CIVIX

Auckland Council, Maxar

1/10/2024

MAHI ROAD 40, HELENSVILLE

FLOOD MODELLING METHODOLOGY – PRIVATE PLAN CHANGE

Development of Mahi Road 40, Helensville | Flood Modelling Methodology – Private Plan Change

Dear Richard,

Thank you for the opportunity for Civix to provide an Flood Modelling Methodology – Private Plan Change for the Development of Mahi Road 40, Helensville.

This report details the flood modelling methodology used in the assessment of the proposed Development of Mahi Road 40, Helensville.

Please do not hesitate to contact us if you have any questions on this report,

Written By:

Gregg Cunningham
Senior Engineer (CPENG 1166283)
022 460 0414
gregg@civix.co.nz
Civix

PLANNING
ENGINEERING
SURVEYING

Contents

1. Introduction

This document details the flood modelling methodology utilised by Civix in the modelling of flood plains in the Tuflow modelling package. Modelling is completed via ARCGIS Pro. The full TuFlow modelling package for a project can be provided on request for review as required. Any deviation from this standard methodology will be outlined in the flooding section of the Infrastructure Report for a specific project.

2. Extent

The extent of the flood model has been set to account for upstream, adjacent and downstream hydraulic features that could affect the location and extent of flow into, through and out of the site. The location of overland flow paths in Council GIS is also taken into account to ensure flow paths entering the site are captured.
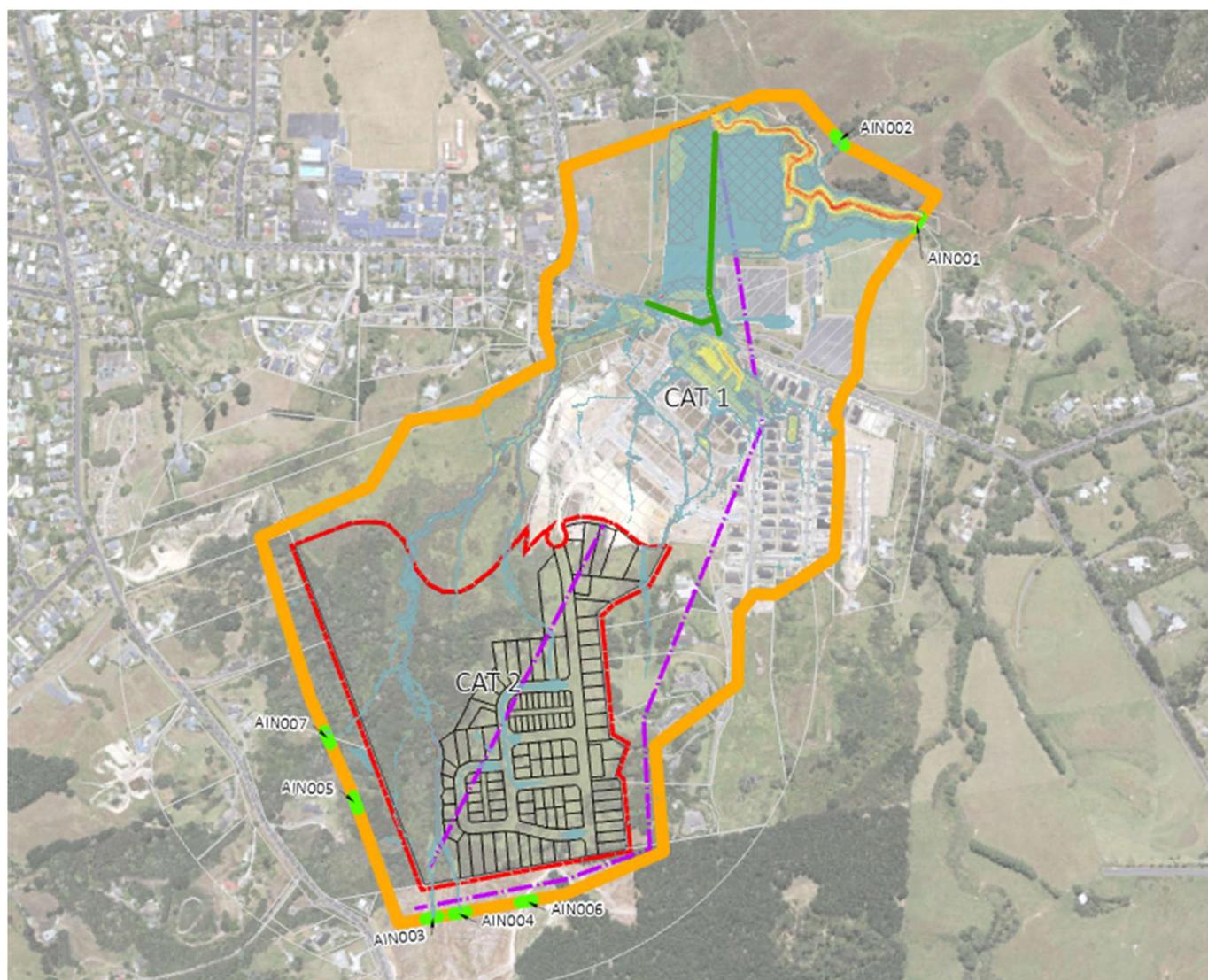

Figure 1- - showing the site (in red), model extent (in orange and purple) and upstream flows entering the model (in green)

3. Inflows

Site characteristics for the TuFlow modelling are determined based on a Citywide overlay of rainfall depths and soil classifications. The rainfall depths have been found through a linear interpolation for each storm based on the rainfall contour plots in TP108. These depths are then adjusted for climate change to provide the rainfall depths used in the modelling. The percentage increase in rainfall depth accounts for future climate change of 3.8 degrees Celsius, as prescribed by Chapter 4: Stormwater Version 4 (March 2024) of the Auckland Code of Practice for Land Development and Subdivision. Refer to Figure 1 below, extracted from the aforementioned document, which shows the percentage increase in TP108 24-hour design rainfall depth based on annual exceedance probability for both 2.1 degrees Celsius and 3.8 degrees Celsius climate change projections.

Figure 2: Percentage increase in Tp108 24-hour design rainfall depth

Annual exceedance probability (AEP)	Percentage Increase in 24-hour design rainfall depth due to future climate change – 2.1°	Percentage Increase in 24-hour design rainfall depth due to future climate change – 3.8°
50%	15.1%	27.4%
20%	16.4%	29.6%
10%	17.0%	30.8%
5%	17.2%	31.2%
2%	17.6%	31.9%
1%	18.1%	32.7%

Soil classifications are determined based on soil mapping information available at Auckland Council and also national datasets. These datasets have been combined to provide an SCS soil classification across the city. This SCS soil classification is then used to determine the permeable curve number for the site which is given below in Table 1.

The upstream catchment areas are set based on the area accumulation model in the Citywide GIS layer. Catchment lengths are determined through the model designer tracing the catchment length in GIS, this is then draped on the Citywide LIDAR layer and the equal area slope calculated to give the upstream catchment slope. The channelisation factor is set based on the nature of the upstream catchment and using TP108.

The catchment factors and then used to calculate inflow Hydrographs using the SCS Curve runoff method, as recommended in TP108.

Table 1 TuFlow Upstream Catchment Details

Scenario ID	Units	01_Ex100yr									02_Pr100yr								
Input ID		AIN 001	AIN 002	AIN 003	AIN 004	AIN 005	AIN 006	AIN 007	CAT 1	CAT 2	AIN 001	AIN 002	AIN 003	AIN 004	AIN 005	AIN 006	AIN 007	CAT 1	CAT 2
Imp. Area	m²	1,336,472	1,683	4,754	1,122	320	222	1,349	254,408	0	1,336,472	1,683	4,754	1,122	320	222	1,349	254,408	109,253
Perv. Area	m²	6,088,373	26,374	16,857	10,100	2,884	2,002	12,139	169,605	182,089	6,088,373	26,374	16,857	10,100	2,884	2,002	12,139	169,605	72,836
Tot. Area	m²	7,424,846	28,058	21,611	11,222	3,204	2,224	13,488	424,014	182,089	7,424,846	28,058	21,611	11,222	3,204	2,224	13,488	424,014	182,089
Imp. %	%	18%	6%	22%	10%	10%	10%	10%	60%	0%	18%	6%	22%	10%	10%	10%	10%	60%	60%

CIVIX

Scenario ID	Units	01_Ex100yr									02_Pr100yr								
Input ID		AIN 001	AIN 002	AIN 003	AIN 004	AIN 005	AIN 006	AIN 007	CAT 1	CAT 2	AIN 001	AIN 002	AIN 003	AIN 004	AIN 005	AIN 006	AIN 007	CAT 1	CAT 2
Length	m	4,032	196	305	144	100	20	86	1,442	554	4,032	196	305	144	100	20	86	1,442	554
Slope	%	3.0 %	17.2 %	12.0 %	16.2 %	18.6 %	3.9 %	9.2 %	5.3 %	9.3 %	3.0 %	17.2 %	12.0 %	16.2 %	18.6 %	3.9 %	9.2 %	5.3 %	9.3 %
Storm Return Period	yr	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Duration	hr	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Perm. Curve No.		73	74	71	74	61	74	61	61	61	73	74	71	74	61	74	61	61	61
Channelisation Fac.		1.0	1.0	0.8	1.0	1.0	1.0	1.0	0.6	0.6	1.0	1.0	0.8	1.0	1.0	1.0	1.0	0.6	0.6
Rainfall Depth No CC.	mm	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4	178.4
Climate Change % Increase	%	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %	16.8 %
Rainfall Depth with CC.	mm	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3	208.3
Runoff Depth	mm	150.6	145.0	149.7	147.5	122.1	147.5	122.1	167.2	113.0	150.6	145.0	149.7	147.5	122.1	147.5	122.1	167.2	167.2
Peak Flow	m³/s	90.6174	0.7678	0.5970	0.3106	0.0728	0.0615	0.3065	10.5459	3.8250	90.6174	0.7678	0.5970	0.3106	0.0728	0.0615	0.3065	10.5459	5.3089
Flow Volume	m³	1,118,441	4,069	3,236	1,655	391	328	1,646	70,890	20,585	1,118,441	4,069	3,236	1,655	391	328	1,646	70,890	30,443

4. Levels and Landuse

Model levels are determined based on survey and LIDAR information. A tin is prepared for the existing and proposed scenarios and used to create the level raster used by the TuFlow modelling engine.

To determine the manning values and to model the existing and proposed buildings in the catchment, an analysis of buildings and surfaces is undertaken. Firstly, the model determines the location of existing and proposed buildings in the catchment and deactivates these cells in the 2D domain, unless the building is flagged as being on poles in the GIS data. The area of roofs that are deactivated is then used to correct the volume of runoff into the remaining active cells, to ensure the total volume of water entering the model is correct.

For the remaining active areas of the model, the manning n value is set based on the surface type. Manning N values used in this model are given below in Table 2.

Table 2 TuFlow Landuse Mannings N Values

Landuse Description	Pipe	Grass	Pavementlot	Pavementroad	Stream	Retainingwall	Building
Mannings N Value	0.014	0.050	0.020	0.020	0.050	0.100	1.000

5. Pipes

Pipe assets that are sufficiently sized to not be considered 100% blocked in the Auckland Council Modelling Guidelines are included in the model as 1D assets with 1D to 2D connections made at the manhole locations. Blockage factors are applied based on the guidance in the Auckland Council Stormwater Code of Practice. To ensure flow is captured at the manhole locations, the level raster for the model is adjusted at manhole locations to lower levels around the manhole. This ensure the manhole is filled up prior to overland flow proceeding downstream of the manhole location. Inlet losses are modelled via an inlet loss on the pipe model link, rather than the manhole model node. An inlet loss value of 0.5 is used in the model on the links. No head discharge relationship is applied on the manhole itself.

6. Outflows

Outflows from the modelled area are modelled using a manning N value channel set at a 1% grade. The TuFlow software automatically determines the ground profile along the outlet location and develops a stage storage relationship using the Manning N values from Table 1. These are then used to control outflow from the model. In general, the model extent will include significant downstream hydraulic features, so the effect of the outflow stage storage should be reduced.

7. Afflux Plots

Where pre and post development scenarios are being modelled our outputs present these results as afflux plots as well as with the results of the pre and post models in the 1300 drawing series. These drawings have three panes, the left hand pane is the existing model results, the middle pane is the proposed modelling results and the right hand pane is the afflux results which is the differences between the pre and the post modelling results. An afflux plot is similar in nature to a cut-fill plan, using the existing and proposed water level surfaces.

The output existing and proposed drawings show the model depth via colours, flow directions at the time of peak flow and peak depth and velocity values are labelled across the drawing to provide further information on modelling results. The afflux plots are also labelled with the depth difference and velocity differences between the pre and post modelling scenarios.

8. Model Health

To determine the accuracy of the modelling, we consider the model health parameters shown below as well as any surrounding flood level information from council where available to determine that the results presented in our analysis are accurate. The results of the modelling undertaken are shown below in Table 3, in general, a Final Cumulative ME of less than 5% is considered good and less than 10% is considered adequate for land development assessment purposes.

Table 3 TuFlow Model Run Statistics

Item	Units	01_Ex100yr	02_Pr100yr
Warnings During Simulation		0	0
Total Volume Out	m³	1,198,302	1,208,162
Volume Error	m³	24 or 0.0%	28 or 0.0%
Final Cumulative ME	%	0.00%	0.00%

9. Results

Please see attached the Tuflow Flooding result plans and associated sections/calculations which compare the pre-development level for the site and show the estimated effects to the upstream/downstream properties post-development. A discussion on the results and how they impact the development is included in the flooding section of the infrastructure report.

10. Limitations

- This assessment contains the professional opinion of Civix Staff relating to this development. Civix Staff used their professional judgement and acted in accordance with the standards of care and skill normally exercised by professional engineers providing similar services in similar circumstances. No other express or implied warranty is made as to the professional advice contained in this report.
- We have prepared this report in accordance with the brief provided and following our terms of engagement. The information contained in this report has been prepared by Civix for the client and is exclusively for its client use and reliance. It is not possible to make an assessment of this report without understanding the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Civix. The assessment will not address issues which would need to be considered for another party if that parties' particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage arising out of the use of or reliance on this assessment by any third party.
- The assessment is also based on information that has been provided to Civix from other sources or by other parties. The assessment has been prepared strictly on the basis that the information that has been provided is accurate, completed, and adequate. To the extent that any information is inaccurate, incomplete or inadequate, Civix takes no responsibility or liability whatsoever for any loss or damage that results from any design and assessment based on information that has been provided to Civix.