A A A A	RINFORMATION iption By ## BY E KWOI I CHA /AIMA PPING LTD DD MC		Date MM/YY MM/YY #### aven maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c SO SO SO SO VA FC VAF	YW By YYY YYY A Asss 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20	ociates
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT	Surve Desig Draw Chec M Projee W Projee K J FL ST FL C	A A A A A A A A A A A A A A A A A A A	RINFORMATION iption By ## BY E KWOI I CHA /AIMA PPING LTD DD MC CHME		Date MM/YY #### aven maven.c maven.c maven.c maven.c maven.c maven.c s SOU SOU SOU FCC VA VAF	YW By YYY YY A Asss 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.0.7 20.	ociates
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT	Surveo Desig Drawi Chec Chec M Projee W PL K/ ST F/ ST F/	A A A A A A A A A A A A A A A A A A A	RINFORMATION iption By ## BY E KWOI A CHA A CHA PING LTD DD MC CHME		Date MM/YY #### aven maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c maven.c SOU SOU FCC VA I VAF	YW By YYY YYY A Asss 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0	ociates
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PLAN CHANGE FOR KA WAIMANAWA LP & STEPPING TOWARDS FAR LTD Title FLOOD MODELLING CATCHMENT LONGSECTION PLAN	Surve Desig Draw Chec M Projee W Projee K/ ST F/A ST F/A ST F/A C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/	A A A A A A A A A A A A A A A C C C C C	RINFORMA iption By ## BY ## E KWOI A CHA A CHA A CHA A CHA PING D MC CHME GSEC 2110		Date MM/Y MM/Y #### aven maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven.o. maven	YW By YYY YY A ASS 0.0.72 4. Epsom UTH DR LP & RDS	ociates
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PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001         Scale         Cad file       CATCHMENT BDYS & LENGTHS EDEN2K.DWG	Surve Desig Draww Chec Proje W Pl K/ ST F/ Title FL C/ LC Proje Calle	A A A A A A A A A A A A A A A A A A A	RINFORMATION		Date MM/YY #### aven @maven.c. maven.d. maven.d. maven.d. maven.d. maven.d. maven.d. SOU SOU E FC VA I VAF	YW By YYY YY A ASSS 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.0.2 20.	ociates
PLAN CHANGE FOR KA WAIMANAWA LP & STEPPING TOWARDS FAR LTD Title FLOOD MODELLING CATCHMENT LONGSECTION PLAN Project no. 211001 Scale Cad file CATCHMENT BDYS & LENGTHS EDEN2K.DWG Drawing no. SK008 Rev A	Surve Desig Draw Chec Chec M Projec K/ S1 F/ S1 F/ Title FL C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/ C/	A A A A A A A A A A A A A A A A A A A	RINFORMATION iption By ## BY ## E KWOI I CHA /AIMA PPING LTD DD MC CHME GSEC 2110 CATCHMI	TION	Date MM/YY MM/YY #### aven maven.c maven.c maven.d maven.d maven.d maven.d maven.d maven.d maven.d maven.d maven.d SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY YYY A ASSS 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0.72 20.0	ociates

DATUM 8.00m				T	
EXISTING LEVELS	11.10	11.77	15.05	15.33	15.00
DESIGN LEVELS	11.10	11.77	15.05	15.33	15.00
CUT/FILL	0.00	0.00	0.00	0.00	0.00
CHAINAGE	0.00	250.00	500.00	750.00	006,00

Downstream Reach Scheme Out B to CD HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

DATUM 6.00m	~~			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
EXISTING LEVELS	9.38	9.81	9.88	11.71	11.00	11.02 11.11
DESIGN LEVELS	9.38	9.81	9.88	11.71	11.00	11.02 11.11
CUT/FILL	0.00	0.00	0.00	0.00	0.00	0.00 0.00
CHAINAGE	0.00	250.00	500.00	750.00	00.00	250.00 303.55
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Downstream Reach CD to EFG HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

DATUM 0.00m				~	
EXISTING LEVELS	2.75	3.92	3.45	5.74	8.00 9.41
DESIGN LEVELS	2.75	3.92	3.45	5.74	8.00 9.41
CUT/FILL	0.00	0.00	0.00	0.00	00.0
CHAINAGE	0.00	250.00	500.00	750.00	000.00

Downstream Reach EFH to Out HORIZONTAL SCALE 1:25000 @ A3 VERTICAL SCALE 1:5000 @ A3

1. Co-ordinates in terms of NZ Geodetic Datum Mt Eden 2000. Levels in terms of the Auckland Vertical Datum 1946.          Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of the Auckland Vertical Datum 1946.         Image: Co-ordinates in terms of	Noto									
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PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Trite         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN	A Rev Desig Drawr Check Drawr Check Projec W/ PL K/ ST FA Title FL C/ LC		R INI riptice By ## ## BY ## KV VA VA P L1 				Date MM/Y MM/Y #### aven 571 0050 @maven. 380 @maven. 380 @maven. 380 SOU 5 FC VA 1 VAF VAF	YW By YYY A Asss 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72 0.0.72	ociat	
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Trite         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN	A Rev Desig Drawr Check Check Projec W/ PL K/ ST FA Title FL C/ LC		R IN				Date MM/Y MM/Y #### aven 571 0050 @maven. ##### wens Rosa @maven. \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU \$ SOU SOU \$ SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY A Asss 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.0	03/20 Date	
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Trite         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001	A Rev Desig Drawr Check M Projec W PL KA ST FA Title FL CA LC	Py n h ked A A A A A A A A C C A C C O C A T C D B C C C C C C C C C C C C C C C C C	R IN				Date MM/YY MM/Y ##### aven S71 0050 @maven.c. maven.s maven.s SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY AASS 00.02 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0	03/20 Date	
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Trite         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001         Scale	A Rev Desig Drawr Check M Projec FA FA Title FL CA LC	Py n h ked A A A A A A A A C E F A A A C A C C A T C Desc A C A C A C C C C C C C C C C C C C C	R IN IS INTERED. INTEREST IN IS INTEREST IN IS INTEREST. INTEREST IN IS INTEREST. INTEREST IN IS INTEREST. INTEREST INTEREST. INTEREST INTEREST. INTEREST INTEREST.				Date MM/YY MM/Y ##### aven @maven.c. maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g maven.g m	YW By YYY AASS 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.0.2 50.00000	03/20 Date	es
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001         Scale	A Rev Desig Drawr Check M Projec WJ PL KJ ST FA Title FL CJ CJ CJ CJ CJ CJ CJ CJ CJ CJ CJ CJ CJ	Provide a constraint of the second se	R IN IS INTERED IS IN IS INTERED IS IN IS INTERED IS				Date MMYY MMYY ##### aven S71 0050 @maven.c. maven.d maven.d maven.d maven.d maven.d SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY AASS 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0.7 0.0	03/20 Date	
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001         Scale         Cad file       CATCHMENT BDYS & LENGTHS EDEN2K.DWG	A Rev Desig Drawr Chect M Projec WJ PL KJ ST FA Title FL CJ CJ Cad f	Provide a constraint of the second se	R IN BY riptic By ## ## K V V A V P D L L I D D C C H G S				Date MMVY MMVY #### aven S10 0050 @maven.c. wens Roa @maven.c. wens Roa @maven.c. SOU SOU SOU SOU SOU SOU SOU SOU SOU SOU	YW By YYY AASS 00.02 0.02 0.02 0.02 0.02 0.02 0.02 0		es
PLAN CHANGE FOR         KA WAIMANAWA LP &         STEPPING TOWARDS         FAR LTD         Title         FLOOD MODELLING         CATCHMENT         LONGSECTION PLAN         Project no.       211001         Scale         Cad file       CATCHMENT BDYS & LENGTHS EDEN2K.DWG         Drawing no.       SK009       Rev       A	A Rev Desig Drawr Chect Chect Projec WJ PL KJ ST FA Title FL CJ CJ CJ Cad f Drawi	Provide a contract of the cont	R IN BY riptical By #### BY ## BY ## K VA VA P DE L1 DE CF SS			DN M 99 50 1 M Auto 1 1 1 1 1 1 1 1 1 1 1 1 1	Date MMVY MMVY #### aven 571 0050 genaren.c. wens Roa wens Roa wens Roa wens Roa SOU 5 FCC VA 5 FCC VA 5 FCC VA 1 PL	YW By YYY AASS 00.02 0.02 0.02 0.02 0.02 0.02 0.02 0		



(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x$
1	32.3	0	0			
2	42.75	10.45	1500	1500	5.225	7837.5
3	52	19.7	3000	1500	15.075	22612.5
4	64	31.7	3750	750	25.7	19275
5	99.4	67.1	4175	425	49.4	20995
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	4175	TOTAL =	70720



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	32.3	0	0			
2	40.6	8.3	1750	1750	4.15	7262.5
3	50.9	18.6	3000	1250	13.45	16812.5
4	57.3	25	3250	250	21.8	5450
5	88	55.7	4250	1000	40.35	40350
6	169.8	137.5	4660	410	96.6	39606
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	Ō	Ō
			TOTAL =	4660	TOTAL =	109481



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	45.5	0	0			
2	70.6	25.1	1500	1500	12.55	18825
3	82.6	37.1	2750	1250	31.1	38875
4	101	55.5	3500	750	46.3	34725
5	133.6	88.1	3750	250	71.8	17950
6	215.5	170	4750	1000	129.05	129050
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	4750	TOTAL =	239425



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	46.95	0	0			
2	76	29.05	1750	1750	14.525	25418.75
3	92.5	45.55	3250	1500	37.3	55950
4	142	95.05	4500	1250	70.3	87875
5	205.84	158.89	5750	1250	126.97	158712.5
6	317	270.05	6750	1000	214.47	214470
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	6750	TOTAL =	542426.25



Point	RL (m)	(m)	(m)	(m)	(m)	$\Lambda A(-\overline{h}\Lambda r)$
		h	x	$\Delta x$	$\overline{h}$	$\Delta n(-n\Delta x)$
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	32.3	0	0			
2	45.1	12.8	2000	2000	6.4	12800
3	57.2	24.9	3750	1750	18.85	32987.5
4	111.4	79.1	4500	750	52	39000
5	135.7	103.4	5750	1250	91.25	114062.5
6	194.8	162.5	6250	500	132.95	66475
7	317	284.7	7250	1000	223.6	223600
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	7250	TOTAL =	488925



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	29.95	0	0			
2	44.86	14.91	2000	2000	7.455	14910
3	55.91	25.96	2750	750	20.435	15326.25
4	99.25	69.3	3250	500	47.63	23815
5	165.1	135.15	4000	750	102.225	76668.75
6	274.7	244.75	4714.4	714.4	189.95	135700.28
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	4714.4	TOTAL =	266420.28



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{m}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	29.95	0	0			
2	31.9	1.95	500	500	0.975	487.5
3	32.01	2.06	750	250	2.005	501.25
4	32.28	2.33	1186	436	2.195	957.02
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1186	TOTAL =	1945.77



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	32.3	0	0			
2	37.2	4.9	1000	1000	2.45	2450
3	39.1	6.8	1500	500	5.85	2925
4	42.1	9.8	2250	750	8.3	6225
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	2250	TOTAL =	11600

S _c =	0.005

Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	27	0	0			
2	33.5	6.5	3000	3000	3.25	9750
3	39.9	12.9	4500	1500	9.7	14550
4	67.56	40.56	5750	1250	26.73	33412.5
5	140	113	6120	370	76.78	28408.6
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	6120	TOTAL =	86121.1



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			10	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	40.7	0	0			
2	48.87	8.17	2000	2000	4.085	8170
3	56.5	15.8	3500	1500	11.985	17977.5
4	94.3	53.6	4500	1000	34.7	34700
5	148.64	107.94	5000	500	80.77	40385
6	288.82	248.12	5306	306	178.03	54477.18
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	5306	TOTAL =	155709.68



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{m}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	11.1	0	0			
2	15.07	3.97	500	500	1.985	992.5
3	15.3	4.2	750	250	4.085	1021.25
4	25.67	14.57	1000	250	9.385	2346.25
5	27.77	16.67	1077	77	15.62	1202.74
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	Ō	Ō
			TOTAL =	1077	TOTAL =	5562.74

$S_c =$	0.010

Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	11.1	0	0			
2	20.2	9.1	1000	1000	4.55	4550
3	29.6	18.5	2000	1000	13.8	13800
4	33.74	22.64	2750	750	20.57	15427.5
5	43.5	32.4	3000	250	27.52	6880
6	79.7	68.6	3250	250	50.5	12625
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	3250	TOTAL =	53282.5

$S_c =$	0.010

Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	8.9	0	0			
2	10.36	1.46	500	500	0.73	365
3	18.24	9.34	750	250	5.4	1350
4	34.2	25.3	1250	500	17.32	8660
5	57.1	48.2	1695	445	36.75	16353.75
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1695	TOTAL =	26728.75

S _c =	0.019

Point	RL (m)	(m) <i>h</i>	(m) x	(m) (Ar	$\frac{(m)}{\overline{I}}$	$\Delta A (= \overline{h} \Delta x)$
		n	л	$\Delta \Lambda$	h	
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	8.98	0	0			
2	10.88	1.9	500	500	0.95	475
3	37.35	28.37	750	250	15.135	3783.75
4	65	56.02	1036	286	42.195	12067.77
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1036	TOTAL =	16326.52

$S_c =$	0.030

Point	RL (m)	(m)	(m)	(m)	(m)	$\Delta A (= \overline{h} \Delta x)$
		n	X	$\Delta x$	h	
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	9.4	0	0			
2	27.5	18.1	1000	1000	9.05	9050
3	38.5	29.1	1750	750	23.6	17700
4	71.5	62.1	2553	803	45.6	36616.8
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	2553	TOTAL =	63366.8

S _c =	0.019

Point	RL (m)	(m)	(m)	(m)	(m)	$\Delta A (= \overline{h} \Delta x)$
		n	X	$\Delta x$	h	
1		0				
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	0	0	0			
2	3.75	3.75	250	250	1.875	468.75
3	5.25	5.25	750	500	4.5	2250
4	18.1	18.1	1000	250	11.675	2918.75
5	43.1	43.1	1250	250	30.6	7650
6	60	60	1520	270	51.55	13918.5
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1520	TOTAL =	27206



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	15	0	0			
2	19.25	4.25	1000	1000	2.125	2125
3	25.66	10.66	2000	1000	7.455	7455
4	31.1	16.1	2973	973	13.38	13018.74
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	2973	TOTAL =	22598.74



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	15	0	0			
2	29.43	14.43	750	750	7.215	5411.25
3	32.25	17.25	2000	1250	15.84	19800
4	35.73	20.73	3250	1250	18.99	23737.5
5	41.7	26.7	4850	1600	23.715	37944
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	4850	TOTAL =	86892.75



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	11.1	0	0			
2	11.77	0.67	250	250	0.335	83.75
3	15	3.9	1000	750	2.285	1713.75
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1000	TOTAL =	1797.5

$S_c =$	0.004

Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			10	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	9.38	0	0			
2	9.8	0.42	250	250	0.21	52.5
3	11	1.62	1000	750	1.02	765
4	11.11	1.73	1303	303	1.675	507.525
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1303	TOTAL =	1325.025



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	Ó
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0





(Calculating the Slope (Sc) using the equal area method)







(This graph is from the ARC TP 108, April 1999, pg.14)

#### **Pre-development**

Point	RL (m)	(m)	(m)	(m)	(m)	_
		h	x	$\Delta x$	$\overline{h}$	$\Delta A (= h \Delta x)$
1	2.75	0	0			
2	3.45	0.7	500	500	0.35	175
3	8	5.25	1000	500	2.975	1487.5
4	9.41	6.66	1080	80	5.955	476.4
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	1080	TOTAL =	2138.9



Point	RL (m)	(m) <i>h</i>	(m) <i>X</i>	(m) $\Delta x$	$\frac{(m)}{h}$	$\Delta A (= \overline{h} \Delta x)$
1		0			11	
2		0		0	0	0
3		0		0	0	0
4		0		0	0	0
5		0		0	0	0
6		0		0	0	0
7		0		0	0	0
8		0		0	0	0
9		0		0	0	0
10		0		0	0	0
11		0		0	0	0
12		0		0	0	0
			TOTAL =	0	TOTAL =	0



	MAVEN ASSOCIATES		Job Number 211001		Sheet 1	Rev A		
Job Title Calc Title	Warkworth TP108 Calcula Upstre	Warkworth South Plan Change TP108 Calculation - Pre-Development Upstream Catchment A		Author YW		Date 30/03/2023	Checked	
1. Runoff Curve Number (CN) and initial Abstraction (Ia)								
Soil name and classification C C	Cover desc	Cover description (cover type, treat hydrologic condition) Total Impervious Total Pervious			Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 6.0077 327.7623	Product of CN x area 588.75 24254.41	
* from Appendix B					Totals =	333.770	24843.16	
CN (weighted) =       total product =       #######       74.4         total area       #######								
la (average) = 2. Time of Concentra	$\frac{5 \text{ x pervious area}}{\text{total area}} = \frac{5 \text{ x } 327.7623}{333.770} 4.9 \text{ mm}$ tion							
Channelisation factor		C =	1	(From Table	e 4.2)			
Catchment length		L =4.117 km (along drainage path)						
Catchment Slope		Sc= 0.008 m/m (by equal area method)						
Runoff factor,	<u>CN</u> 200 - CN	= 200-	74.4 74.4	=	0.59	-		
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN}/200\text{-CN})^{-0.55} \text{ Sc}^{-0.30}$								
= 0.14		2.54	1.33	4.26	=	2.02	hrs	
SCS Lag for HEC-HMS		$t_{p} = 2/3 t_{c}$			= <u>1.35</u> hrs			
						OK use 2.0218088	hrs	
Worksheet 1: Runoff Parameters and Time of Concentration								
	MAVEN A	SSOCIAT	ĒS	Job N 211	lumber I001	Sheet 1	Rev A	
-------------------------------------------------	-----------------------------------------------------	------------------------------------------------------------------------------------------------------------	----------------------	--------------------	------------------------------------	-----------------------------------------------------	------------------------------------------------	
Job Title Calc Title	Warkworth TP108 Calcula Upstre	n South Plan Cha ation - Pre-Deve am Catchment I	ange lopment B	Au Y	thor W	Date 30/03/2023	Checked	
1. Runoff Curve Nur	nber (CN) and in	itial Abstractio	n (la)					
Soil name and classification C C	Cover desc	Cover description (cover type, treatment, a hydrologic condition) Total Impervious Total Pervious			Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 10.3517 401.8183	Product of CN x area 1014.47 29734.55	
* from Appendix B					Totals =	412.170	30749.02	
CN (weighted) =	total product = total area	<u> </u>	####### ########	=	74.6			
la (average) = 2. Time of Concentra	<u>5 x pervious a</u> total area <b>ation</b>	area =	5 x 41	401.8183 12.170	4.9	mm		
Channelisation factor		C =	1	(From Table	e 4.2)			
Catchment length		L = .	4.29	km (along d	rainage path	)		
Catchment Slope		Sc=	0.01	m/m (by equ	ual area meth	nod)		
Runoff factor,	<u>CN</u> 200 - CN	= 200-	74.6 74.6	=	0.59	-		
t _c = 0.14 C L ^{0.66} (CN/2	200-CN) ^{-0.55} Sc ^{-0.30}	0						
= 0.	.14 1	1 2.61	1.33	3.98	=	1.94	hrs	
SCS Lag for HEC-HM	1S	$t_p = 2/3 t_c$			=	1.30	hrs	
						OK use 1.939068	hrs	
	Worksheet 1	: Runoff Param	neters ar	nd Time of C	Concentratio	on		

	MAVEN A	SSOCIAT	ËS	Job Number 211001		Sheet 1	Rev A
Job Title Calc Title	Warkworth TP108 Calcula Upstre	n South Plan Cha ation - Pre-Devel am Catchment (	ange lopment C	Au Y	thor W	Date 18/01/2023	Checked
1. Runoff Curve Nur	nber (CN) and in	itial Abstractio	n (la)				
Soil name and classification C C	Cover desc	ription (cover ty hydrologic con Total Imperv Total Pervio	pe, treat dition) ious ous	ment, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 3.8056 287.7544	Product of CN x area 372.95 21293.83
* from Appendix B					Totals =	291.560	21666.77
CN (weighted) =	total product = total area	<u> </u>	####### ########	.=	74.3	-	
la (average) = 2. Time of Concentra	<u>5 x pervious a</u> total area <b>ation</b>	irea =	<u>5 x</u> 29	287.7544 91.560	4.9	mm	
Channelisation factor		C =	1	(From Table	e 4.2)		
Catchment length		L =	4.89	km (along d	rainage path	)	
Catchment Slope		Sc=	0.021	m/m (by equ	ual area meth	nod)	
Runoff factor,	<u>CN</u> 200 - CN	= 200-	74.3 74.3	=	0.59	-	
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/2})$	200-CN) ^{-0.55} Sc ^{-0.30}	)					
= 0.	.14 1	2.85	1.34	3.19	=	1.70	hrs
SCS Lag for HEC-HM	1S	$t_p = 2/3 t_c$			=	1.14	hrs
						OK use 1.6979653	hrs
	Worksheet 1	: Runoff Param	neters ar	nd Time of C	Concentratio	on	

	MAVEN ASSOCIATES		Job Number 211001		Sheet 1	Rev A	
Job Title Calc Title	Warkworth South Plan ( TP108 Calculation - Pre-De Upstream Catchmer	Change velopment nt D	Aut Y	hor W	Date 18/01/2023	Checked	
1. Runoff Curve Numb	per (CN) and initial Abstraction	on (la)					
Soil name and classification C C	Cover description (cover type, treatment, and hydrologic condition) Total Impervious Total Pervious			Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 4.8100 505.2700	Product of CN x area 471.38 37389.98	
* from Appendix B				Totals =	510.080	37861.36	
CN (weighted) = $total product = 37861.36 = 74.2$ total area 510.080							
la (average) = 2. Time of Concentrat	<u> </u>	<u>5 x 505.2700</u> 5.0 mm 510.080					
Channelisation factor	C =	1	(From Table	From Table 4.2)			
Catchment length	L =	6.687	km (along di	drainage path)			
Catchment Slope	Sc=	0.024	m/m (by equ	ial area meth	nod)		
Runoff factor,	<u>CN</u> = 200 - CN 200-	74.2 74.2	=	0.59	-		
t _c = 0.14 C L ^{0.66} (CN/20	0-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	4 1 3.50	1.34	3.06	=	2.01	hrs	
SCS Lag for HEC-HMS	$t_p = 2/3 t_c$			=	1.35	hrs	
					OK use 2.0076355	hrs	
	Worksheet 1: Runoff Par	ameters and	Time of Co	ncentration			

	MAVEN ASSC	CIATES	TES Job N 211		Sheet 1	Rev A	
Job Title Calc Title	Warkworth South TP108 Calculation - Upstream Ca	Plan Change Pre-Development cchment E	Aut Y	hor W	Date 30/03/2023	Checked	
1. Runoff Curve Num	per (CN) and initial Abs	traction (la)					
Soil name and classification C C	Cover description hydro Tota To	Cover description (cover type, treatment, and hydrologic condition) Total Impervious Total Pervious			Area (ha) 10000m2= 1ha 5.7200 567.5700	Product of CN x area 560.56 42000.18	
* from Appendix B				Totals =	573.290	42560.74	
$CN (weighted) = \underbrace{total \ product =}_{total \ area} \underbrace{42560.74}_{573.290} = \underbrace{74.2}_{74.2}$							
la (average) = 2. Time of Concentrat	<u>5 x pervious area</u> = total area <b>ion</b>	<u>5 x</u> 573	<u>5 x 567.5700</u> 5.0 mm 573.290				
Channelisation factor	C =	1	1_(From Table 4.2)				
Catchment length	L =	7.153	km (along di	ong drainage path)			
Catchment Slope	Sc=	0.019	m/m (by equ	al area meth	iod)		
Runoff factor,	<u>CN</u> = 200 - CN	74.2 200- 74.2	=	0.59			
t _c = 0.14 C L ^{0.66} (CN/20	0-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	4 1	3.66 1.34	3.28	=	2.25	hrs	
SCS Lag for HEC-HMS	5 t _p = 2/3	t _c		=	1.51	hrs	
					OK use 2.2509428	hrs	
	Worksheet 1: Runo	ff Parameters and	Time of Co	ncentration			

	MAVEN AS	MAVEN ASSOCIATES Job No 211		umber 001	Sheet 1	Rev A	
Job Title Calc Title	Warkworth TP108 Calculat Upstrea	South Plan C ion - Pre-Dev m Catchmen	hange velopment t F	Aut Y	hor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initia	I Abstractio	on (la)				
Soil name and classification C	Cover descri	ption (cover nydrologic cc Total Impe	type, treatm ondition) rvious	ent, and	Curve Number CN* 98	Area (ha) 10000m2= 1ha 4.8193	Product of CN x area 472.29
С	_	Total Pervious			74	299.1107	22134.19
* from Appendix B					Totals =	303.930	22606.48
CN (weighted) = $\frac{\text{total product =}}{\text{total area}}$ $\frac{22606.48}{303.930}$ = 74.4							
la (average) =	5 x pervious area	<u>a</u> =	<u>5 x</u>	299.1107	. 4.9	mm	
2. Time of Concentrat	total area		303	.930			
Channelization factor	0	_	1	(From Toble	(1.0)		
	C		1		4.2)		
Catchment length	L	= .	4.596	km (along di	rainage path	)	
Catchment Slope	S	c=	0.024	m/m (by equ	ial area meth	iod)	
Runoff factor,	CN =		74.4	=	0.59		
	200 - CN	200-	74.4				
t _c = 0.14 C L ^{0.66} (CN/20	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	4 1	2.74	1.33	3.06	=	1.56	hrs
SCS Lag for HEC-HMS	5 t _p	= 2/3 t _c			=	1.05	hrs
						OK use 1.5646387	hrs
	Worksheet 1:	Runoff Para	meters and	I Time of Co	ncentration		

	MAVEN ASSOC	MAVEN ASSOCIATES Job N 211		umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth South Pla TP108 Calculation - Posi Upstream Catch	an Change t Development ment F	Aut Y	hor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial Abstra	ction (la)				
Soil name and classification C C	Cover description (co hydrologi Total Ir Total I	Cover description (cover type, treatment, and hydrologic condition) Total Impervious Total Pervious			Area (ha) 10000m2= 1ha 15.1030 288.8270	Product of CN x area 1480.09 21373.20
* from Appendix B				Totals =	303.930	22853.29
CN (weighted) = $total product = 22853.29 = 75.2$ total area 303.930						
la (average) = 2. Time of Concentrat	<u>5 x pervious area</u> = total area <b>ion</b>	<u> </u>	<u>5 x 288.8270</u> 4.8 mm 303.930			
Channelisation factor	C =	1	(From Table	4.2)		
Catchment length	L =	4.596	km (along di	rainage path	)	
Catchment Slope	Sc=	0.024	m/m (by equ	ial area meth	iod)	
Runoff factor,	<u>CN</u> = 200 - CN 2	75.2 00- 75.2	=	0.60		
t _c = 0.14 C L ^{0.66} (CN/20	0-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	4 1 2	.74 1.32	3.06	=	1.55	hrs
SCS Lag for HEC-HMS	5 $t_p = 2/3 t_c$			=	1.04	hrs
					OK use 1.5497843	hrs
	Worksheet 1: Runoff F	Parameters and	I Time of Co	ncentration		

	MAVEN AS	SSOCIAT	ΓES	Job Number 211001		Sheet 1	Rev A
Job Title Calc Title	Warkworth TP108 Calcula pstream Reach	South Plan Ch tion - Pre-Deve Catchment AB	nange elopment BE - Inflow	Au Y	thor W	Date 30/03/2023	Checked
1. Runoff Curve Num	ber (CN) and init	ial Abstractic	on (la)				
Soil name and classification C C	Cover descr	iption (cover tչ hydrologic cor Total Imperv Total Pervie	ype, treat ndition) vious ous	ment, and	Curve Number CN* 98 74	Area (ha) 10000m2=1ha 22.0794 1297.1506	Product of CN x area 2163.78 95989.14
* from Appendix B					Totals =	1319.230	98152.93
CN (weighted) =	total product = total area		####### ########	=	74.4		
la (average) = 2. Time of Concentra	<u>5 x pervious ar</u> total area <b>tion</b>	<u>ea</u> =	<u> </u>	<u>1297.1506</u> 19.230	4.9	mm	
Channelisation factor		C =	1	(From Table	e 4.2)		
Catchment length		L =	1.186	km (along d	rainage path	)	
Catchment Slope		Sc=	0.003	m/m (by equ	ual area meth	iod)	
Runoff factor,	CN 200 - CN	= 200-	74.4 74.4	=	0.59		
t _c = 0.14 C L ^{0.66} (CN/20	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	14 1	1.12	1.33	5.71	=	1.19	hrs
SCS Lag for HEC-HM	S	$t_{\rm p}$ = 2/3 $t_{\rm c}$			=	0.80	hrs
						OK use 1.193873089	hrs
	Worksheet	1: Runoff Par	ameters	and Time o	f Concentra	tion	

	MAVEN A	SSOCIAT	ES	Job Number 211001		Sheet 1	Rev A
Job Title Calc Title	Warkworth TP108 Calcula Upstream	n South Plan Cha ation - Pre-Devel n Reach CD to Al	ange opment BE	Au Y	thor W	Date 18/01/2023	Checked
1. Runoff Curve Nun	nber (CN) and ini	itial Abstraction	n (la)				
Soil name and classification C C	Cover desc	Cover description (cover type, treat hydrologic condition) Total Impervious Total Pervious			Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 8.6156 793.0244	Product of CN x area 844.33 58683.81
* from Appendix B					 Totals =	801.640	59528.13
CN (weighted) =	total product = total area	<u> </u>	####### ########	=	74.3	-	
la (average) = 2. Time of Concentra	<u>5 x pervious a</u> total area <b>ation</b>	<u>rea</u> =	<u>5 x</u> 80	793.0244 )1.640	4.9	mm	
Channelisation factor		C =	1	(From Table	e 4.2)		
Catchment length		L = _	2.25	km (along d	rainage path	)	
Catchment Slope		Sc= _	0.005	m/m (by equ	ual area meth	nod)	
Runoff factor,	CN 200 - CN	= 200-	74.3 74.3	=	0.59	-	
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/2})$	200-CN) ^{-0.55} Sc ^{-0.30}	)					
= 0.	.14 1	1.71	1.34	4.90	=	1.57	hrs
SCS Lag for HEC-HN	IS	$t_p = 2/3 t_c$			=	1.05	hrs
						OK use 1.5656087	hrs
	Worksheet 1:	Runoff Param	eters ar	nd Time of C	Concentratio	on	

	MAVEN AS	1AVEN ASSOCIATES Job Nu 2110		umber 001	Sheet 1	Rev A	
Job Title Calc Title	Warkworth S TP108 Calculati Downstrea	South Plan C on - Pre-Dev am Catchme	hange velopment nt A	Author YW		Date 30/03/2023	Checked
1. Runoff Curve Num	ber (CN) and initial	Abstractio	on (la)				
Soil name and classification C	Cover descrip	otion (cover ydrologic co Total Imper	type, treatm ondition) rvious	ent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 9.4054 575 1346	Product of CN x area 921.73 42559.96
						575.1540	42333.90
* from Appendix B					Totals =	584.540	43481.69
$CN \text{ (weighted)} = \frac{\text{total product} =}{\text{total area}} = \frac{43481.69}{584.540} = \frac{74.4}{74.4}$							
la (average) = 2. Time of Concentrat	<u>5 x pervious area</u> total area t <b>ion</b>	.= .	<u>5 x</u> 584	<u>5 x 575.1346</u> 4.9 mm 584.540			
Channelisation factor	С	= .	1	(From Table	4.2)		
Catchment length	L:	= .	4.848	km (along di	rainage path	)	
Catchment Slope	Sc	;= .	0.005	m/m (by equ	ial area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	200-	74.4 74.4	=	0.59		
$t_c = 0.14 \text{ C L}^{0.66} \text{ (CN/20)}$	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	4 1	2.83	1.33	4.90	=	2.59	hrs
SCS Lag for HEC-HMS	S t _p	= 2/3 t _c			=	1.74	hrs
						OK use 2.5945274	hrs
	Worksheet 1: F	Runoff Para	meters and	I Time of Co	ncentration		

	MAVEN ASS	ociates	DCIATES Job No. 211		Sheet 1	Rev A
Job Title Calc Title	Warkworth So TP108 Calculatior Downstrean	uth Plan Change - Pre-Development i Catchment B	Aut Y	thor W	Date 30/03/2023	Checked
1. Runoff Curve Num	ber (CN) and initial A	bstraction (la)				
Soil name and classification C C	Cover descripti hyd	Cover description (cover type, treatment, hydrologic condition) Total Impervious Total Pervious			Area (ha) 10000m2= 1ha 12.0476 836.7124	Product of CN x area 1180.66 61916.72
* from Appendix B CN (weighted) =	total product = total area	<u>63097.38</u> 848.760	_=	Totals = 74.3	848.760	63097.38
la (average) = <u>5 x pervious area</u> = total area 2. Time of Concentration			<u>836.7124</u> 3.760	4.9	mm	
Channelisation factor	C =	1	(From Table	: 4.2)		
Catchment length	L =	5.031	km (along d	rainage path	)	
Catchment Slope	Sc=	0.011	m/m (by equ	ial area metł	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	74.3 200- 74.3	_=	0.59	-	
t _c = 0.14 C L ^{0.66} (CN/20	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	4 1	2.90 1.33	3.87	=	2.10	hrs
SCS Lag for HEC-HMS	S t _p =	2/3 t _c		=	1.41	hrs
					OK use 2.0998325	hrs
	Worksheet 1: Ru	noff Parameters and	d Time of Co	oncentration	I	

	MAVEN ASSOCIA	TES	Job Number 211001		Sheet 1	Rev A	
Job Title Calc Title	Warkworth South Plan ( TP108 Calculation - Pre-De Downstream Catchme	Change velopment ent C	Aut Y	thor W	Date 30/03/2023	Checked	
1. Runoff Curve Num	ber (CN) and initial Abstracti	ion (la)					
Soil name and classification C C	Cover description (cover hydrologic c Total Impe Total Per	Cover description (cover type, treatment, and hydrologic condition) Total Impervious Total Pervious			Area (ha) 10000m2= 1ha 7.3200 16.2500	Product of CN x area 717.36 1202.50	
* from Appendix B				Totals =	23.570	1919.86	
CN (weighted) = total product = 1919.86 = 81.5 total area 23.570							
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area <b>tion</b>	<u> </u>	<u>16.2500</u> 3.570	. 3.4	mm		
Channelisation factor	C =	1	(From Table	: 4.2)			
Catchment length	L =	1.018	km (along di	rainage path	)		
Catchment Slope	Sc=	0.01	m/m (by equ	ial area meth	nod)		
Runoff factor,	<u>CN =</u> 200 - CN 200	81.5 - 81.5	.=	0.69			
t _c = 0.14 C L ^{0.66} (CN/2	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.	14 1 1.01	1 1.23	3.98	=	0.69	hrs	
SCS Lag for HEC-HM	S $t_p = 2/3 t_c$			=	0.46	hrs	
					OK use 0.6932339	hrs	
	Worksheet 1: Runoff Para	ameters an	d Time of C	oncentratio	1		

	MAVENA	ASSOCIA	ATES Job Nu 2110		umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkwor TP108 Calcu TP108 Dov	th South Plan C lation - Pre-Dev vnstream Catch	Change velopment nment D	Author YW		Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and ini	tial Abstractio	on (la)				
Soil name and classification C	Cover des	cription (cover hydrologic co Total Impe	type, treatm ondition) rvious	ent, and	Curve Number CN* 98	Area (ha) 10000m2= 1ha 8.4586	Product of CN x area 828.94 20379 70
		Total Fervious			74	273.4014	20379.70
* from Appendix B					Totals =	283.860	21208.65
$CN \text{ (weighted)} = \underbrace{\frac{\text{total product}}{\text{total area}}}_{283.860} \underbrace{\frac{21208.65}{283.860}}_{=} \underbrace{74.7}_{-}$							
la (average) = 2. Time of Concentra	<u>5 x pervious a</u> total area <b>tion</b>	<u>rea</u> =	<u> </u>	<u>5 x 275.4014</u> 4.9 mm 283.860			
Channelisation factor		C =	1	(From Table	4.2)		
Catchment length		L =	3.056	km (along di	ainage path	)	
Catchment Slope		Sc=	0.01	m/m (by equ	ial area meth	nod)	
Runoff factor,	CN 200 - CN	= 200-	74.7 74.7	=	0.60	-	
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/20})$	00-CN) ^{-0.55} Sc ^{-0.30}	I					
= 0.1	14 1	2.09	1.33	3.98	=	1.55	hrs
SCS Lag for HEC-HMS	S	$t_{\rm p}$ = 2/3 $t_{\rm c}$			=	1.04	hrs
						OK use 1.5480986	hrs
	Worksheet	1: Runoff Para	imeters and	I Time of Co	ncentration		

	MAVEN ASSOC	CIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth South P TP108 Calculation - Pro Down Catchn	Plan Change e-Development nent E	Aut Y	hor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial Abst	raction (la)				
Soil name and classification C C	Cover description (c hydrolog Total Total	over type, treatn gic condition) Impervious Pervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 45.2715 26.8785	Product of CN x area 4436.61 1989.01
* from Appendix B CN (weighted) =	total product = total area	<u>6425.62</u> 72.150	.=	Totals = 89.1	72.150	6425.62
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area <b>tion</b>	<u>5 x</u> 72	26.8785 2.150	1.9	mm	
Channelisation factor	C =	1	(From Table	4.2)		
Catchment length	L =	1.665	km (along di	rainage path	)	
Catchment Slope	Sc=	0.019	m/m (by equ	ial area meth	iod)	
Runoff factor,	<u>CN</u> = 200 - CN	89.1 200- 89.1	=	0.80		
t _c = 0.14 C L ^{0.66} (CN/2	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.	14 1	1.40 1.13	3.28	=	0.73	hrs
SCS Lag for HEC-HM	S $t_p = 2/3$ t	t _c		=	0.49	hrs
					OK use 0.7262942	hrs
	Worksheet 1: Runoff	Parameters an	d Time of C	oncentratio	ı	

	MAVEN ASSC	CIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth South TP108 Calculation - I Downstream C	Plan Change Pre-Development atchment F	Aut Y	thor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial Ab	straction (la)				
Soil name and classification C C	Cover description hydro Tota Tot	(cover type, treatn logic condition) al Impervious tal Pervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 0.2200 21.5700	Product of CN x area 21.56 1596.18
* from Appendix B				Totals =	21.790	1617.74
CN (weighted) =	total product = total area	<u>1617.74</u> 21.790	=	74.2	-	
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area t <b>ition</b>	<u>5 x</u> 21	21.5700 .790	4.9	mm	
Channelisation factor	C =	1	(From Table	: 4.2)		
Catchment length	L =	1.076	km (along di	rainage path	)	
Catchment Slope	Sc=	0.03	m/m (by equ	ial area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	74.2 200- 74.2	=	0.59	-	
t _c = 0.14 C L ^{0.66} (CN/2	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	14 1	1.05 1.34	2.86	=	0.56	hrs
SCS Lag for HEC-HM	S t _p = 2/	3 t _c		=	0.38	hrs
					OK use 0.5621775	hrs
	Worksheet 1: Runo	ff Parameters an	d Time of C	oncentratio	n	

	MAVEN ASSO	OCIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth Sour TP108 Calculation Downstream	Warkworth South Plan Change A TP108 Calculation - Pre-Development Downstream Catchment G		Author YW		Checked
1. Runoff Curve Num	ber (CN) and initial At	ostraction (la)				
Soil name and classification C C	Cover description hydr Tc T	n (cover type, treatm ologic condition) ttal Impervious otal Pervious	ent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 67.7100 59.8900	Product of CN x area 6635.58 4431.86
* from Appendix B				Totals =	127.600	11067.44
CN (weighted) =	total product = total area	<u>11067.44</u> 127.600	=	86.7		
la (average) = 2. Time of Concentrat	<u>5 x pervious area</u> = total area <b>ion</b>	<u>5 x</u> 127	<u>59.8900</u> 7.600	2.3	mm	
Channelisation factor	C =	1	(From Table	4.2)		
Catchment length	L =	2.412	km (along di	rainage path	)	
Catchment Slope	Sc=	0.019	m/m (by equ	ial area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	86.7 200- 86.7	=	0.77		
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/20})$	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	4 1	1.79 1.16	3.28	=	0.95	hrs
SCS Lag for HEC-HMS	8 t _p = 2	/3 t _c		=	0.64	hrs
					OK use 0.9519511	hrs
	Worksheet 1: Run	off Parameters and	d Time of Co	ncentration		

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	MAVEN ASSC	OCIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth Sout TP108 Calculation - Downstream (	h Plan Change Pre-Development Catchment H	Au Y	thor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial Al	ostraction (Ia)				
Soil name and classification C C	Cover descriptior hydro To	n (cover type, treatr blogic condition) tal Impervious btal Pervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 23.6020 25.5680	Product of CN x area 2313.00 1892.03
CN (weighted) =	total product = total area	<u>4205.03</u> 49.170	=	85.5	-	4205.03
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area <b>tion</b>	<u>5 x</u> 49	<u>25.5680</u> 9.170	2.6	mm	
Channelisation factor	C =	1	(From Table	4.2)		
Catchment length	L =	1.471	km (along d	rainage path	)	
Catchment Slope	Sc=	0.024	m/m (by equ	ıal area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	85.5 200- 85.5	.=	0.75	-	
t _c = 0.14 C L ^{0.66} (CN/2	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	14 1	1.29 1.17	3.06	=	0.65	hrs
SCS Lag for HEC-HM	S t _p = 2	//3 t _c		=	0.43	hrs
					OK use 0.6491606	hrs
	Worksheet 1: Run	off Parameters an	d Time of C	oncentratio	n	

	MAVEN ASSOC	CIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth South P TP108 Calculation - Pro Reach Scheme	Warkworth South Plan Change A TP108 Calculation - Pre-Development Reach Scheme in to out		Author YW		Checked
1. Runoff Curve Num	ber (CN) and initial Abst	raction (Ia)				
Soil name and classification C	Cover description (c hydrolog Total	over type, treatn gic condition) Impervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2=1h a 30.9143 2111 7450	Product of CN x area 3029.60
		T CI VIOUS			2111.7430	130203.10
* from Appendix B				Totals =	2142.659	159298.73
CN (weighted) =	total product = total area	######## 2142.659	=	74.3		
la (average) =	<u>5 x pervious area</u> = total area	<u>5 x</u> 214	2111.7450	. 4.9	mm	
2. Time of Concentrat	tion					
Channelisation factor	C =	1	(From Table	e 4.2)		
Catchment length	L =	2.973	km (along d	rainage path)	)	
Catchment Slope	Sc=	0.005	m/m (by equ	ual area meth	iod)	
Runoff factor,	<u>CN</u> = 200 - CN	74.3 200- 74.3	=	0.59		
$t_c = 0.14 \text{ C L}^{0.66} \text{ (CN/20)}$	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	4 1	2.05 1.33	4.90	=	1.88	hrs
SCS Lag for HEC-HMS	5 $t_p = 2/3 t_p$	c		=	1.26	hrs
					OK use 1.87974775	hrs
	Worksheet 1: Runof	f Parameters ar	nd Time of C	Concentratio	'n	

	MAVEN AS	SOCIA	ΓES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth So Calculation Downstream R	outh Plan Cha n - Pre-Develo leach B to SC	nge TP108 opment HEME OUT	Aut Y	hor W	Date 30/03/2023	Checked
1. Runoff Curve Num	ber (CN) and initia	I Abstractio	n (la)				
Soil name and classification C C	Cover descri	ption (cover t nydrologic co Total Imper Total Pervi	ype, treatm ndition) vious ious	ent, and	Curve Number CN* 98 74	Area (ha) 10000m2= 1ha 12.0476 836.7124	Product of CN x area 1180.66 61916.72
* from Appendix B					Totals =	848.760	63097.38
CN (weighted) =	total product = total area	-	63097.38 848.760	=	74.3		
la (average) = 2. Time of Concentrat	<u>5 x pervious area</u> total area t <b>ion</b>	<u>a</u> =	<u>5 x</u> 848	<u>836.7124</u> .760	4.9	mm	
Channelisation factor	С	= _	1	(From Table	4.2)		
Catchment length	L	= _	4.85	km (along dı	ainage path)	)	
Catchment Slope	S	c= _	0.007	m/m (by equ	al area meth	iod)	
Runoff factor,	<u>CN</u> = 200 - CN	200-	74.3 74.3	=	0.59		
$t_c = 0.14 \text{ C L}^{0.66} \text{ (CN/20)}$	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	4 1	2.84	1.33	4.43	=	2.35	hrs
SCS Lag for HEC-HMS	6 t _p	= 2/3 t _c			=	1.57	hrs
						OK use 2.3473116	hrs
Worksheet 1: Runoff Parameters and Time of Concentration							

	MAVEN ASSC	CIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth South Plan Change TP108 Calculation - Pre-Development Downstream Reach Scheme out to CD		Author YW		Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial Ab	straction (la)		_		
Soil name and classification C C	Cover description hydrol Tota	(cover type, treatn logic condition) al Impervious tal Pervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2=1h a 68.7906 3992.4987	Product of CN x area 6741.48 295444.90
* from Appendix B				Totals =	4061.289	302186.38
CN (weighted) =	total product = total area	######## 4061.289	=	74.4		
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area <b>tion</b>	<u>5 x</u> 406	<u>3992.4987</u> 1.289	4.9	mm	
Channelisation factor	C =	1	(From Table	e 4.2)		
Catchment length	L =	1	km (along di	rainage path)	)	
Catchment Slope	Sc=	0.004	m/m (by equ	ual area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	74.4 200- 74.4	=	0.59		
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/20})$	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	14 1	1.00 1.33	5.24	=	0.98	hrs
SCS Lag for HEC-HM	S t _p = 2/3	3 t _c		=	0.66	hrs
					OK use 0.97848894	hrs
	Worksheet 1: Run	off Parameters ar	nd Time of C	Concentratio	n	

MAEN	MAVEN ASSO	DCIATES	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth Sou TP108 Calculation Downstream Re	th Plan Change - Pre-Development ach CD to EFG	Aut Y	thor W	Date 18/01/2023	Checked
1. Runoff Curve Num	ber (CN) and initial A	bstraction (la)				
Soil name and classification C C	Cover description hydr Tc T	n (cover type, treatn ologic condition) tal Impervious otal Pervious	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2=1h a 84.5692 4284.1501	Product of CN x area 8287.78 317027.11
* from Appendix B				Totals =	4368.719	325314.89
CN (weighted) =	total product = total area	<u>#######</u> 4368.719	=	74.5		
la (average) = 2. Time of Concentra	<u>5 x pervious area</u> = total area t <b>ion</b>	<u>5 x</u> 436	4284.1501 68.719	4.9	mm	
Channelisation factor	C =	1	(From Table	4.2)		
Catchment length	L =	1	km (along di	rainage path)	)	
Catchment Slope	Sc=	0.002	m/m (by equ	ial area meth	nod)	
Runoff factor,	<u>CN</u> = 200 - CN	74.5 200- 74.5	=	0.59	-	
t _c = 0.14 C L ^{0.66} (CN/2)	00-CN) ^{-0.55} Sc ^{-0.30}					
= 0.1	14 1	1.00 1.33	6.45	=	1.20	hrs
SCS Lag for HEC-HM	S t _p = 2	2/3 t _c		=	0.81	hrs
					OK use 1.2038381	hrs
	Worksheet 1: Ru	noff Parameters ar	nd Time of C	oncentratio	n	

	MAVEN AS	SOCIATE	S	Job N 211	umber 001	Sheet 1	Rev A
Job Title Calc Title	Warkworth S TP108 Calculat Downstream	arkworth South Plan Change Auti 8 Calculation - Pre-Development YV wnstream Reach EFG to Outlet		thor W	Date 31/03/2023	Checked	
1. Runoff Curve Num	ber (CN) and initia	al Abstraction (I	la)			-	
Soil name and classification C C	Cover descri	otion (cover type hydrologic conditi Total Imperviou Total Pervious	, treatm ion) us	nent, and	Curve Number CN* 98 74	Area (ha) 10000m2=1h a 197.7707 4392.4886	Product of CN x area 19381.53 325044.16
CN (weighted) =	total product = total area	<u>###</u> 459	<u>####</u> 90.259	=	75.0		344423.09
la (average) = 2. Time of Concentra	<u>5 x pervious are</u> total area <b>tion</b>	<u>a</u> =	<u>5 x</u> 459	<u>4392.4886</u> 0.259	4.8	mm	
Channelisation factor	C	;=	1	(From Table	4.2)		
Catchment length	L	=	1.08	km (along di	rainage path)	)	
Catchment Slope	S	6c=	0.004	m/m (by equ	ial area meth	iod)	
Runoff factor,	<u> </u>	200-	75.0 75.0	=	0.60		
$t_c = 0.14 \text{ C L}^{0.66} (\text{CN/20})$	00-CN) ^{-0.55} Sc ^{-0.30}						
= 0.1	14 1	1.05	1.32	5.24	=	1.02	hrs
SCS Lag for HEC-HM	S t _r	$_{\rm o}$ = 2/3 t _c			=	0.68	hrs
						OK use 1.02191107	hrs
	Worksheet 1:	Runoff Parame	ters an	d Time of C	concentratio	n	



**APPENDIX D – TP108 and Time of concentration calculations** 

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

# WOODCOCK BRIDGE (Existing scenario 100yr no Climate Change)

User-defined		Highlighted	
Invert Elev (m)	= 16.0500	Depth (m)	= 5.6054
Slope (%)	= 0.2000	Q (cms)	= 347
N-Value	= 0.030	Area (sqm)	= 107.6504
		Velocity (m/s)	= 3.2187
Calculations		Wetted Perim (m)	= 34.0348
Compute by:	Known Q	Crit Depth, Yc (m)	= 4.2215
Known Q (cms)	= 346.5000	Top Width (m)	= 31.7164
		EGL (m)	= 6.1338

(Sta, El, n)-(Sta, El, n)... ( 0.0000, 23.7500)-(4.4200, 23.7500, 0.030)-(20.9300, 16.2500, 0.030)-(23.9300, 16.0500, 0.030)-(28.0300, 16.2500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030) -(50.0000, 23.7500, 0.030)



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

# WOODCOCK BRIDGE (Existing scenario 100yr + Climate Change)

User-defined		Highlighted	
Invert Elev (m)	= 16.0500	Depth (m)	= 6.1205
Slope (%)	= 0.2000	Q (cms)	= 422
N-Value	= 0.030	Area (sqm)	= 124.5731
		Velocity (m/s)	= 3.3851
Calculations		Wetted Perim (m)	= 36.5283
Compute by:	Known Q	Crit Depth, Yc (m)	= 4.6483
Known Q (cms)	= 421.7000	Top Width (m)	= 33.9872
		EGL (m)	= 6.7050

(Sta, El, n)-(Sta, El, n)... ( 0.0000, 23.7500)-(4.4200, 23.7500, 0.030)-(20.9300, 16.2500, 0.030)-(23.9300, 16.0500, 0.030)-(28.0300, 16.2500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030) -(50.0000, 23.7500, 0.030)



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

### WOODCOCK BRIDGE (Proposed scenario 100yr + Climate Change)

User-defined		Highlighted	
Invert Elev (m)	= 16.0500	Depth (m)	= 6.1144
Slope (%)	= 0.2000	Q (cms)	= 421
N-Value	= 0.030	Area (sqm)	= 124.3660
		Velocity (m/s)	= 3.3819
Calculations		Wetted Perim (m)	= 36.4988
Compute by:	Known Q	Crit Depth, Yc (m)	= 4.6422
Known Q (cms)	= 420.6000	Top Width (m)	= 33.9603
		EGL (m)	= 6.6978

(Sta, El, n)-(Sta, El, n)... ( 0.0000, 23.7500)-(4.4200, 23.7500, 0.030)-(20.9300, 16.2500, 0.030)-(23.9300, 16.0500, 0.030)-(28.0300, 16.2500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(29.3700, 16.5000, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 23.7500, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030)-(45.3700, 0.030) -(50.0000, 23.7500, 0.030)

