

# **Katikati Stormwater**

Model Build and Flood Hazard  
Mapping Report

**Western Bay of Plenty District  
Council**

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# Contents

<b>1</b>	<b>Project Overview and Objectives.....</b>	<b>1</b>
1.1	Project Overview .....	1
1.2	Project Objectives.....	1
<b>2</b>	<b>Study Area.....</b>	<b>2</b>
<b>3</b>	<b>Input Data .....</b>	<b>3</b>
3.1	Lidar.....	3
3.2	Building Footprints.....	3
3.3	Road and Parcel Boundaries .....	3
3.4	Stormwater Asset Data.....	3
3.5	Stormwater As-Built Plans.....	4
3.6	Survey.....	4
<b>4</b>	<b>Approach and Model Schematisation .....</b>	<b>5</b>
4.1	Base Model – Uretara Stream.....	5
4.2	Model Expansion to all of Katikati .....	5
4.3	Model Schematisation .....	5
<b>5</b>	<b>Hydrological Modelling.....</b>	<b>7</b>
5.1	Uretara Stream Upper Catchment Hydrology .....	7
5.2	Study Area Hydrology.....	9
5.3	McKinney Stream Catchment.....	13
<b>6</b>	<b>Hydrodynamic Modelling.....</b>	<b>14</b>
6.1	Mike 11 .....	14
6.2	Mike 21 .....	14
6.3	Mike Urban .....	15
6.4	Mike Flood.....	15
<b>7</b>	<b>Scenarios / Boundary Conditions.....</b>	<b>17</b>
7.1	Scenarios.....	17
7.2	Tidal boundaries .....	18
7.3	Uretara Stream Inflows.....	18
7.4	Rainfall.....	19
<b>8</b>	<b>Results.....</b>	<b>20</b>
<b>9</b>	<b>Limitations and Applicability .....</b>	<b>21</b>

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## Appendices

<b>Appendix A</b> .....	<b>23</b>
Field Survey.....	23
<b>Appendix B</b> .....	<b>25</b>
Pond Outlet Q-H Relationships .....	25
<b>Appendix C</b> .....	<b>27</b>
Maximum Flood Depth Maps.....	27
<b>Appendix D</b> .....	<b>29</b>
Subcatchment Boundaries .....	29

## Figures

Figure 1: Study Area.....	2
Figure 2: 2015 LiDAR extent (hatched).....	3
Figure 3: BOPRC Uretara Stream Model subcatchments.....	7
Figure 4: Uretara Stream catchments upstream of SH2 .....	8
Figure 5: Study Area Subcatchments.....	9
Figure 6: Existing Development Land Use .....	10
Figure 7: Maximum Probable Development Land Use .....	12
Figure 8: McKinney Stream Catchment .....	13
Figure 9: McKinney Stream Catchment Loading Point .....	13

## Tables

Table 1: Peak Design Flows at SH2.....	7
Table 2: MPD Imperviousness Assumptions.....	11
Table 3: Hydrological Model Parameters .....	12
Table 4: Scenarios.....	17
Table 5: Rainfall/Tide Combinations Modelled.....	17
Table 6: Tidal Boundaries (m RL) .....	18
Table 7: Uretara Stream Inflows (m <sup>3</sup> /s) .....	18
Table 8: Six Hour Rainfall Depths (mm).....	19

# 1 Project Overview and Objectives

## 1.1 Project Overview

Western Bay of Plenty District Council (WBOPDC) wish to have a comprehensive flood hazard model for the Katikati Catchment (refer Figure 1) for their use as described in section 2 below.

The model should be developed in line with the Bay of Plenty Regional Council's Hydrological and Hydraulic Guidelines.

## 1.2 Project Objectives

WBOPDC have outlined the following purposes for the model:

### 1.2.1 Inform future planning processes (i.e. Structure Plan review)

Council is currently preparing a Structure Plan for a proposed new urban growth area at Beach Road in Katikati. The output of the model will be utilised to inform this process and ensure future developments either avoid areas of potential flooding or are designed to minimise risk and stormwater impact. It will also be used to meet Council's susceptibility mapping and flood risk assessment requirements under Change 2 Natural Hazards of the Regional Policy Statement in relation to developments on land of more than 5ha.

A Plan Change will follow to introduce the proposed urban growth area into the District Plan.

### 1.2.2 Set minimum floor level requirements

Any new developments are required to meet Council's minimum floor level requirements. The model outputs will be used to inform this process. This will be used for existing and future development areas within Katikati.

### 1.2.3 To assess Council's performance against Level of Service

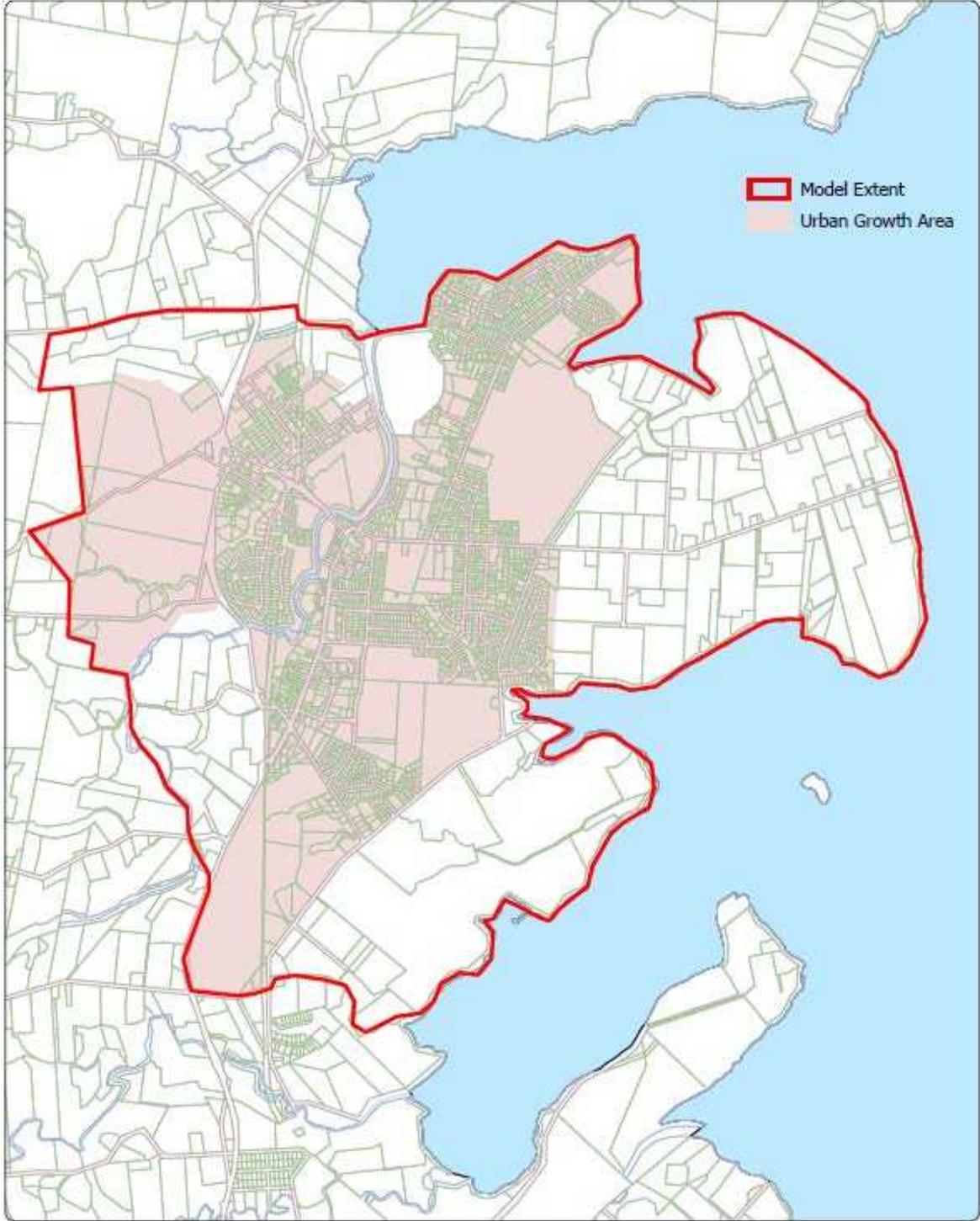
Council's Level of Service for stormwater focuses on protecting properties from flooding during a 10 year flood event. The model outputs will be used to assess Council's stormwater infrastructure performance against this Level of Service.

### 1.2.4 To be integrated into a wider planning review in line with the Natural Hazard provisions of the Bay of Plenty Regional Council Policy Statement (RPS)

Council is progressively working through the District to develop a stormwater model for all urban catchments. Once all models for the District are complete, Council will be using the models for a District-wide susceptibility mapping exercise and risk assessment in accordance with the requirements of Change 2 – Natural Hazards of the Regional Policy Statement. The mapping and risk assessment will then be used to implement a District Plan Change.

# 2 Study Area

Figure 1: Study Area

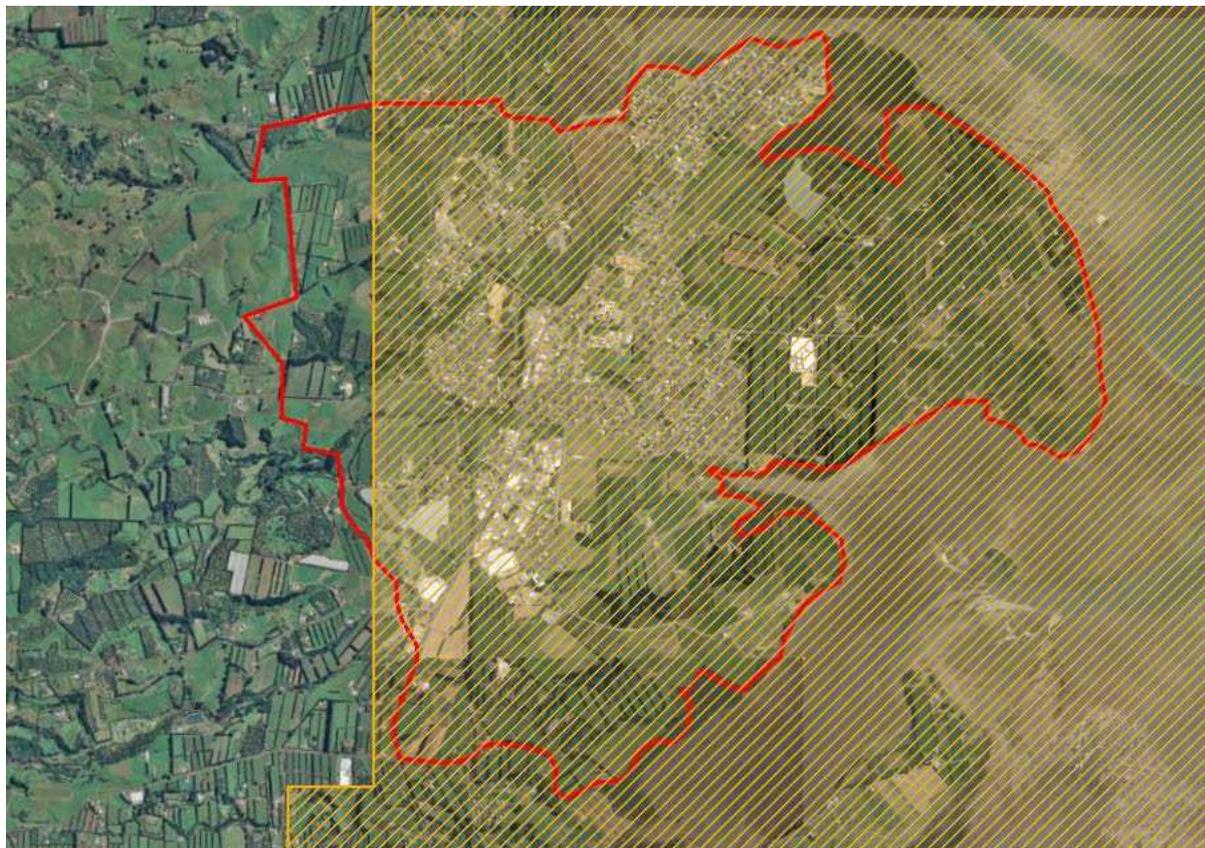


## 3 Input Data

### 3.1 Lidar

Most of the study area is covered by the Bay of Plenty coastal strip LiDAR flown in 2015 (refer hatched area in Figure 2 below). The remaining area was based on 2011 LiDAR.

Figure 2: 2015 LiDAR extent (hatched)



### 3.2 Building Footprints

A shape file of building footprints was provided by Council. It is noted that this file is based on data from 2014/15 and therefore did not include the most recent buildings.

### 3.3 Road and Parcel Boundaries

Road and parcel boundaries were supplied by Council based on the latest LINZ information

### 3.4 Stormwater Asset Data

Council supplied all their stormwater assets data including:

- Manholes;
- Pipes;
- Sumps;
- Sump leads;
- Open drains.

Where data was missing or conflicting – engineering judgement was generally used to interpolate or estimate values. The exception to this was in areas where the missing information was considered to potentially have a significant bearing on modelled results in which case survey was requested.

### **3.5 Stormwater As-Built Plans**

As built plans for several stormwater ponds in Katikati were supplied. Generally, the as-built plans did not have sufficient detail of the outlet structure, so survey was required.

### **3.6 Survey**

Survey was undertaken by Aurecon's survey team in June 2019. It included areas of confusing, conflicting or missing asset data, pipe outlet locations and stormwater pond structures. The survey is shown in diagrammatic form in Appendix A. WBOPDC has also been provided with this data as a CAD dwg file.

## 4 Approach and Model Schematisation

The modelling approach adopted was to take the base Uretara Stream model, currently being developed for the Bay of Plenty Regional Council (BOPRC) and adapt it to cover more accurately the Katikati township as described below.

### 4.1 Base Model – Uretara Stream

Aurecon are currently developing a Mike Flood model of the Uretara Stream for Bay of Plenty Regional Council (BOPRC). It was agreed by WBOPDC that this model should be used as a base model for the Katikati Mike Flood model.

The Uretara Stream model includes a Mike 11 branch from the western end of Wharawhara Road at the base of the Kaimai Range.

The model also includes a Mike 21 2m x 2m grid topography of the floodplain. The Mike 11 and Mike 21 model were coupled using lateral links along the banks (or stopbanks where present) of the stream.

### 4.2 Model Expansion to all of Katikati

The changes to the Uretara base model to extend to include the full Katikati catchment are described broadly below, with more detailed descriptions in the following sections of this report:

- The Uretara Stream Mike 11 branch has been truncated to the Study Area (refer Figure 1);
- The Mike 21 2m x 2m grid has been extended over the full study area. It is noted that much of the Study area is outside the Uretara Stream catchment (refer Figure 3 below) and discharges instead to local gully streams and drains;
- The full pipe network has been included in Mike Urban and coupled to Mike 11/Mike 21;
- Upper catchment inflows to the Uretara Stream have been removed and instead a constant peak flow along the truncated Uretara Stream is used;
- Detailed subcatchments have been delineated over the Study Area (refer Figure 5) and flows from each subcatchment loaded into the model at appropriate locations.

### 4.3 Model Schematisation

The stormwater catchment is represented by three interconnected components: the underground stormwater infrastructure (pipes, manholes and inlets) are represented in Mike Urban and referred to as *1D*, the overland surface flow model is represented in Mike 21 and referred to as *2D*, The Uretara Stream and road culverts are represented in Mike 11 and referred to as *1D*.

Specifically, the following should be noted about the modelling schematisation:

- The Uretara Stream and bridges over the stream are represented in Mike 11;
- The Mike 21 2m x 2m grid topography covers the whole Study Area, except for the Uretara Stream which is modelled in Mike 11. The Mike 21 model has been blocked out between the Uretara Stream banks to prevent double counting of conveyance and storage;
- The Mike 11 and Mike 21 model are coupled using lateral links along the banks (or stopbanks where present) of the stream;
- All public stormwater mains and manholes were included in the model. The pipe network was imported directly from WBOPDC asset data into the Mike Urban model, and all stormwater mains were reviewed and longitudinal profiles used to find and remedy unrealistic or unlikely pipe configurations in the model;
- All sumps and sump leads were also included in the Mike Urban network model with the lid level taken from the Mike 21 bathymetry at that location;

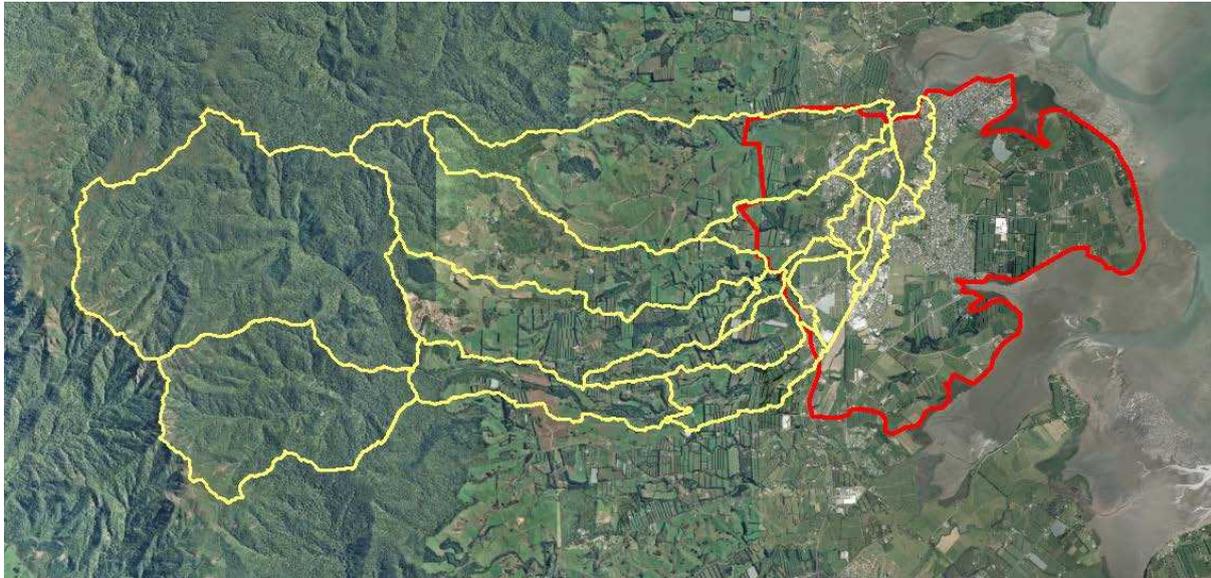
- Sumps in Mike Urban were linked to Mike 21 based on the sump size details in WBOPDC's asset database;
- House connections and soakholes were not explicitly modelled but included implicitly in the hydrological assumptions as described in 5.2.1;
- Buildings were represented by increased roughness on the Mike 21 surface model;
- Surface storage and areas of natural ponding were accounted for in the Mike 21 model;
- Ponds were included in the Mike 21 bathymetry. Generally, the pond base levels were set in the bathymetry at the ponds permanent water level;
- The Q-H relationship for each pond outlet structure was calculated separately in a spreadsheet using orifice and weir equations etc and applied as Q-H flow regulation on the pond outlet pipe;
- Coastal boundaries were applied to both the Mike 21 grid and the downstream end of the Mike 11 Uretara Stream channel. The tide was conservatively applied as a constant peak level;
- Open drains are generally represented in the Mike 21 topography. The 2m grid used for the Mike 21 topography will generally not represent the base low flow part of these channels very well. However, this is not considered important as these base flow channels are of low capacity and will be in large storm events.

# 5 Hydrological Modelling

## 5.1 Uretara Stream Upper Catchment Hydrology

Figure 3 shows the Uretara Stream subcatchments (yellow polygons) delineated for the BOPRC Uretara stream flood model. The Uretara Stream catchment covers only the north-western portion of the Study Area (red polygon). The rest of the Study Area discharges to other smaller local gully streams and rural drains.

Figure 3: BOPRC Uretara Stream Model subcatchments



At the time of building the Katikati Stormwater model, calibration of the Uretara Stream model was still being undertaken, and no hydrological parameters had been settled on. However, Table 1 below shows the estimated peak design flows for the Uretara Stream at the State Highway 2 (SH2) bridge using a variety of methods.

It was agreed with BOPRC that the average of these methods would be adopted as the design peak flow. A 30% increase in flow has been assumed for climate change. (This is based on about a 30% increase in rainfall depth between the current and RCP 8.5 2081 to 2100 scenario for this area).

Table 1: Peak Design Flows at SH2

Method	ARI				
	100y	50y	20y	10y	5y
TM61	160	136	110	93	78
Rational Method	118	100	81	68	57
Transposed Taupiro	155	139	118	102	85
Transposed Waipapa	129	118	103	92	80
<b>Adopted (Average) – Existing Climate</b>	<b>141</b>	<b>123</b>	<b>103</b>	<b>89</b>	<b>75</b>
<b>Adopted – Plus 30% for climate change</b>	<b>183</b>	<b>160</b>	<b>134</b>	<b>116</b>	<b>98</b>

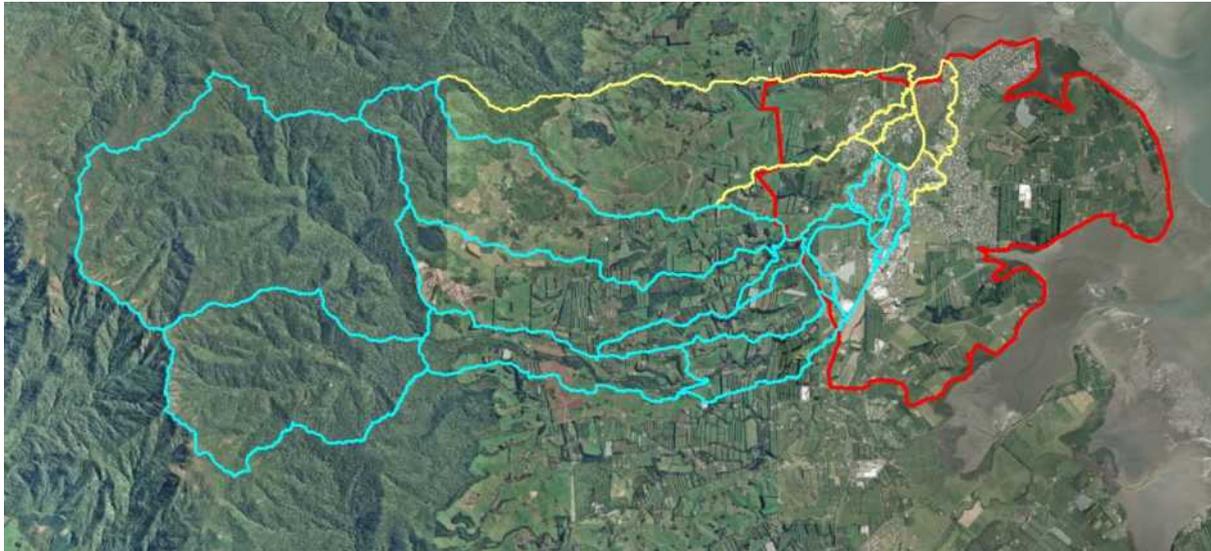
The focus of the Katikati stormwater model is the township. Modelling the Uretara Stream and its floodplain is less crucial and is mainly important as a boundary condition for discharge from the township (e.g. the tailwater for the stormwater pipe networks).

As such, for the Katikati stormwater model, the Uretara Stream hydrology was modelled simplistically with the peak design flow from Table 1 input as a constant flow at the upstream end of the truncated Mike 11 model (i.e. just downstream of the Wharawhara Road bridge.)

This method is obviously conservative, as it has much more volume than a real hydrograph but does provide a simple method of providing approximate downstream boundaries for the Katikati stormwater model.

The combinations of tide recurrence and rainfall recurrences modelled is detailed in Table 5: Rainfall/Tide Combinations Modelled

**Figure 4: Uretara Stream catchments upstream of SH2**

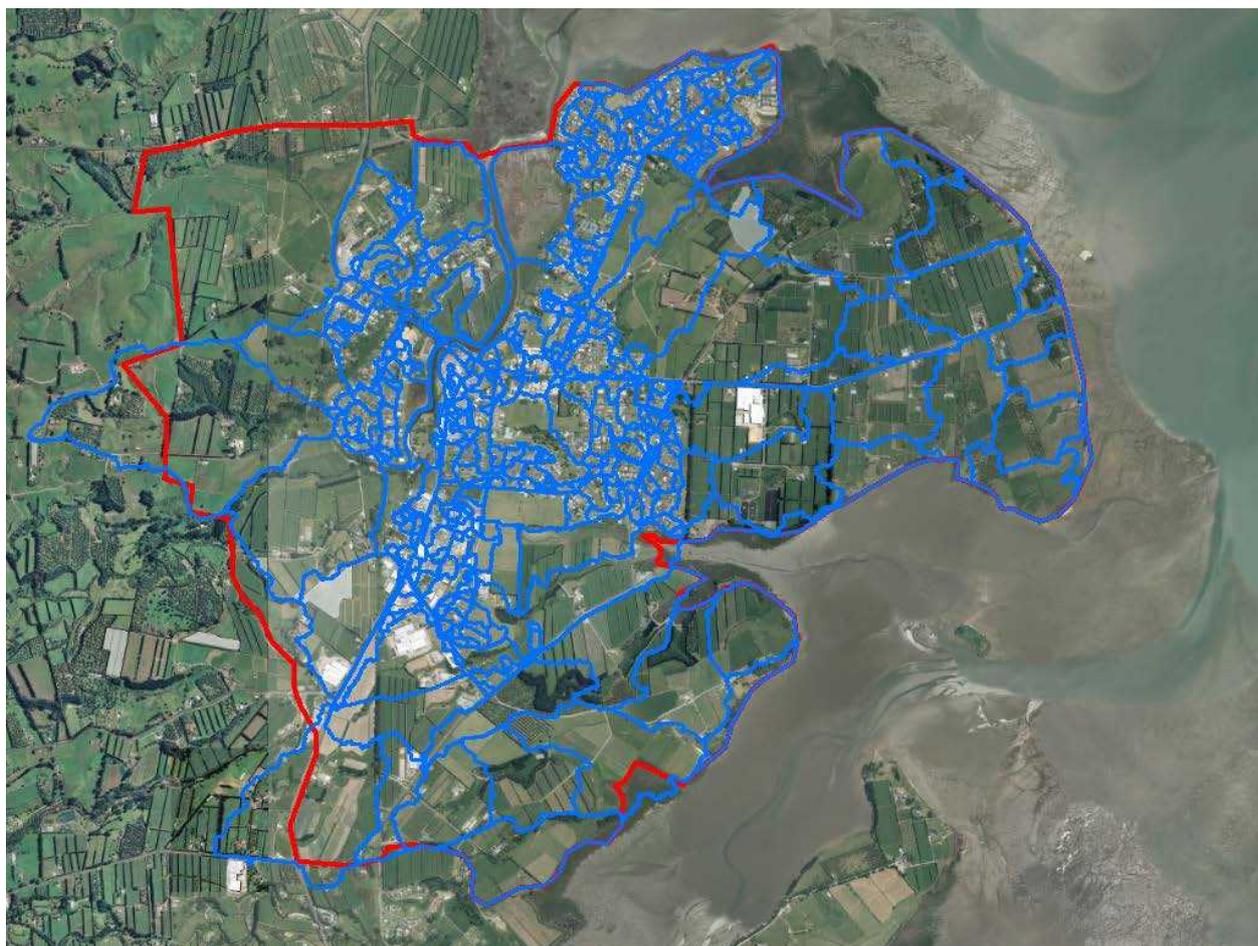


## 5.2 Study Area Hydrology

The study area was split into 387 subcatchments as shown on Figure 5 below. The subcatchments were auto-delineated using GIS techniques based on the Mike 21 2m x 2m topography grid. Stormwater sumps, open drains and culverts were used as 'sink points'. These were then manually checked and refined where necessary. Generally, in developed areas the subcatchment sizes were kept to around 1 to 2ha, but with larger subcatchment sizes in undeveloped and rural areas.

For each delineated sub-catchment, two completely overlapping sub-catchments were modelled, one representing the impervious surface and the other modelling the pervious surfaces. The actual area of the subcatchment was split between the two sub-catchments with the ratio depending on the imperviousness of that subcatchment. The imperviousness of each subcatchment was calculated as described in the following sections.

Figure 5: Study Area Subcatchments



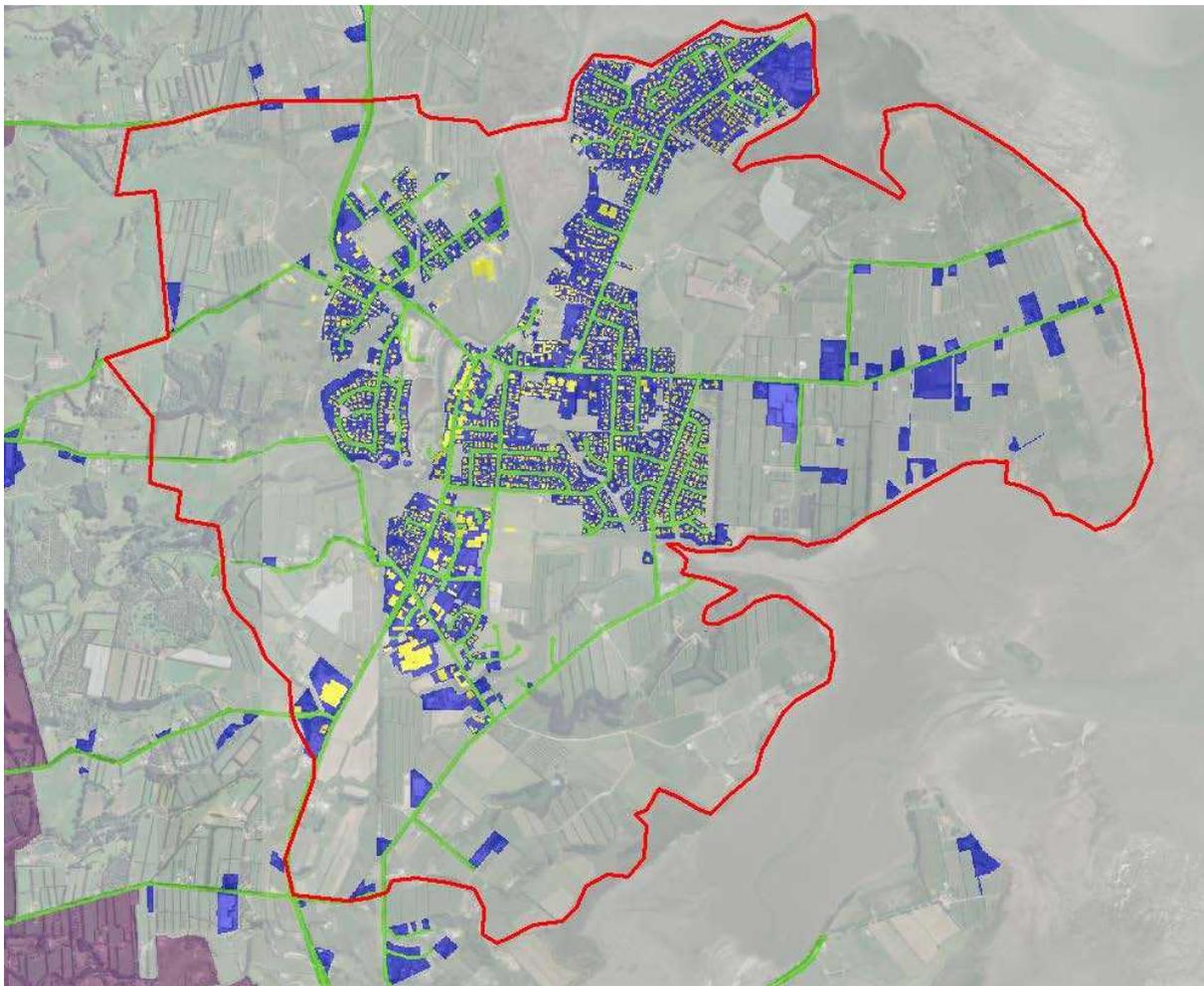
*\*This Figure is also shown as an A3 plan in Appendix D*

## 5.2.1 Existing Development Imperviousness

WBOPDC has not digitised existing land-use in Katikati and the scope of the project did not include digitising existing land use. Instead 4 land class uses were used as shown in Figure 6 below.

- Yellow – Building Footprints - Provided by WBOPDC – 100% impervious;
- Green – Road Polygons – Provided by WBOPDC from LINZ database – 80% impervious (includes grass berms);
- Blue – Urban Other – This is generally based on Lots with building footprints in them with a few other areas also added manually by Aurecon – 50% impervious (excludes the building footprint but includes gardens driveways etc);
- Grey – All Other Areas – 10% impervious.

Figure 6: Existing Development Land Use



## 5.2.2 Maximum Probable Development Imperviousness

The Maximum Probable Development (MPD) imperviousness in each subcatchment was calculated based on the Council's District Plan Zoning provided by Council as a GIS shape file. This zoning is shown in Figure 7. The percentage impervious assumed for each land use was provided by WBOPDC and is shown in Table 2 below.

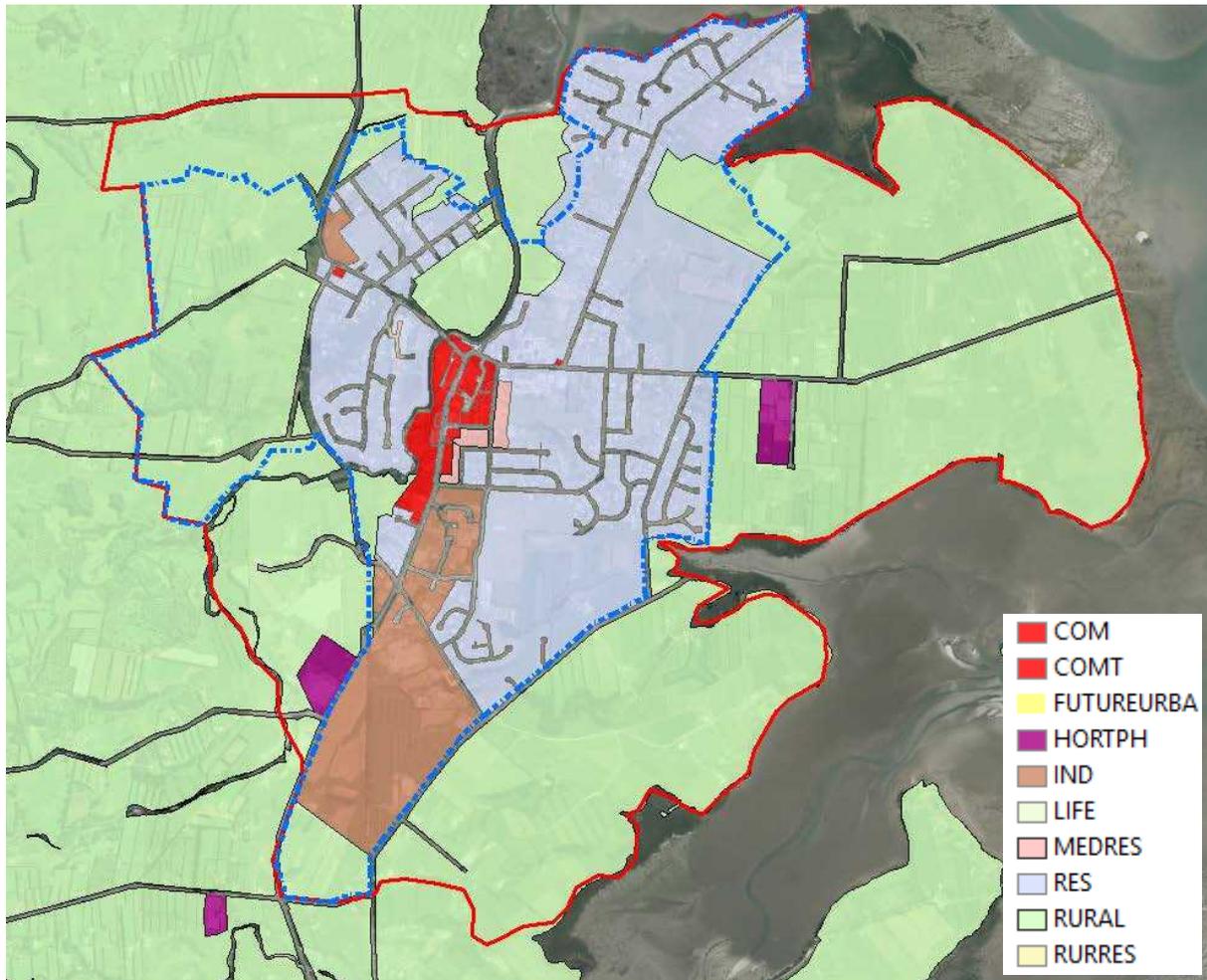
**Table 2: MPD Imperviousness Assumptions**

DP Zone	Full name	% impervious (MPD)
Com	Commercial	90
ComT	Commercial Transitional	90
FutureUrba	Future urban growth	60
Hortph	Horticulture	3
Ind	Industrial	90
Life	Lifestyle	50
Medres	Medium density residential	70
Res	Residential	60
Rural	Rural	3
Rurres	Rural residential	20

Additionally, WBOPDC advised that all rural areas (green areas on Figure 7) within the Katikati Urban growth zone (dashed blue polygon on Figure 7) are assumed to be converted to residential (60% impervious) in the MPD scenario.

In a few isolated subcatchments the existing development (ED) imperviousness was found to be greater than the MPD imperviousness calculated. In these cases, the ED imperviousness was adopted for the MPD scenario for that subcatchment.

Figure 7: Maximum Probable Development Land Use



\*Note the dashed blue polygon denotes the Katikati urban growth zone

### 5.2.3 Study Area Hydrological Parameters

The subcatchments were modelled in Mike Urban using the SCS unit hydrograph method.

The time of concentration for each catchment was calculated using the TP108 SCS method, based on the catchment length and slope. For most urban catchments a lag time of 10 minutes was adopted.

The hydrological parameters adopted are shown in Table 3 below.

Table 3: Hydrological Model Parameters

	Pervious	Impervious
Initial Abstraction	5	0
Curve Number	74	98

It is noted that the curve number chosen for pervious areas is probably quite conservative for this area, as most of the soils around Katikati (except in low lying areas) are generally well drained and probably have fairly high infiltration rates. Unfortunately, validation or calibration of the model is beyond the scope of this study (and it is not known if any validation data exists).

While using a high curve number is conservative for flood mapping, it is not conservative for assessments of development impacts as the difference between the pre and post development runoff will be smaller with a higher pervious curve number. This could mean the impact of the development is underestimated. Using lower curve numbers for pervious surfaces in the areas of interest is therefore recommended in any impact assessments.

### 5.3 McKinney Stream Catchment

The McKinney Stream catchment highlighted in blue in Figure 8 below is not included in the Uretara Stream catchment upstream of SH2 (refer Figure 4). As most of this catchment is outside of the Study Area, it is not included in the Study subcatchments (Figure 5) either.

Flows from the McKinney Stream catchment were therefore calculated separately in Mike 11 with the flows loaded at the upstream end of the culverts under SH2 (also modelled in Mike 11) - refer Figure 9.

Figure 8: McKinney Stream Catchment

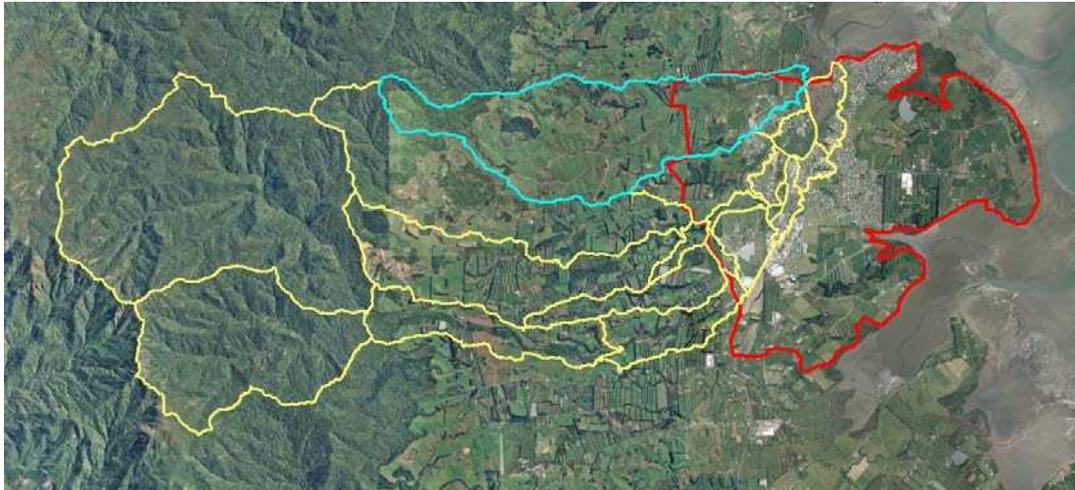
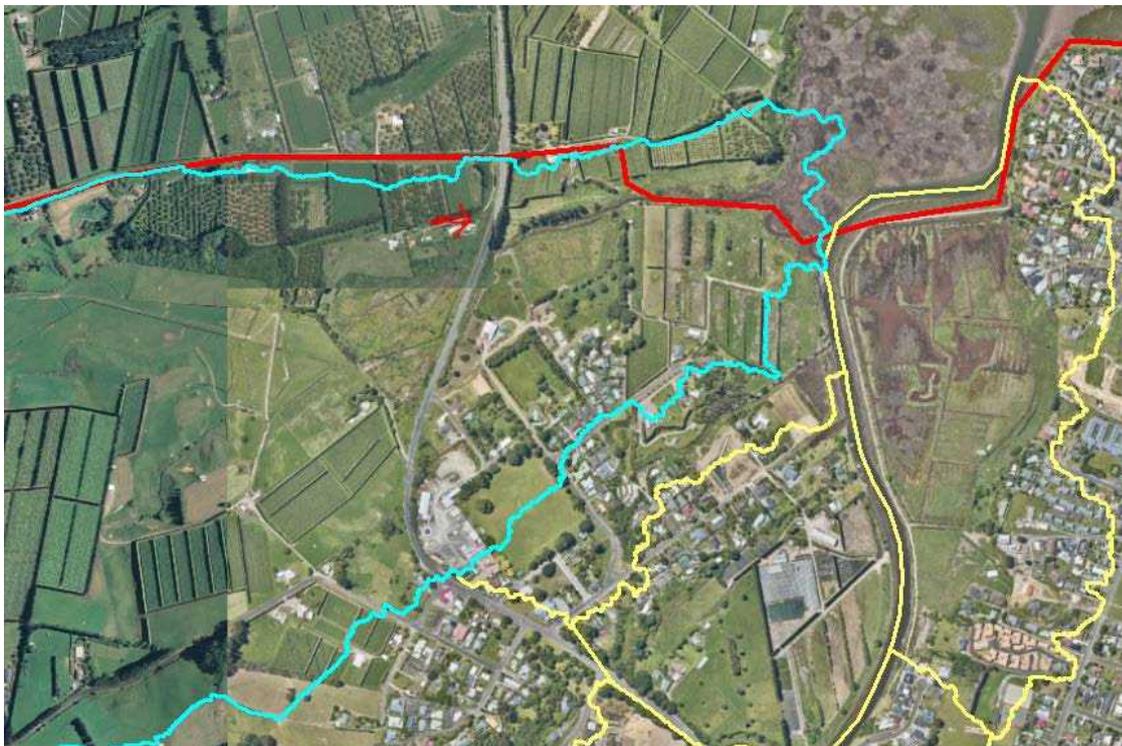


Figure 9: McKinney Stream Catchment Loading Point



The McKinney Stream Catchment was modelled using a unit hydrograph method with a proportional loss coefficient of 0.3. The lag time of 1.25 hours was calculated using Ramser-Kirpich.

# 6 Hydrodynamic Modelling

## 6.1 Mike 11

The Mike 11 model was developed for BOPRC Uretara Stream model and is based on cross-section survey of the Uretara Stream undertaken for BOPRC by East Bay Surveyors Ltd in June/July 2018. Survey of the bridges across the Uretara Stream was also undertaken at this time.

For the purposes of the Katikati Stormwater model the Uretara Stream model has been truncated at the Wharawhara bridge. The Manning's  $n$  adopted for the Uretara stream varies from 0.045 at the upstream (Wharawhara Road) end to 0.035 at the downstream (harbour) end. The four bridges over the Uretara Stream (Rawaka Drive, 2 footbridges and SH2) have been modelled using the FHWA WSPRO method.

Nine culverts are modelled in Mike 11. Information for these culverts has come either from GIS or survey (refer Appendix A). In some cases, only diameter information was available in GIS and the invert was estimated. A Manning's  $n$  value of 0.013 has been adopted for culverts.

Boundary conditions (tide and Uretara Stream inflows) for the Mike 11 model are described in Section 7 of this report.

## 6.2 Mike 21

The Mike 21 topography is a 2m x 2m grid based on the Lidar described in Section 3.1. The Uretara Stream extent modelled in Mike 11 has been removed from the Mike 21 topography to avoid double counting of system conveyance.

Surface roughness of the 2D model is based on the 4 land uses shown in Figure 6 with the following Manning's  $n$  values adopted:

- Building Footprints  $n= 5$
- Road polygons  $n= 0.015$
- Urban Other  $n = 0.08$  (includes some allowance for garden fences etc.)
- All Other Areas  $n=0.03$

A 6-hour nested rainfall is used with the peak at 3 hours. A simulation period of 9 hours has been adopted to allow for post flood draining of the catchment. A minimum and maximum time step of 0.1 and 0.5 seconds has been adopted.

The model uses the 'higher order' solution techniques with the default eddy viscosity adopted, namely, Smagorinsky Formulation with a constant value of 0.28.

The drying, flooding and wetting values have been set at 10, 20 and 30 mm respectively.

As the model is not rain on grid, infiltration is implicitly included in the Mike Urban hydrology. No infiltration is therefore allowed for in Mike 21.

Initial water levels in the harbour and coastline for each scenario are based on the tidal level. Elsewhere the initial water level has been set at the ground level. In ponds the initial water level has been set at the permanent water level.

Boundary conditions (tide) for the Mike 21 model are described in Section 7 of this report.

## 6.3 Mike Urban

All public stormwater mains and manholes were included in the model. The pipe network was imported directly from WBOPDC asset data into the Mike Urban model, and all stormwater mains were reviewed and longitudinal profiles used to find and remedy unrealistic or unlikely pipe configurations in the model.

Where data was missing or conflicting – engineering judgement was generally used to interpolate or estimate values. The exception to this was in areas where the missing information was considered to potentially have a significant bearing on modelled results in which case survey was requested.

Survey was undertaken by Aurecon’s survey team in June 2019. The survey is shown in diagrammatic form in Appendix A.

All sumps and sump leads were also included in the Mike Urban network model with the lid level taken from the Mike 21 bathymetry at that location. Flapgates were included as non-return valves in the pipe immediately upstream.

House connections and soakholes were not explicitly modelled but included implicitly in the hydrological assumptions.

Pipe friction losses were based on the Manning Explicit methodology based on pipe material type with a majority of the pipes being concrete (normal) with a Manning’s M of 75 ( $n = 1/M = 0.013$ ).

Manhole losses have adopted the mean energy approach with a  $K_m$  value of 0.25.

The Q-H relationship for each pond outlet structure was calculated separately in a spreadsheet using orifice and weir equations etc and applied as Q-H flow regulation on the pond outlet pipe. These are provided in Appendix B.

## 6.4 Mike Flood

### 6.4.1 Mike 11 to Mike 21

#### Lateral Links

Mike 11 was linked to Mike 21 along both banks via ‘lateral links’. Where stopbanks were present and surveyed (by East Bay Surveyors June July 2018), these were included explicitly as xyz files. In other places the lateral link height was based on the Mike 21 bathymetry value at that location.

#### Standard Links

‘Standard links’ were used at the upstream and downstream ends of culverts. The Mike 21 bathymetry value at the standard link locations were modified to match the culvert invert. Further smoothing of the Mike 21 bathymetry adjacent to the standard link location and along associated open channels were also undertaken where necessary.

### 6.4.2 Mike Urban to Mike 11

Where pipes discharged to the Uretara Stream a ‘Mike Urban outlet to Mike 11 link’ was used. Where a flapgate was recorded in WBOPDC’s GIS a non-return valve was placed on the pipe immediately upstream of the outlet.

### 6.4.3 Mike Urban to Mike 21

Subcatchment loading nodes (i.e. nodes that a Mike urban subcatchment is connected to) were linked to Mike 21 using a ‘Weir to Mike 21’ link. This is a one-way link that discharges any of the subcatchment hydrograph in excess of the downstream network capacity onto the Mike 21 surface at that location.

This method was agreed to be used by WBOPDC (it is also the standard approach used by Auckland Council) with the advantage that it ensures that the pipes run full prior to any runoff coming onto the surface model. The disadvantage of this method is that it does not restrict pipe flow in areas where there are only a limited number of sumps or service leads connected to the system.

The same methodology was applied to subcatchments where no piped network exists to service the area. For these areas, the subcatchments were loaded onto dummy nodes with complete spill of the loaded subcatchments from the dummy node onto the surface model.

Non subcatchment nodes were connected to Mike 21 using a 'Mike 21 to inlet link' using the orifice equation based on the manhole lid size. This is to allow for discharge from surcharging manholes where the manhole lid 'pops' off.

Sumps in Mike Urban were linked to Mike 21 using a Mike 21 to inlet link based on the sump size details in WBOPDC's asset database. A maximum inflow of 35 l/s was applied to single sumps and 70 l/s applied to double sumps.

An exponential smoothing factor of 0.4 was used to aid model stability

# 7 Scenarios / Boundary Conditions

## 7.1 Scenarios

WBOPDC requested that eight scenarios were modelled. The eight scenarios run are listed in Table 4 below.

**Table 4: Scenarios**

No.	Scenario	Climate Change	Development
1	10y ED	Current climate	Existing imperviousness
2	10y MPD	Climate change	Maximum probable development
3	50y ED	Current climate	Existing imperviousness
4	50y MPD	Climate change	Maximum probable development
5	100y ED	Current climate	Existing imperviousness
6	100y MPD	Climate change	Maximum probable development
7	500y MPD	Climate change	Maximum probable development
8	Maximum Credible Event	Climate change	Maximum probable development

For each scenario two runs were undertaken, Run A with a higher rainfall and lower tide combination, and Run B with a lower rainfall and higher tide combination. These are detailed in Table 5 below.

**Table 5: Rainfall/Tide Combinations Modelled**

Scenario No.	Run A			Run B		
	Rainfall	Uretara Stream Inflow	Tide	Rainfall	Uretara Stream Inflow	Tide
1	10y	10y	2y	2y	2y	10y
2	10y cc	10y cc	2y cc	2y cc	2y cc	10y cc
3	50y	50y	20y	20y	20y	50y
4	50y cc	50y cc	20y cc	20y cc	20y cc	50y cc
5	100y	100y	20y	20y	20y	100y
6	100y cc	100y cc	20y cc	20y cc	20y cc	100y cc
7	500y cc	500y cc	100y cc	100y cc	100y cc	500y cc
8	Maximum Credible	Maximum Credible	100y cc	100y cc	100y cc	Maximum Credible

\*cc – denotes with climate change

For each scenario a combined maximum depth map was produced with the maximum depth being extracted from either Run A or Run B – whichever was the higher at each grid location. The Maximum Depth Maps produced are included in Appendix C.

## 7.2 Tidal boundaries

Tidal boundaries have been applied as a constant peak level which while conservative provides a simple method of providing downstream boundaries for the Katikati stormwater model.

Tidal levels were taken from the letter report from NIWA (Dr Scott Stephens) to BOPRC (Kathy Thiel- Lardon dated 28 February 2019).

Values were extracted for 'Location 76' which is at the mouth of the Uretara Stream.

**Table 6: Tidal Boundaries (m RL)**

Annual Recurrence Interval (ARI)	Current Climate (+0.13m sea level rise)	Climate Change (+1.25m sea level rise to 2130)
2y	1.50	2.70
10y	1.71	2.91
20y	1.86	3.05
50y	2.11	3.30
100y	2.27	3.44
500y	2.64	3.81
Maximum Credible	n/a	4.0

## 7.3 Uretara Stream Inflows

As discussed in Section 5.1.1 design peak flows for the Uretara Stream were estimated by several techniques (e.g. Rational, TM61, Transposed catchment). These were applied at the at the upstream end of the truncated Mike 11 model of the Uretara Stream (i.e. just downstream of the Wharawhara Road bridge). Flows for the 500y and PMP events were extrapolated using the method outlined in the report "Flood Frequency in New Zealand" (McKerchar and Pearson 1989).

The inflows used in the model are given in Table 7 below.

**Table 7: Uretara Stream Inflows (m<sup>3</sup>/s)**

Annual Recurrence Interval (ARI)	Current Climate	Climate Change (+30%)
2y	70	91
10y	89	116
20y	103	134
50y	123	160
100y	141	183
500y	177	230
Maximum Credible	294	382

## 7.4 Rainfall

Rainfall data for the study was extracted from HIRDS v4. The location chosen was the SH2 bridge over the Uretara Stream which is central to the Katikati urban area of interest.

The probable maximum precipitation was estimated using the method outlined in the NIWA report “A Guide to Probable Maximum precipitation in New Zealand (Tomlinson and Tomlinson June 1995).

The rainfall was applied as a 6 hour centrally nested storm, using the rainfall depths extracted from HIRDS v4 for all time increments from 10 minutes to 6 hours. The 6-hour rainfall depths used are given in Table 8 below.

**Table 8: Six Hour Rainfall Depths (mm)**

<b>Annual Recurrence Interval (ARI)</b>	<b>Current Climate (HIRDS v4)</b>	<b>Climate Change (HIRDS v4) (RCP 8.5 period 2081 to 2100)</b>
2y	67.5	84.6
10y	106	136
20y	124	160
50y	149	193
100y	169	219
500y	n/a	275
Maximum Credible	n/a	368

## 8 Results

Flood Depth Maps are included in Appendix C. These results have also been provided to WBOPDC in electronic format.

While these flood depth maps come from detailed modelling it is still important to understand the limitations to their accuracy. For example, no validation or calibration of the model has been undertaken.

Caution should therefore be used when applying these results and the factors to consider are described in detail in the next section.

## 9 Limitations and Applicability

As with any model, the Katikati Stormwater model includes assumptions and simplifications of the complex real-world processes. However, the model does include significant detail including the full pipe network and a 2m x 2m grid topography.

- On a broad scale it is believed the model should provide a reasonable representation of flood depths and extents although no model validation or calibration has been undertaken to confirm this.
- The model is therefore considered to be fit for purpose for broad-scale planning measures and also for testing of stormwater mitigation designs and options.
- The model is a snapshot of the catchment when the LiDAR was flown, mostly 2015, and does not include any subsequent development. It may therefore not be applicable in newly developed areas (i.e. post 2015) or where flows from newly developed areas impact on results.
- It should be noted that localised ponding depths may vary significantly where overland flow is obstructed or blocked (e.g. by obstacles, debris, solid fences or sheds etc.). Results could also be impacted in places by kerb heights which are not necessarily fully resolved by the 2m DEM used in this study. Maximum flood depths on a property by property basis should therefore only be used with caution.
- In addition to the above, flood risk at properties could also be affected by wave run up from passing vehicles or other dynamic interaction between stormwater and its immediate environment.
- Subcatchment loading nodes (i.e. nodes that a Mike Urban subcatchment is connected to) were linked to Mike 21 using a 'Weir to Mike 21' link. This is a one-way link that discharges any of the subcatchment hydrograph in excess of the downstream network capacity onto the Mike 21 surface at that location. This method was agreed to be used by WBOPDC (it is also the standard approach used by Auckland Council) with the advantage that it ensures that the pipes run full prior to any spill onto the surface model. The disadvantage of this method is that it does not restrict pipe flow in areas where there are only a limited number of sumps or service leads connected to the system. For testing stormwater mitigation designs including improved catchpit capacity, an alternative coupling methodology should therefore be used in the area of interest.
- Open drains are generally represented in the Mike 21 topography. The 2m grid used for the Mike 21 topography will generally not represent the base, low flow, part of these channels very well, but this is not considered to be significant for large storm events. Refinement of these drains is recommended if events smaller than the 10 year ARI event are to be modelled, especially in rural areas.
- Subcatchments are generally only 1 to 2 ha in size developed areas, but much larger subcatchments cover rural areas. For testing developments in current rural areas, it is recommended that the subcatchments in the area of interest be refined.
- It is noted that the curve number chosen for pervious areas of 74 is probably quite conservative for this area, as most of the soils around Katikati (except in low lying areas) are generally well drained and probably have fairly high infiltration rates. However, validation or calibration of the model, especially this key parameter, is beyond the scope of this study. While using a high curve number is conservative for flood mapping, it is not conservative for assessments of development impacts as the difference between the pre and post development runoff will be smaller with a higher pervious curve number. This could mean the impact of the development is underestimated. Using lower curve numbers for pervious surfaces in the areas of interest is therefore recommended in any impact assessments.
- For simplicity and robustness, constant peak values have been adopted as the boundary conditions for the Uretara Stream flow and the tide. However, this approach means Uretara Stream floodplain values are likely to be very conservative. If flood levels in the Uretara floodplain are of particular interest, it is suggested that the BOPRC Uretara Stream model be consulted.

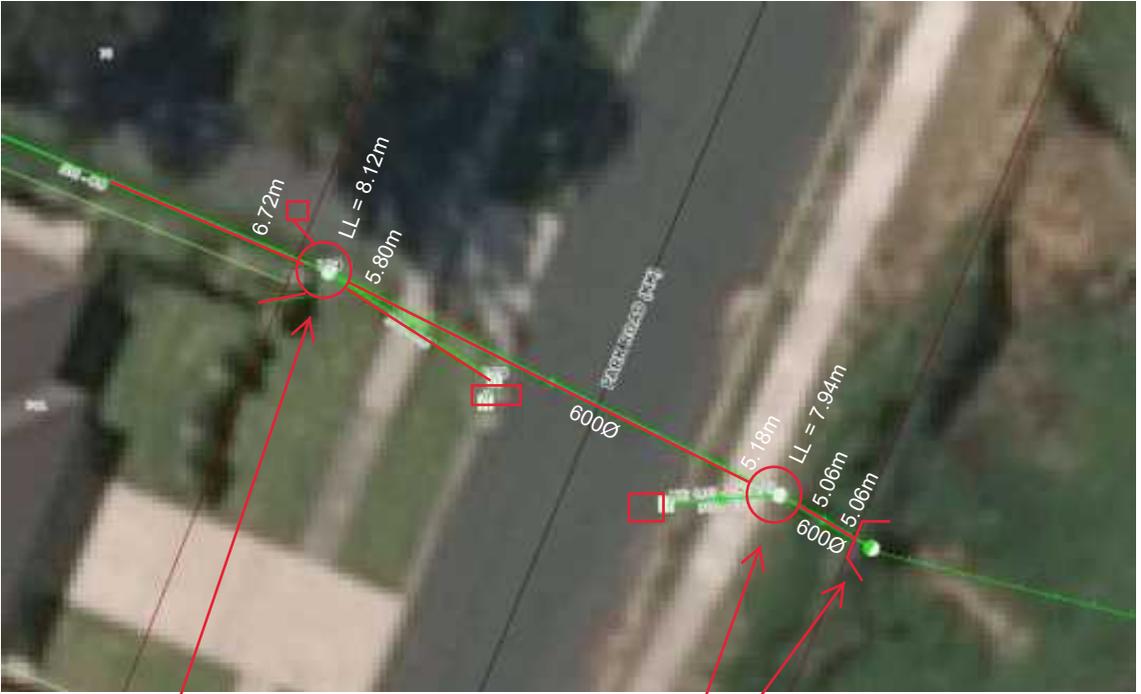
A large green polygon with a yellow-orange triangle at the bottom left corner. The green area is a trapezoid-like shape with a diagonal line from the top-left to the bottom-right. The yellow-orange triangle is at the bottom-left corner, pointing towards the center of the green area.

A

Field Survey

# Appendix A

## Field Survey



# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

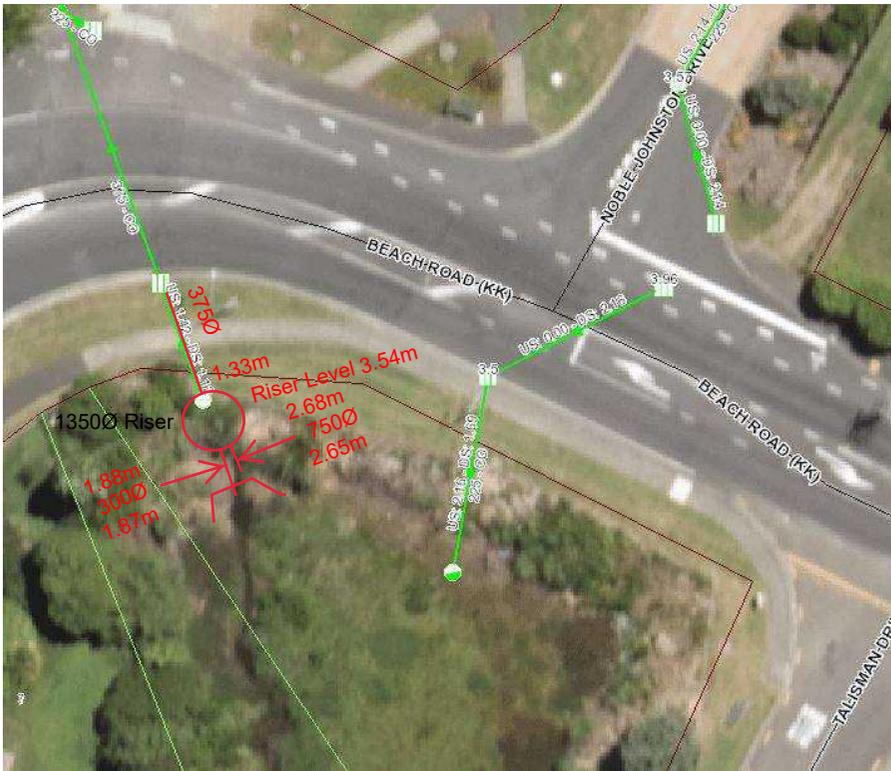
Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

## 141 Wills Road

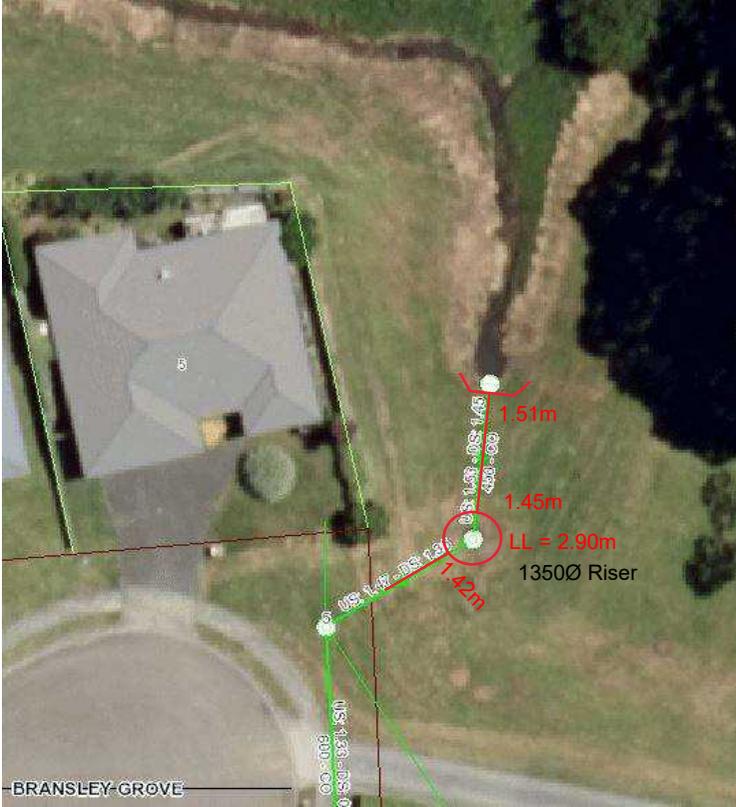




# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUG (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise



# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

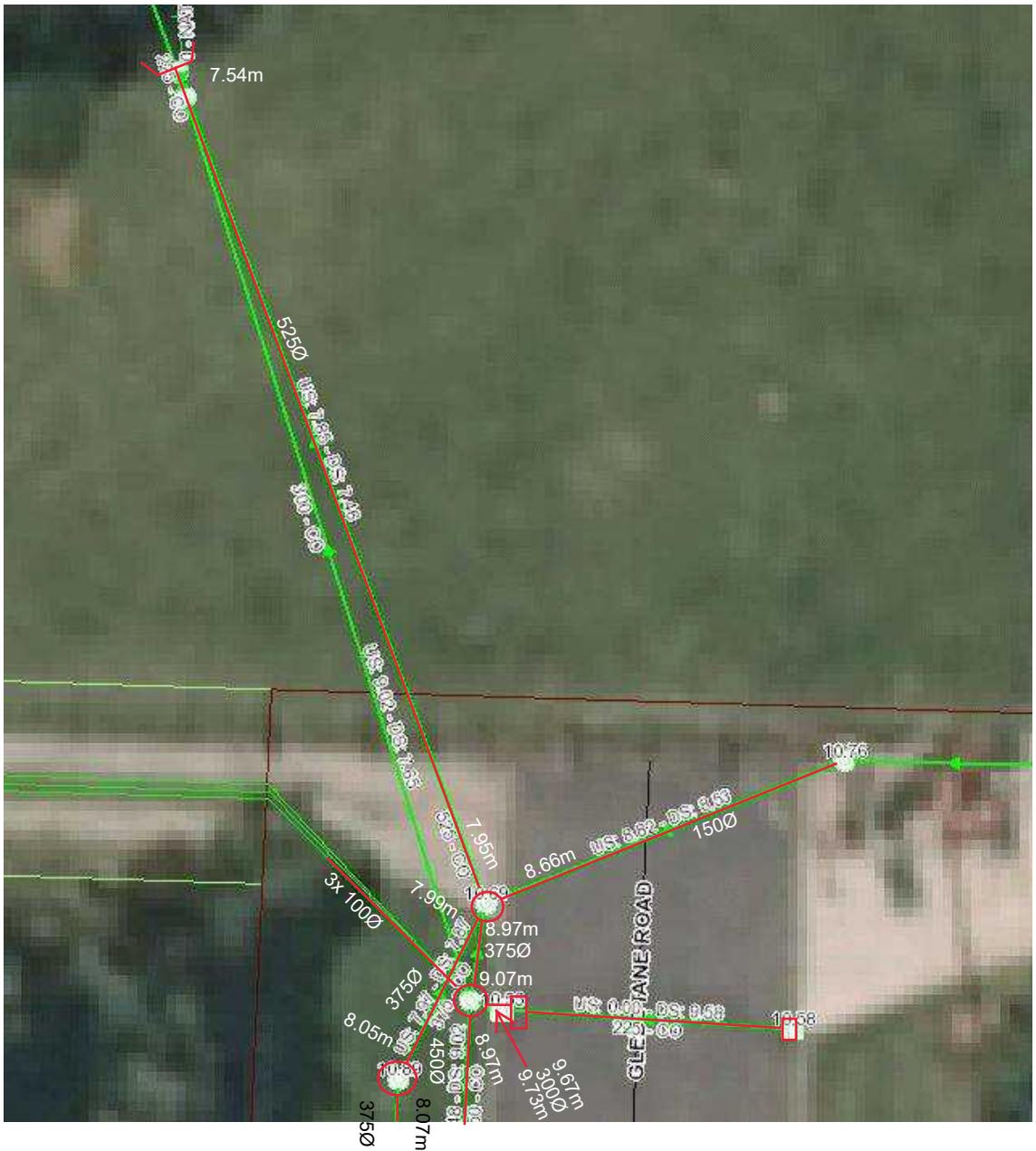
Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

Off Church Street





# arecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise



**aurecon**

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

## Highfield Drive - Waterford Reserve



## 2 Highfield Drive



# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUG (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

Malta Cres



# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

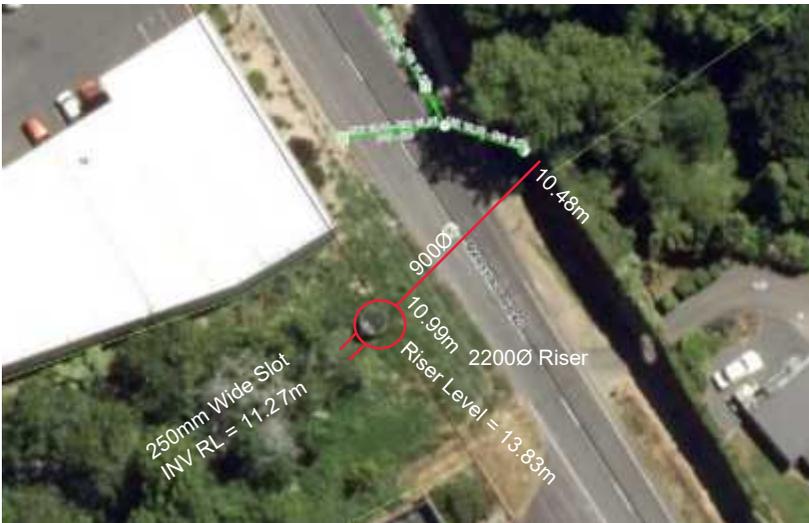
Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

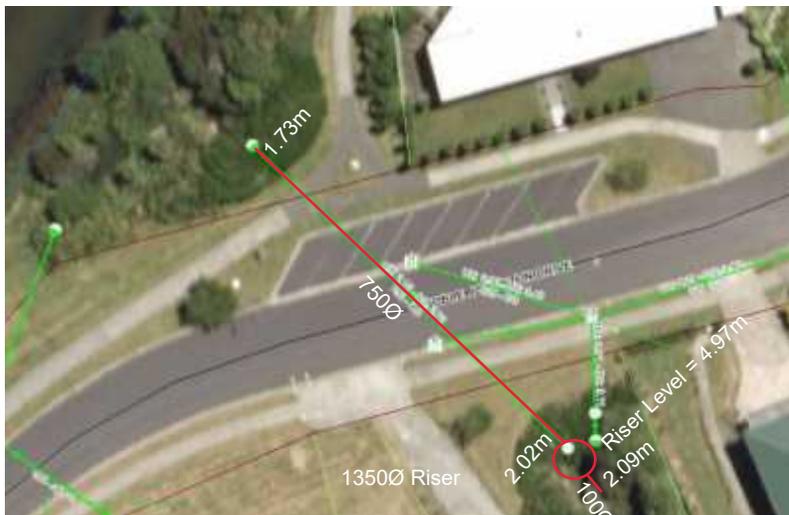


# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise





**aurecon**

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

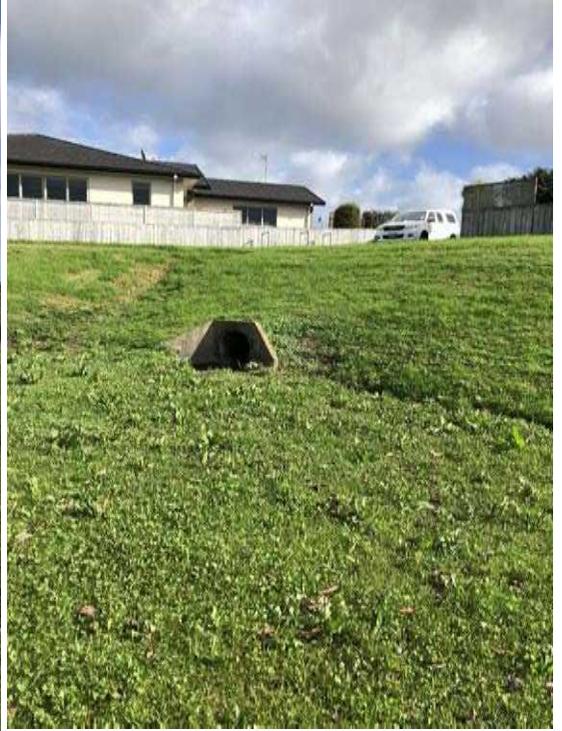
# Pond between Uretara Drive and River



Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise





**aurecon**

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise





Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUG (AP45) RL 14.36  
Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise

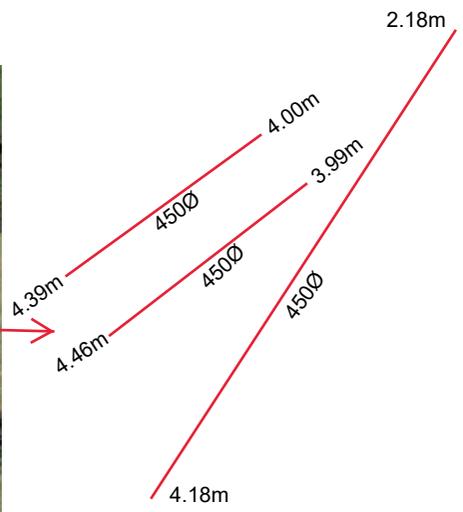


# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise





# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUG (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise



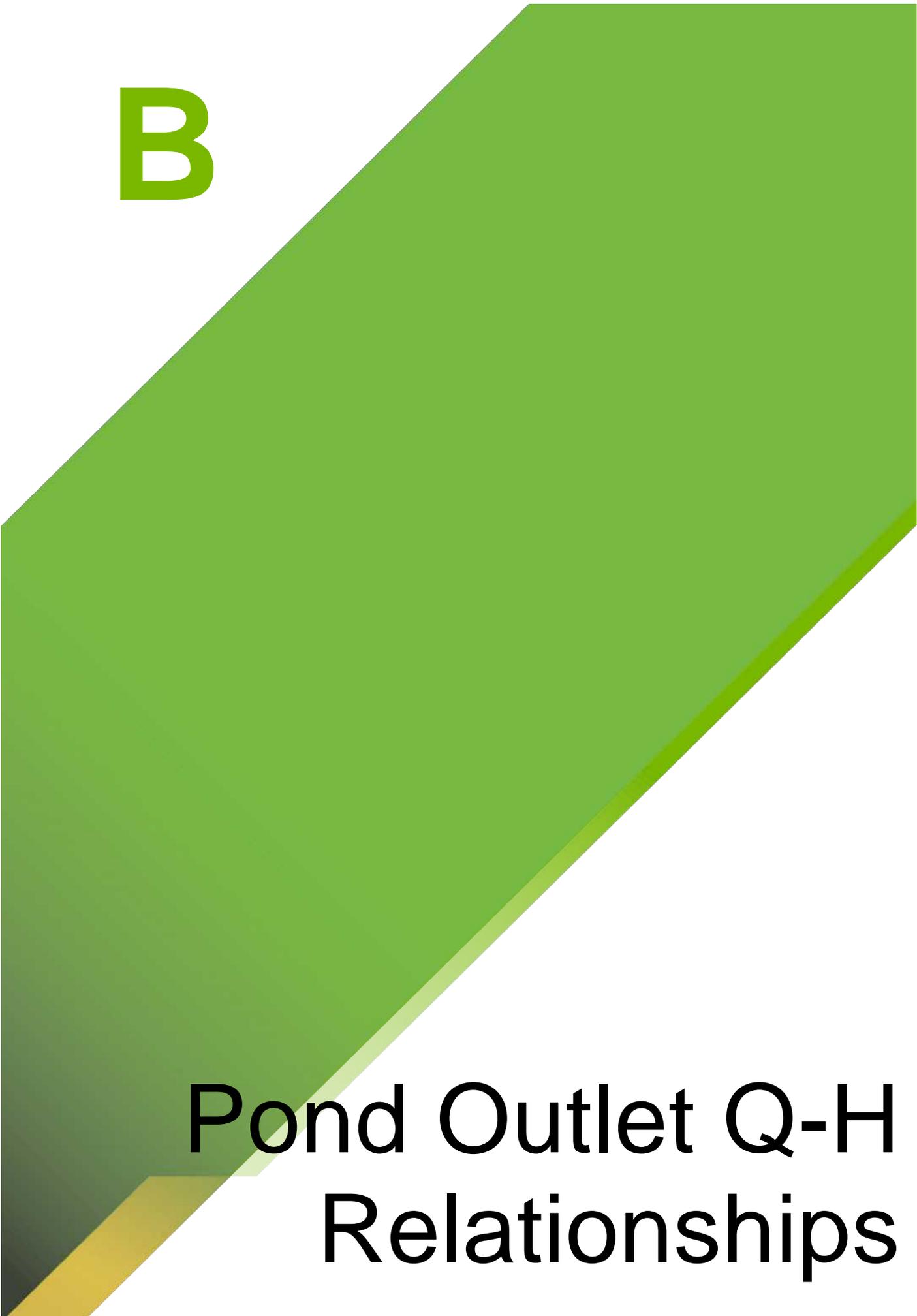


# aurecon

Survey Date: May 2019  
Coordinates: NZTM  
Height Datum: Auckland Vertical Datum 1946  
Origin of Heights: Mark Levelled off ABUK (AP45) RL 14.36

Notes:  
Surveyed by GNSS  
Levels shown are pipe invert level unless shown otherwise





**B**

**Pond Outlet Q-H  
Relationships**

# Appendix B

## Pond Outlet Q-H Relationships

**Marshall Road S SWPO0005**

**Low flow**

Slot width (m)	<b>0.5</b>
invert level	<b>12.93</b>
g	

<b>Orifice</b>	
diameter (m)	<b>0</b>
radius (m)	0
area	0.00
invert level	<b>2.68</b>
centroid level	2.68
g	9.81

<b>Riser</b>	
diameter (m)	<b>2.3</b>
circumference (m)	14.45
area	4.15
Level	<b>15.66</b>

Subtotal Subtotal

<b>Outlet pipe</b>	
diameter (m)	<b>0.9</b>
radius (m)	0.45
area	0.636
invert level	<b>12.4</b>
centroid level	12.85
g	9.81

Total Outflow

Add low flow until orifice equation fully activates

$Q=1.8w h^{3/2}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6*PI*R*head^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.00
14	0.00
14.1	0.00
14.2	0.00
14.3	0.00
14.4	0.00
14.5	0.00
14.6	0.00
14.7	0.00
14.8	0.00
14.9	0.00
15	0.00
15.1	0.00
15.2	0.00
15.3	0.00
15.4	0.00
15.5	0.00
15.6	0.00
15.7	0.00
15.8	0.00
15.9	0.00
16	0.00
16.1	0.00
16.2	0.00
16.3	0.00
16.4	0.00
16.5	0.00
16.6	0.00
16.7	0.00
16.8	0.00
16.9	0.00
17	0.00

Slot 1	
Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.02
13.1	0.06
13.2	0.13
13.3	0.20
13.4	0.29
13.5	0.39
13.6	0.49
13.7	0.61
13.8	0.73
13.9	0.86
14	1.00
14.1	1.14
14.2	1.29
14.3	1.44
14.4	1.60
14.5	1.77
14.6	1.94
14.7	2.12
14.8	2.30
14.9	2.49
15	2.68
15.1	2.88
15.2	3.08
15.3	3.28
15.4	3.49
15.5	3.71
15.6	3.93
15.7	4.15
15.8	4.38
15.9	4.61
16	4.84
16.1	5.08
16.2	5.32
16.3	5.57
16.4	5.82
16.5	6.07
16.6	6.33
16.7	6.59
16.8	6.85
16.9	7.12
17	7.39

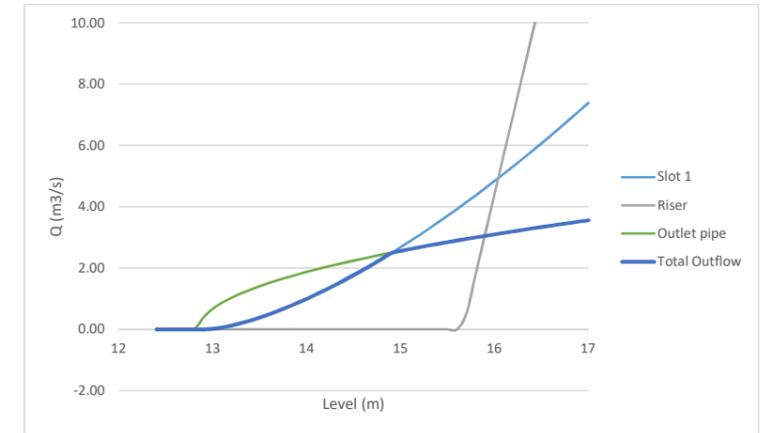
Orifice 2	
Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.00
14	0.00
14.1	0.00
14.2	0.00
14.3	0.00
14.4	0.00
14.5	0.00
14.6	0.00
14.7	0.00
14.8	0.00
14.9	0.00
15	0.00
15.1	0.00
15.2	0.00
15.3	0.00
15.4	0.00
15.5	0.00
15.6	0.00
15.7	0.00
15.8	0.00
15.9	0.00
16	0.00
16.1	0.00
16.2	0.00
16.3	0.00
16.4	0.00
16.5	0.00
16.6	0.00
16.7	0.00
16.8	0.00
16.9	0.00
17	0.00

Riser	
Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.00
14	0.00
14.1	0.00
14.2	0.00
14.3	0.00
14.4	0.00
14.5	0.00
14.6	0.00
14.7	0.00
14.8	0.00
14.9	0.00
15	0.00
15.1	0.00
15.2	0.00
15.3	0.00
15.4	0.00
15.5	0.00
15.6	0.00
15.7	0.52
15.8	1.82
15.9	3.12
16	4.42
16.1	5.72
16.2	7.02
16.3	8.32
16.4	9.62
16.5	10.93
16.6	12.23
16.7	13.53
16.8	14.83
16.9	16.13
17	17.43

Subtotal	
Level	Q
12.40	0.00
12.50	0.00
12.60	0.00
12.70	0.00
12.80	0.00
12.90	0.00
13.00	0.02
13.10	0.06
13.20	0.13
13.30	0.20
13.40	0.29
13.50	0.39
13.60	0.49
13.70	0.61
13.80	0.73
13.90	0.86
14.00	1.00
14.10	1.14
14.20	1.29
14.30	1.44
14.40	1.60
14.50	1.77
14.60	1.94
14.70	2.12
14.80	2.30
14.90	2.49
15.00	2.68
15.10	2.88
15.20	3.08
15.30	3.28
15.40	3.49
15.50	3.71
15.60	3.93
15.70	4.67
15.80	6.20
15.90	7.73
16.00	9.26
16.10	10.80
16.20	12.35
16.30	13.89
16.40	15.44
16.50	17.00
16.60	18.55
16.70	20.11
16.80	21.68
16.90	23.25
17.00	24.82

Outlet pipe	
Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.39
13	0.68
13.1	0.87
13.2	1.03
13.3	1.17
13.4	1.30
13.5	1.41
13.6	1.51
13.7	1.61
13.8	1.70
13.9	1.79
14	1.87
14.1	1.95
14.2	2.03
14.3	2.10
14.4	2.18
14.5	2.24
14.6	2.31
14.7	2.38
14.8	2.44
14.9	2.50
15	2.56
15.1	2.62
15.2	2.68
15.3	2.73
15.4	2.79
15.5	2.84
15.6	2.90
15.7	2.95
15.8	3.00
15.9	3.05
16	3.10
16.1	3.15
16.2	3.20
16.3	3.25
16.4	3.29
16.5	3.34
16.6	3.38
16.7	3.43
16.8	3.47
16.9	3.52
17	3.56

Total Outflow	
Level	Q
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.02
13.1	0.06
13.2	0.13
13.3	0.20
13.4	0.29
13.5	0.39
13.6	0.49
13.7	0.61
13.8	0.73
13.9	0.86
14	1.00
14.1	1.14
14.2	1.29
14.3	1.44
14.4	1.60
14.5	1.77
14.6	1.94
14.7	2.12
14.8	2.30
14.9	2.49
15	2.56
15.1	2.62
15.2	2.68
15.3	2.73
15.4	2.79
15.5	2.84
15.6	2.90
15.7	2.95
15.8	3.00
15.9	3.05
16	3.10
16.1	3.15
16.2	3.20
16.3	3.25
16.4	3.29
16.5	3.34
16.6	3.38
16.7	3.43
16.8	3.47
16.9	3.52
17	3.56



**Marshall Road N SWPO0005**

**Low flow**

Slot width (m)	0.25
invert level	11.27
g	

Orifice diameter (m)	0
radius (m)	0
area	0.00
invert level	2.68
centroid level	2.68
g	9.81

Riser diameter (m)	2.3
circumference (m)	14.45
area	4.15
Level	13.83

Subtotal Subtotal

Outlet pipe diameter (m)	0.9
radius (m)	0.45
area	0.636
invert level	10.99
centroid level	11.44
g	9.81

Total Outflow

Add low flow until orifice equation fully activates

$Q=1.8w h^{3/2}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6 \cdot \pi \cdot R^3 \cdot \text{head}^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.01
11.4	0.00
11.5	0.00
11.6	0.00
11.7	0.00
11.8	0.00
11.9	0.00
12	0.00
12.1	0.00
12.2	0.00
12.3	0.00
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.00
14	0.00
14.1	0.00
14.2	0.00
14.3	0.00
14.4	0.00
14.5	0.00
14.6	0.00
14.7	0.00
14.8	0.00
14.9	0.00
15	0.00
15.1	0.00
15.2	0.00
15.3	0.00
15.4	0.00
15.5	0.00

Slot 1	
Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.00
11.4	0.02
11.5	0.05
11.6	0.09
11.7	0.13
11.8	0.17
11.9	0.23
12	0.28
12.1	0.34
12.2	0.40
12.3	0.47
12.4	0.54
12.5	0.61
12.6	0.69
12.7	0.77
12.8	0.85
12.9	0.94
13	1.02
13.1	1.11
13.2	1.21
13.3	1.30
13.4	1.40
13.5	1.50
13.6	1.60
13.7	1.70
13.8	1.81
13.9	1.92
14	2.03
14.1	2.14
14.2	2.26
14.3	2.37
14.4	2.49
14.5	2.61
14.6	2.73
14.7	2.86
14.8	2.98
14.9	3.11
15	3.24
15.1	3.37
15.2	3.51
15.3	3.64
15.4	3.78
15.5	3.91

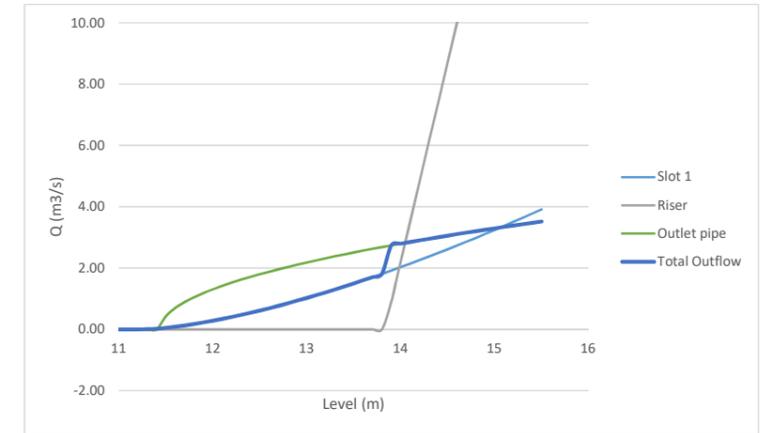
Orifice 2	
Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.00
11.4	0.00
11.5	0.00
11.6	0.00
11.7	0.00
11.8	0.00
11.9	0.00
12	0.00
12.1	0.00
12.2	0.00
12.3	0.00
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.00
14	0.00
14.1	0.00
14.2	0.00
14.3	0.00
14.4	0.00
14.5	0.00
14.6	0.00
14.7	0.00
14.8	0.00
14.9	0.00
15	0.00
15.1	0.00
15.2	0.00
15.3	0.00
15.4	0.00
15.5	0.00

Riser	
Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.00
11.4	0.00
11.5	0.00
11.6	0.00
11.7	0.00
11.8	0.00
11.9	0.00
12	0.00
12.1	0.00
12.2	0.00
12.3	0.00
12.4	0.00
12.5	0.00
12.6	0.00
12.7	0.00
12.8	0.00
12.9	0.00
13	0.00
13.1	0.00
13.2	0.00
13.3	0.00
13.4	0.00
13.5	0.00
13.6	0.00
13.7	0.00
13.8	0.00
13.9	0.91
14	2.21
14.1	3.51
14.2	4.81
14.3	6.11
14.4	7.41
14.5	8.71
14.6	10.01
14.7	11.32
14.8	12.62
14.9	13.92
15	15.22
15.1	16.52
15.2	17.82
15.3	19.12
15.4	20.42
15.5	21.72

Subtotal	
Level	Q
10.90	0.00
11.00	0.00
11.10	0.00
11.20	0.00
11.30	0.01
11.40	0.02
11.50	0.05
11.60	0.09
11.70	0.13
11.80	0.17
11.90	0.23
12.00	0.28
12.10	0.34
12.20	0.40
12.30	0.47
12.40	0.54
12.50	0.61
12.60	0.69
12.70	0.77
12.80	0.85
12.90	0.94
13.00	1.02
13.10	1.11
13.20	1.21
13.30	1.30
13.40	1.40
13.50	1.50
13.60	1.60
13.70	1.70
13.80	1.81
13.90	2.83
14.00	4.24
14.10	5.65
14.20	7.07
14.30	8.49
14.40	9.91
14.50	11.33
14.60	12.75
14.70	14.17
14.80	15.60
14.90	17.03
15.00	18.46
15.10	19.89
15.20	21.32
15.30	22.76
15.40	24.20
15.50	25.64

Outlet pipe	
Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.00
11.4	0.00
11.5	0.43
11.6	0.70
11.7	0.89
11.8	1.05
11.9	1.18
12	1.31
12.1	1.42
12.2	1.52
12.3	1.62
12.4	1.71
12.5	1.80
12.6	1.88
12.7	1.96
12.8	2.04
12.9	2.11
13	2.18
13.1	2.25
13.2	2.32
13.3	2.38
13.4	2.45
13.5	2.51
13.6	2.57
13.7	2.63
13.8	2.68
13.9	2.74
14	2.80
14.1	2.85
14.2	2.90
14.3	2.95
14.4	3.01
14.5	3.06
14.6	3.11
14.7	3.15
14.8	3.20
14.9	3.25
15	3.30
15.1	3.34
15.2	3.39
15.3	3.43
15.4	3.48
15.5	3.52

Total Outflow	
Level	Q
10.9	0.00
11	0.00
11.1	0.00
11.2	0.00
11.3	0.01
11.4	0.02
11.5	0.05
11.6	0.09
11.7	0.13
11.8	0.17
11.9	0.23
12	0.28
12.1	0.34
12.2	0.40
12.3	0.47
12.4	0.54
12.5	0.61
12.6	0.69
12.7	0.77
12.8	0.85
12.9	0.94
13	1.02
13.1	1.11
13.2	1.21
13.3	1.30
13.4	1.40
13.5	1.50
13.6	1.60
13.7	1.70
13.8	1.81
13.9	2.74
14	2.80
14.1	2.85
14.2	2.90
14.3	2.95
14.4	3.01
14.5	3.06
14.6	3.11
14.7	3.15
14.8	3.20
14.9	3.25
15	3.30
15.1	3.34
15.2	3.39
15.3	3.43
15.4	3.48
15.5	3.52



**Ureatra Drive SWPO0007**

**Low flow**

Orifice diameter (m)	0.15
radius (m)	0.075
area	0.02
invert level	1.51
centroid level	1.585
g	9.81

Orifice diameter (m)	2@0.15
radius (m)	0.075
area	0.04
invert level	1.6
centroid level	1.675
g	9.81

Riser diameter (m)	1.35
circumference (m)	8.48
area	1.43
Level	2.52

**Subtotal Subtotal**

Outlet pipe diameter (m)	0.9
radius (m)	0.45
area	0.636
invert level	0.61
centroid level	1.06
g	9.81

**Total Outflow**

Add low flow until orifice equation fully activates

$Q=0.62A(2gh)^{0.5}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6*PI*R*head^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.00
1.2	0.00
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00

Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.00
1.2	0.00
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.01
1.7	0.02
1.8	0.02
1.9	0.03
2	0.03
2.1	0.03
2.2	0.04
2.3	0.04
2.4	0.04
2.5	0.05
2.6	0.05
2.7	0.05
2.8	0.05
2.9	0.06
3	0.06
3.1	0.06
3.2	0.06
3.3	0.06
3.4	0.07
3.5	0.07
3.6	0.07
3.7	0.07
3.8	0.07
3.9	0.07
4	0.08
4.1	0.08
4.2	0.08
4.3	0.08
4.4	0.08
4.5	0.08
4.6	0.08
4.7	0.09
4.8	0.09
4.9	0.09
5	0.09
5.1	0.09
5.2	0.09

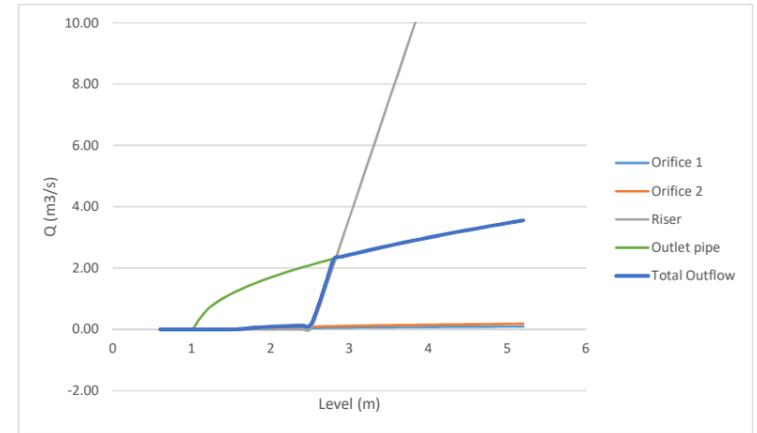
Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.00
1.2	0.00
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.02
1.8	0.03
1.9	0.05
2	0.06
2.1	0.06
2.2	0.07
2.3	0.08
2.4	0.08
2.5	0.09
2.6	0.09
2.7	0.10
2.8	0.10
2.9	0.11
3	0.11
3.1	0.12
3.2	0.12
3.3	0.12
3.4	0.13
3.5	0.13
3.6	0.13
3.7	0.14
3.8	0.14
3.9	0.14
4	0.15
4.1	0.15
4.2	0.15
4.3	0.16
4.4	0.16
4.5	0.16
4.6	0.17
4.7	0.17
4.8	0.17
4.9	0.17
5	0.18
5.1	0.18
5.2	0.18

Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.00
1.2	0.00
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.61
2.7	1.37
2.8	2.14
2.9	2.90
3	3.66
3.1	4.43
3.2	5.19
3.3	5.95
3.4	6.72
3.5	7.48
3.6	8.24
3.7	9.01
3.8	9.77
3.9	10.54
4	11.30
4.1	12.06
4.2	12.83
4.3	13.59
4.4	14.35
4.5	15.12
4.6	15.88
4.7	16.64
4.8	17.41
4.9	18.17
5	18.93
5.1	19.70
5.2	20.46

Level	Q
0.60	0.00
0.70	0.00
0.80	0.00
0.90	0.00
1.00	0.00
1.10	0.00
1.20	0.00
1.30	0.00
1.40	0.00
1.50	0.00
1.60	0.01
1.70	0.03
1.80	0.06
1.90	0.07
2.00	0.09
2.10	0.10
2.20	0.11
2.30	0.12
2.40	0.13
2.50	0.13
2.60	0.75
2.70	1.52
2.80	2.29
2.90	3.06
3.00	3.83
3.10	4.60
3.20	5.37
3.30	6.14
3.40	6.91
3.50	7.68
3.60	8.45
3.70	9.22
3.80	9.99
3.90	10.75
4.00	11.52
4.10	12.29
4.20	13.06
4.30	13.83
4.40	14.59
4.50	15.36
4.60	16.13
4.70	16.90
4.80	17.66
4.90	18.43
5.00	19.20
5.10	19.97
5.20	20.73

Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.35
1.2	0.65
1.3	0.86
1.4	1.02
1.5	1.16
1.6	1.28
1.7	1.40
1.8	1.50
1.9	1.60
2	1.69
2.1	1.78
2.2	1.87
2.3	1.95
2.4	2.02
2.5	2.10
2.6	2.17
2.7	2.24
2.8	2.30
2.9	2.37
3	2.43
3.1	2.50
3.2	2.56
3.3	2.61
3.4	2.67
3.5	2.73
3.6	2.78
3.7	2.84
3.8	2.89
3.9	2.94
4	3.00
4.1	3.05
4.2	3.10
4.3	3.14
4.4	3.19
4.5	3.24
4.6	3.29
4.7	3.33
4.8	3.38
4.9	3.42
5	3.47
5.1	3.51
5.2	3.55

Level	Q
0.6	0.00
0.7	0.00
0.8	0.00
0.9	0.00
1	0.00
1.1	0.00
1.2	0.00
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.01
1.7	0.03
1.8	0.06
1.9	0.07
2	0.09
2.1	0.10
2.2	0.11
2.3	0.12
2.4	0.13
2.5	0.13
2.6	0.75
2.7	1.52
2.8	2.29
2.9	3.06
3	3.83
3.1	4.60
3.2	5.37
3.3	6.14
3.4	6.91
3.5	7.68
3.6	8.45
3.7	9.22
3.8	9.99
3.9	10.75
4	11.52
4.1	12.29
4.2	13.06
4.3	13.83
4.4	14.59
4.5	15.36
4.6	16.13
4.7	16.90
4.8	17.66
4.9	18.43
5	19.20
5.1	19.97
5.2	20.73



**Ureatra Drive Landing SWPO0033**

Low flow

Orifice diameter (m)	0.1
radius (m)	0.05
area	0.01
invert level	2.09
centroid level	2.14
g	9.81

Orifice diameter (m)	0
radius (m)	0
area	0.00
invert level	2.68
centroid level	2.68
g	9.81

Riser diameter (m)	1.35
circumference (m)	8.48
area	1.43
Level	4.97

Subtotal Subtotal

Outlet pipe diameter (m)	0.75
radius (m)	0.375
area	0.442
invert level	2.02
centroid level	2.40
g	9.81

Total Outflow

Add low flow until orifice equation fully activates

$Q=0.62A(2gh)^{0.5}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6*PI*R*head^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
2	0.00
2.1	0.01
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00
6.2	0.00
6.3	0.00
6.4	0.00
6.5	0.00
6.6	0.00

Level	Q
2	0.00
2.1	0.00
2.2	0.01
2.3	0.01
2.4	0.01
2.5	0.01
2.6	0.01
2.7	0.02
2.8	0.02
2.9	0.02
3	0.02
3.1	0.02
3.2	0.02
3.3	0.02
3.4	0.02
3.5	0.03
3.6	0.03
3.7	0.03
3.8	0.03
3.9	0.03
4	0.03
4.1	0.03
4.2	0.03
4.3	0.03
4.4	0.03
4.5	0.03
4.6	0.03
4.7	0.03
4.8	0.04
4.9	0.04
5	0.04
5.1	0.04
5.2	0.04
5.3	0.04
5.4	0.04
5.5	0.04
5.6	0.04
5.7	0.04
5.8	0.04
5.9	0.04
6	0.04
6.1	0.04
6.2	0.04
6.3	0.04
6.4	0.04
6.5	0.05
6.6	0.05

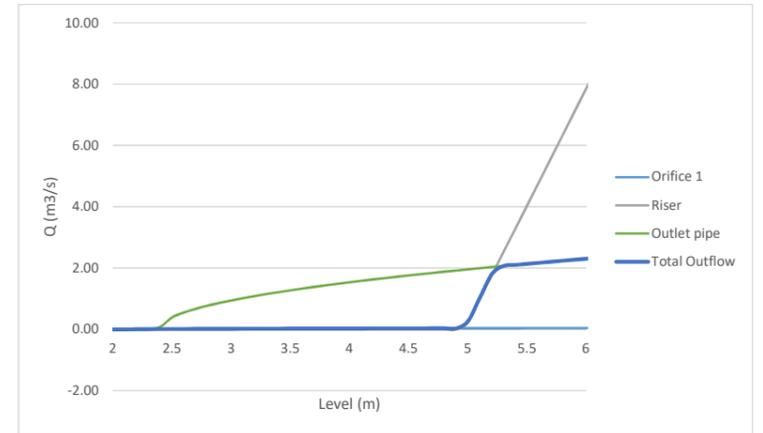
Level	Q
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00
6.2	0.00
6.3	0.00
6.4	0.00
6.5	0.00
6.6	0.00

Level	Q
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.23
5.1	0.99
5.2	1.76
5.3	2.52
5.4	3.28
5.5	4.05
5.6	4.81
5.7	5.57
5.8	6.34
5.9	7.10
6	7.86
6.1	8.63
6.2	9.39
6.3	10.15
6.4	10.92
6.5	11.68
6.6	12.44

Level	Q
2.00	0.00
2.10	0.01
2.20	0.01
2.30	0.01
2.40	0.01
2.50	0.01
2.60	0.01
2.70	0.02
2.80	0.02
2.90	0.02
3.00	0.02
3.10	0.02
3.20	0.02
3.30	0.02
3.40	0.02
3.50	0.03
3.60	0.03
3.70	0.03
3.80	0.03
3.90	0.03
4.00	0.03
4.10	0.03
4.20	0.03
4.30	0.03
4.40	0.03
4.50	0.03
4.60	0.03
4.70	0.03
4.80	0.04
4.90	0.04
5.00	0.27
5.10	1.03
5.20	1.79
5.30	2.56
5.40	3.32
5.50	4.09
5.60	4.85
5.70	5.61
5.80	6.38
5.90	7.14
6.00	7.91
6.10	8.67
6.20	9.43
6.30	10.20
6.40	10.96
6.50	11.73
6.60	12.49

Level	Q
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.09
2.5	0.39
2.6	0.55
2.7	0.67
2.8	0.77
2.9	0.86
3	0.94
3.1	1.02
3.2	1.09
3.3	1.15
3.4	1.22
3.5	1.28
3.6	1.33
3.7	1.39
3.8	1.44
3.9	1.49
4	1.54
4.1	1.58
4.2	1.63
4.3	1.67
4.4	1.72
4.5	1.76
4.6	1.80
4.7	1.84
4.8	1.88
4.9	1.92
5	1.96
5.1	2.00
5.2	2.03
5.3	2.07
5.4	2.10
5.5	2.14
5.6	2.17
5.7	2.21
5.8	2.24
5.9	2.27
6	2.30
6.1	2.34
6.2	2.37
6.3	2.40
6.4	2.43
6.5	2.46
6.6	2.49

Level	Q
2	0.00
2.1	0.00
2.2	0.01
2.3	0.01
2.4	0.01
2.5	0.01
2.6	0.01
2.7	0.02
2.8	0.02
2.9	0.02
3	0.02
3.1	0.02
3.2	0.02
3.3	0.02
3.4	0.02
3.5	0.03
3.6	0.03
3.7	0.03
3.8	0.03
3.9	0.03
4	0.03
4.1	0.03
4.2	0.03
4.3	0.03
4.4	0.03
4.5	0.03
4.6	0.03
4.7	0.03
4.8	0.04
4.9	0.04
5	0.27
5.1	1.03
5.2	1.79
5.3	2.07
5.4	2.10
5.5	2.14
5.6	2.17
5.7	2.21
5.8	2.24
5.9	2.27
6	2.30
6.1	2.34
6.2	2.37
6.3	2.40
6.4	2.43
6.5	2.46
6.6	2.49



**Preston Drive Pond SWPO0013**

Low flow

Orifice diameter (m)	0.1
radius (m)	0.05
area	0.01
invert level	2.53
centroid level	2.58
g	9.81

Orifice diameter (m)	0
radius (m)	0
area	0.00
invert level	2.68
centroid level	2.68
g	9.81

Riser diameter (m)	1.5
circumference (m)	9.42
area	1.77
Level	3.77

Subtotal Subtotal

Outlet pipe diameter (m)	0.9
radius (m)	0.45
area	0.636
invert level	1.55
centroid level	2.00
g	9.81

Total Outflow

Add low flow until orifice equation fully activates

$Q=0.62A(2gh)^{0.5}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6 * \pi * R * \text{head}^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.01
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00

Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.01
2.8	0.01
2.9	0.01
3	0.01
3.1	0.02
3.2	0.02
3.3	0.02
3.4	0.02
3.5	0.02
3.6	0.02
3.7	0.02
3.8	0.02
3.9	0.02
4	0.03
4.1	0.03
4.2	0.03
4.3	0.03
4.4	0.03
4.5	0.03
4.6	0.03
4.7	0.03
4.8	0.03
4.9	0.03
5	0.03
5.1	0.03
5.2	0.03
5.3	0.04
5.4	0.04
5.5	0.04
5.6	0.04
5.7	0.04
5.8	0.04
5.9	0.04
6	0.04
6.1	0.04

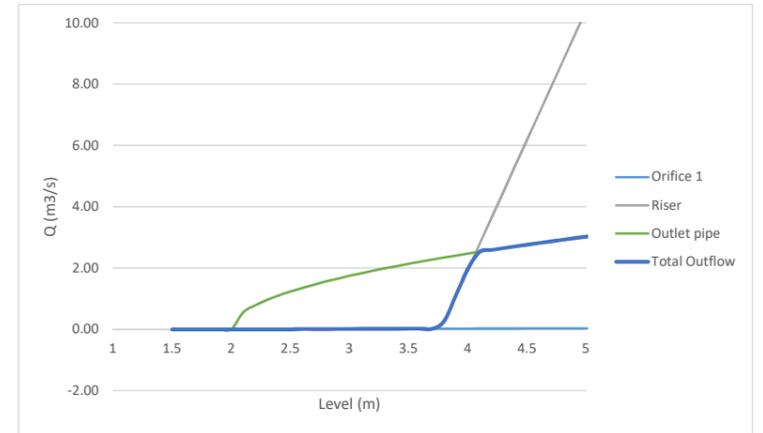
Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00

Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.25
3.9	1.10
4	1.95
4.1	2.80
4.2	3.65
4.3	4.50
4.4	5.34
4.5	6.19
4.6	7.04
4.7	7.89
4.8	8.74
4.9	9.58
5	10.43
5.1	11.28
5.2	12.13
5.3	12.98
5.4	13.83
5.5	14.67
5.6	15.52
5.7	16.37
5.8	17.22
5.9	18.07
6	18.92
6.1	19.76

Level	Q
1.50	0.00
1.60	0.00
1.70	0.00
1.80	0.00
1.90	0.00
2.00	0.00
2.10	0.00
2.20	0.00
2.30	0.00
2.40	0.00
2.50	0.00
2.60	0.01
2.70	0.01
2.80	0.01
2.90	0.01
3.00	0.01
3.10	0.02
3.20	0.02
3.30	0.02
3.40	0.02
3.50	0.02
3.60	0.02
3.70	0.02
3.80	0.28
3.90	1.13
4.00	1.98
4.10	2.83
4.20	3.67
4.30	4.52
4.40	5.37
4.50	6.22
4.60	7.07
4.70	7.92
4.80	8.77
4.90	9.62
5.00	10.47
5.10	11.32
5.20	12.16
5.30	13.01
5.40	13.86
5.50	14.71
5.60	15.56
5.70	16.41
5.80	17.26
5.90	18.11
6.00	18.96
6.10	19.80

Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.55
2.2	0.78
2.3	0.96
2.4	1.10
2.5	1.24
2.6	1.35
2.7	1.46
2.8	1.56
2.9	1.66
3	1.75
3.1	1.83
3.2	1.91
3.3	1.99
3.4	2.07
3.5	2.14
3.6	2.21
3.7	2.28
3.8	2.34
3.9	2.41
4	2.47
4.1	2.53
4.2	2.59
4.3	2.65
4.4	2.71
4.5	2.76
4.6	2.82
4.7	2.87
4.8	2.92
4.9	2.98
5	3.03
5.1	3.08
5.2	3.13
5.3	3.17
5.4	3.22
5.5	3.27
5.6	3.31
5.7	3.36
5.8	3.41
5.9	3.45
6	3.49
6.1	3.54

Level	Q
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.01
2.7	0.01
2.8	0.01
2.9	0.01
3	0.01
3.1	0.02
3.2	0.02
3.3	0.02
3.4	0.02
3.5	0.02
3.6	0.02
3.7	0.02
3.8	0.28
3.9	1.13
4	1.98
4.1	2.53
4.2	2.59
4.3	2.65
4.4	2.71
4.5	2.76
4.6	2.82
4.7	2.87
4.8	2.92
4.9	2.98
5	3.03
5.1	3.08
5.2	3.13
5.3	3.17
5.4	3.22
5.5	3.27
5.6	3.31
5.7	3.36
5.8	3.41
5.9	3.45
6	3.49
6.1	3.54



**Park Road Pond SWPO0014**

Low flow

Orifice diameter (m)	0.1
radius (m)	0.05
area	0.01
invert level	3.94
centroid level	3.99
g	9.81

Orifice diameter (m)	0
radius (m)	0
area	0.00
invert level	2.68
centroid level	2.68
g	9.81

Riser diameter (m)	1.5
circumference (m)	9.42
area	1.77
Level	5.47

Subtotal Subtotal

Outlet pipe diameter (m)	0.9
radius (m)	0.45
area	0.636
invert level	2.12
centroid level	2.57
g	9.81

Total Outflow

Add 50 l/s low flow until orifice equation fully activates

$Q=0.62A(2gh)^{0.5}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6 \cdot \pi \cdot R^3 \cdot \text{head}^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.01
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00
6.2	0.00
6.3	0.00
6.4	0.00
6.5	0.00
6.6	0.00
6.7	0.00

Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.01
4.2	0.01
4.3	0.01
4.4	0.01
4.5	0.02
4.6	0.02
4.7	0.02
4.8	0.02
4.9	0.02
5	0.02
5.1	0.02
5.2	0.02
5.3	0.02
5.4	0.03
5.5	0.03
5.6	0.03
5.7	0.03
5.8	0.03
5.9	0.03
6	0.03
6.1	0.03
6.2	0.03
6.3	0.03
6.4	0.03
6.5	0.03
6.6	0.03
6.7	0.04

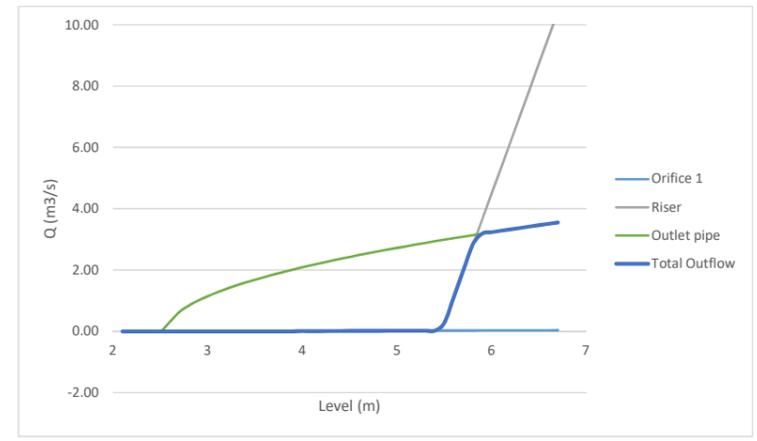
Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00
6	0.00
6.1	0.00
6.2	0.00
6.3	0.00
6.4	0.00
6.5	0.00
6.6	0.00
6.7	0.00

Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.25
5.6	1.10
5.7	1.95
5.8	2.80
5.9	3.65
6	4.50
6.1	5.34
6.2	6.19
6.3	7.04
6.4	7.89
6.5	8.74
6.6	9.58
6.7	10.43

Level	Q
2.10	0.00
2.20	0.00
2.30	0.00
2.40	0.00
2.50	0.00
2.60	0.00
2.70	0.00
2.80	0.00
2.90	0.00
3.00	0.00
3.10	0.00
3.20	0.00
3.30	0.00
3.40	0.00
3.50	0.00
3.60	0.00
3.70	0.00
3.80	0.00
3.90	0.00
4.00	0.01
4.10	0.01
4.20	0.01
4.30	0.01
4.40	0.01
4.50	0.02
4.60	0.02
4.70	0.02
4.80	0.02
4.90	0.02
5.00	0.02
5.10	0.02
5.20	0.02
5.30	0.02
5.40	0.03
5.50	0.28
5.60	1.13
5.70	1.98
5.80	2.83
5.90	3.68
6.00	4.53
6.10	5.38
6.20	6.22
6.30	7.07
6.40	7.92
6.50	8.77
6.60	9.62
6.70	10.47

Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.30
2.7	0.63
2.8	0.84
2.9	1.00
3	1.15
3.1	1.27
3.2	1.39
3.3	1.49
3.4	1.59
3.5	1.68
3.6	1.77
3.7	1.86
3.8	1.94
3.9	2.01
4	2.09
4.1	2.16
4.2	2.23
4.3	2.30
4.4	2.36
4.5	2.43
4.6	2.49
4.7	2.55
4.8	2.61
4.9	2.67
5	2.72
5.1	2.78
5.2	2.83
5.3	2.89
5.4	2.94
5.5	2.99
5.6	3.04
5.7	3.09
5.8	3.14
5.9	3.19
6	3.24
6.1	3.28
6.2	3.33
6.3	3.37
6.4	3.42
6.5	3.46
6.6	3.51
6.7	3.55

Level	Q
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.01
4.1	0.01
4.2	0.01
4.3	0.01
4.4	0.01
4.5	0.02
4.6	0.02
4.7	0.02
4.8	0.02
4.9	0.02
5	0.02
5.1	0.02
5.2	0.02
5.3	0.02
5.4	0.03
5.5	0.28
5.6	1.13
5.7	1.98
5.8	2.83
5.9	3.68
6	4.53
6.1	5.38
6.2	6.22
6.3	7.07
6.4	7.92
6.5	8.77
6.6	9.62
6.7	10.47



**Talisman Drive SWPO0016**

Low flow

Orifice	
diameter (m)	0.3
radius (m)	0.15
area	0.071
invert level	1.88
centroid level	2.03
g	9.81

Orifice	
diameter (m)	0.75
radius (m)	0.375
area	0.442
invert level	2.68
centroid level	3.055
g	9.81

Riser	
diameter (m)	1.35
circumference (m)	8.48
area	1.431
Level	3.54

Subtotal

Outlet pipe	
diameter (m)	0.375
radius (m)	0.1875
area	0.110
invert level	1.33
centroid level	1.5175
g	9.81

Total Outflow

Add 10 l/s low flow until orifice equation fully activates

$Q=0.62A(2gh)^{0.5}$

$Q=0.62A(2gh)^{0.5}$

$Q = 3.6 * \pi * R * head^{3/2}$

$Q=0.62A(2gh)^{0.5}$

Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.01
2	0.03
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.00
3.7	0.00
3.8	0.00
3.9	0.00
4	0.00
4.1	0.00
4.2	0.00
4.3	0.00
4.4	0.00
4.5	0.00
4.6	0.00
4.7	0.00
4.8	0.00
4.9	0.00
5	0.00
5.1	0.00
5.2	0.00
5.3	0.00
5.4	0.00
5.5	0.00
5.6	0.00
5.7	0.00
5.8	0.00
5.9	0.00

Orifice 1	
Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.05
2.2	0.08
2.3	0.10
2.4	0.12
2.5	0.13
2.6	0.15
2.7	0.16
2.8	0.17
2.9	0.18
3	0.19
3.1	0.20
3.2	0.21
3.3	0.22
3.4	0.23
3.5	0.24
3.6	0.24
3.7	0.25
3.8	0.26
3.9	0.27
4	0.27
4.1	0.28
4.2	0.29
4.3	0.29
4.4	0.30
4.5	0.31
4.6	0.31
4.7	0.32
4.8	0.32
4.9	0.33
5	0.33
5.1	0.34
5.2	0.35
5.3	0.35
5.4	0.36
5.5	0.36
5.6	0.37
5.7	0.37
5.8	0.38
5.9	0.38

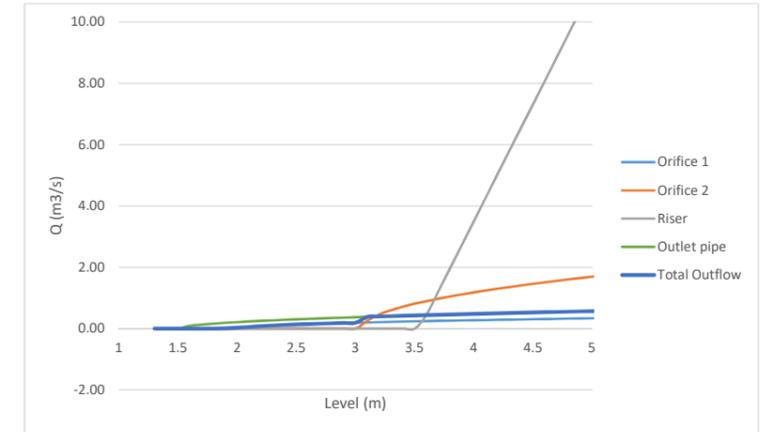
Orifice 2	
Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.26
3.2	0.46
3.3	0.60
3.4	0.71
3.5	0.81
3.6	0.90
3.7	0.97
3.8	1.05
3.9	1.12
4	1.18
4.1	1.24
4.2	1.30
4.3	1.35
4.4	1.41
4.5	1.46
4.6	1.51
4.7	1.56
4.8	1.60
4.9	1.65
5	1.69
5.1	1.74
5.2	1.78
5.3	1.82
5.4	1.86
5.5	1.90
5.6	1.94
5.7	1.97
5.8	2.01
5.9	2.05

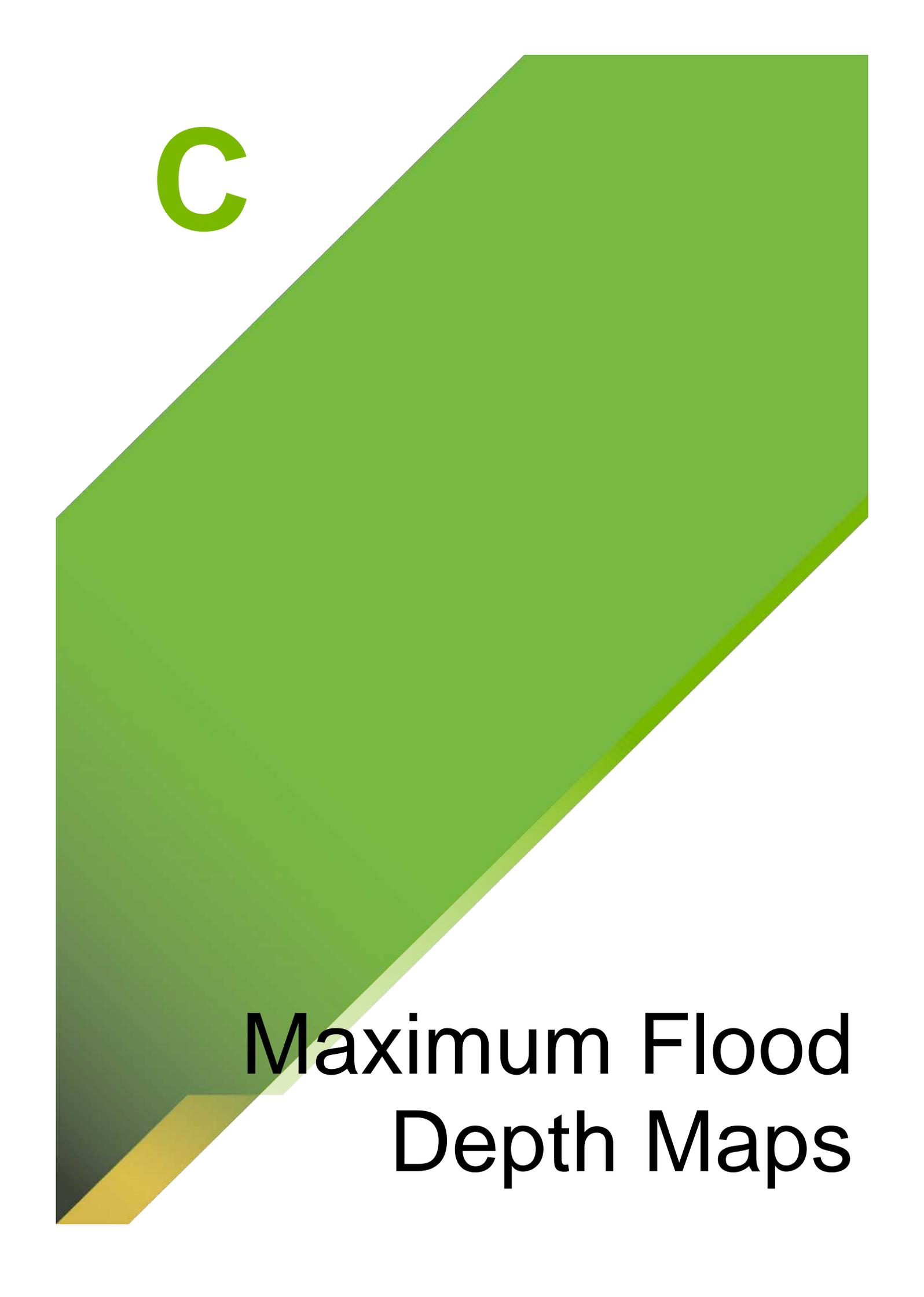
Riser	
Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.00
2	0.00
2.1	0.00
2.2	0.00
2.3	0.00
2.4	0.00
2.5	0.00
2.6	0.00
2.7	0.00
2.8	0.00
2.9	0.00
3	0.00
3.1	0.00
3.2	0.00
3.3	0.00
3.4	0.00
3.5	0.00
3.6	0.46
3.7	1.22
3.8	1.98
3.9	2.75
4	3.51
4.1	4.28
4.2	5.04
4.3	5.80
4.4	6.57
4.5	7.33
4.6	8.09
4.7	8.86
4.8	9.62
4.9	10.38
5	11.15
5.1	11.91
5.2	12.67
5.3	13.44
5.4	14.20
5.5	14.96
5.6	15.73
5.7	16.49
5.8	17.25
5.9	18.02

Subtotal	
Level	Q
1.30	0.00
1.40	0.00
1.50	0.00
1.60	0.00
1.70	0.00
1.80	0.00
1.90	0.01
2.00	0.03
2.10	0.05
2.20	0.08
2.30	0.10
2.40	0.12
2.50	0.13
2.60	0.15
2.70	0.16
2.80	0.17
2.90	0.18
3.00	0.19
3.10	0.46
3.20	0.67
3.30	0.82
3.40	0.94
3.50	1.04
3.60	1.60
3.70	2.45
3.80	3.29
3.90	4.13
4.00	4.96
4.10	5.79
4.20	6.62
4.30	7.45
4.40	8.27
4.50	9.09
4.60	9.91
4.70	10.73
4.80	11.54
4.90	12.36
5.00	13.17
5.10	13.98
5.20	14.80
5.30	15.60
5.40	16.41
5.50	17.22
5.60	18.03
5.70	18.83
5.80	19.64
5.90	20.44

Outlet pipe	
Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.09
1.7	0.13
1.8	0.16
1.9	0.19
2	0.21
2.1	0.23
2.2	0.25
2.3	0.27
2.4	0.28
2.5	0.30
2.6	0.32
2.7	0.33
2.8	0.34
2.9	0.36
3	0.37
3.1	0.38
3.2	0.39
3.3	0.40
3.4	0.42
3.5	0.43
3.6	0.44
3.7	0.45
3.8	0.46
3.9	0.47
4	0.48
4.1	0.49
4.2	0.50
4.3	0.51
4.4	0.51
4.5	0.52
4.6	0.53
4.7	0.54
4.8	0.55
4.9	0.56
5	0.57
5.1	0.57
5.2	0.58
5.3	0.59
5.4	0.60
5.5	0.61
5.6	0.61
5.7	0.62
5.8	0.63
5.9	0.63

Total Outflow	
Level	Q
1.3	0.00
1.4	0.00
1.5	0.00
1.6	0.00
1.7	0.00
1.8	0.00
1.9	0.01
2	0.03
2.1	0.05
2.2	0.08
2.3	0.10
2.4	0.12
2.5	0.13
2.6	0.15
2.7	0.16
2.8	0.17
2.9	0.18
3	0.19
3.1	0.38
3.2	0.39
3.3	0.40
3.4	0.42
3.5	0.43
3.6	0.44
3.7	0.45
3.8	0.46
3.9	0.47
4	0.48
4.1	0.49
4.2	0.50
4.3	0.51
4.4	0.51
4.5	0.52
4.6	0.53
4.7	0.54
4.8	0.55
4.9	0.56
5	0.57
5.1	0.57
5.2	0.58
5.3	0.59
5.4	0.60
5.5	0.61
5.6	0.61
5.7	0.62
5.8	0.63
5.9	0.63



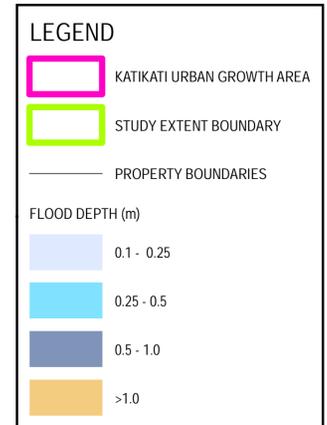
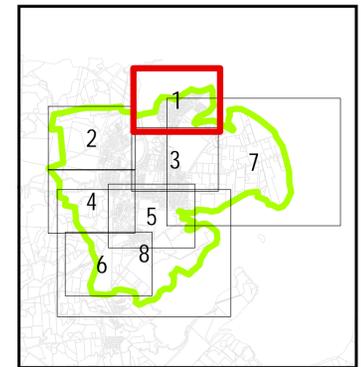


C

# Maximum Flood Depth Maps

# Appendix C

## Maximum Flood Depth Maps



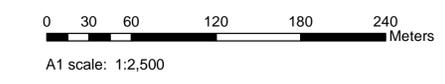
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



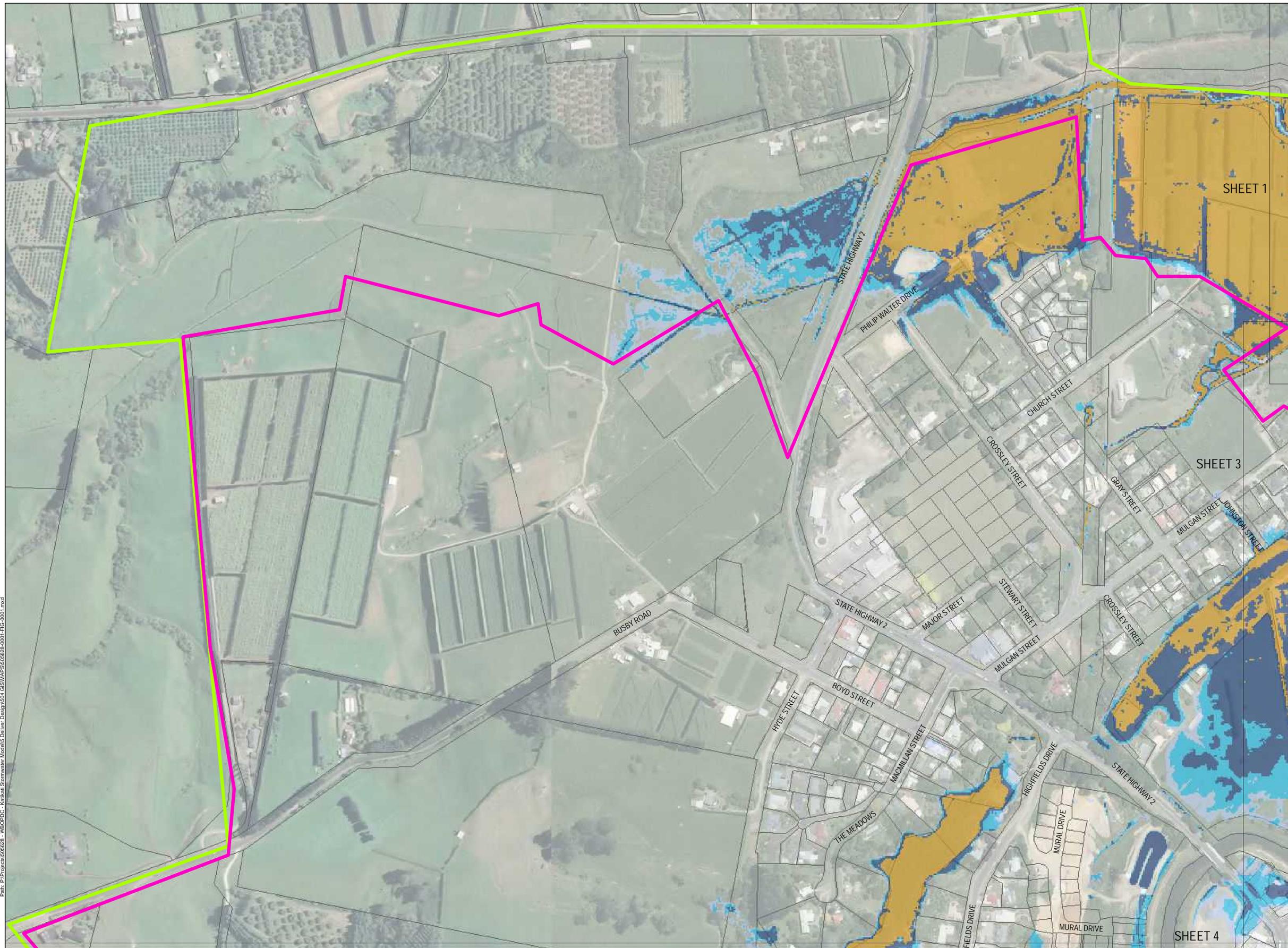
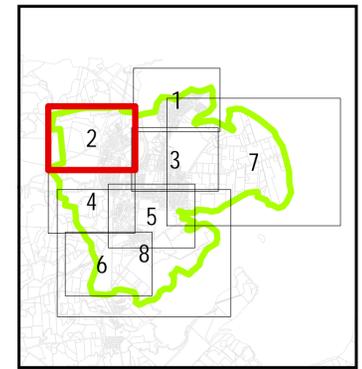
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 1 RevB - July 2019





**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

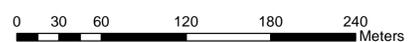
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



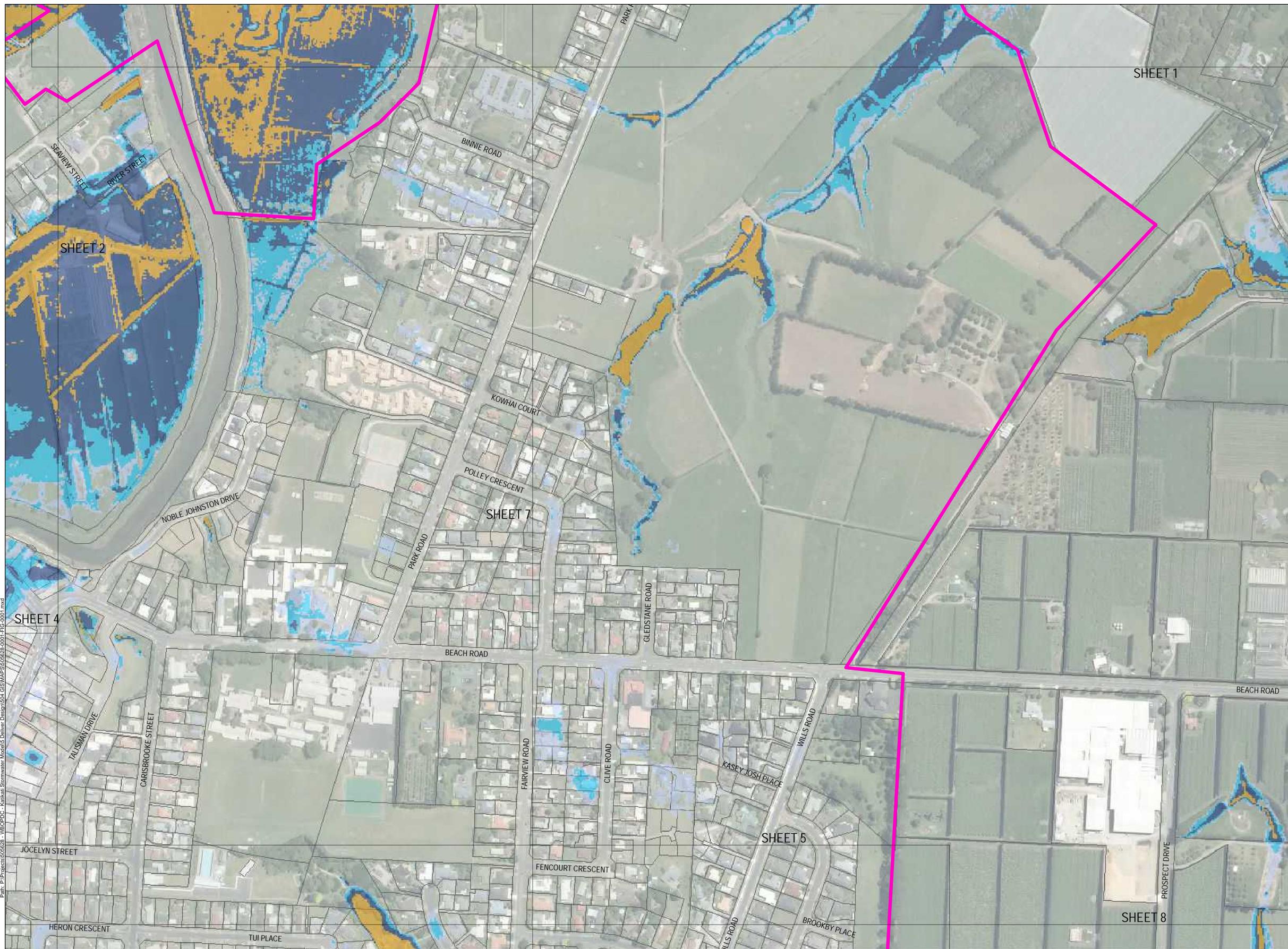
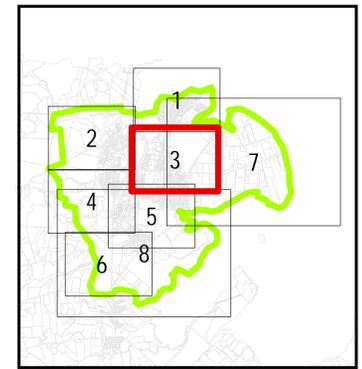
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-001-FIG-001.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

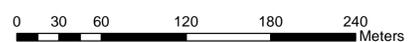
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500

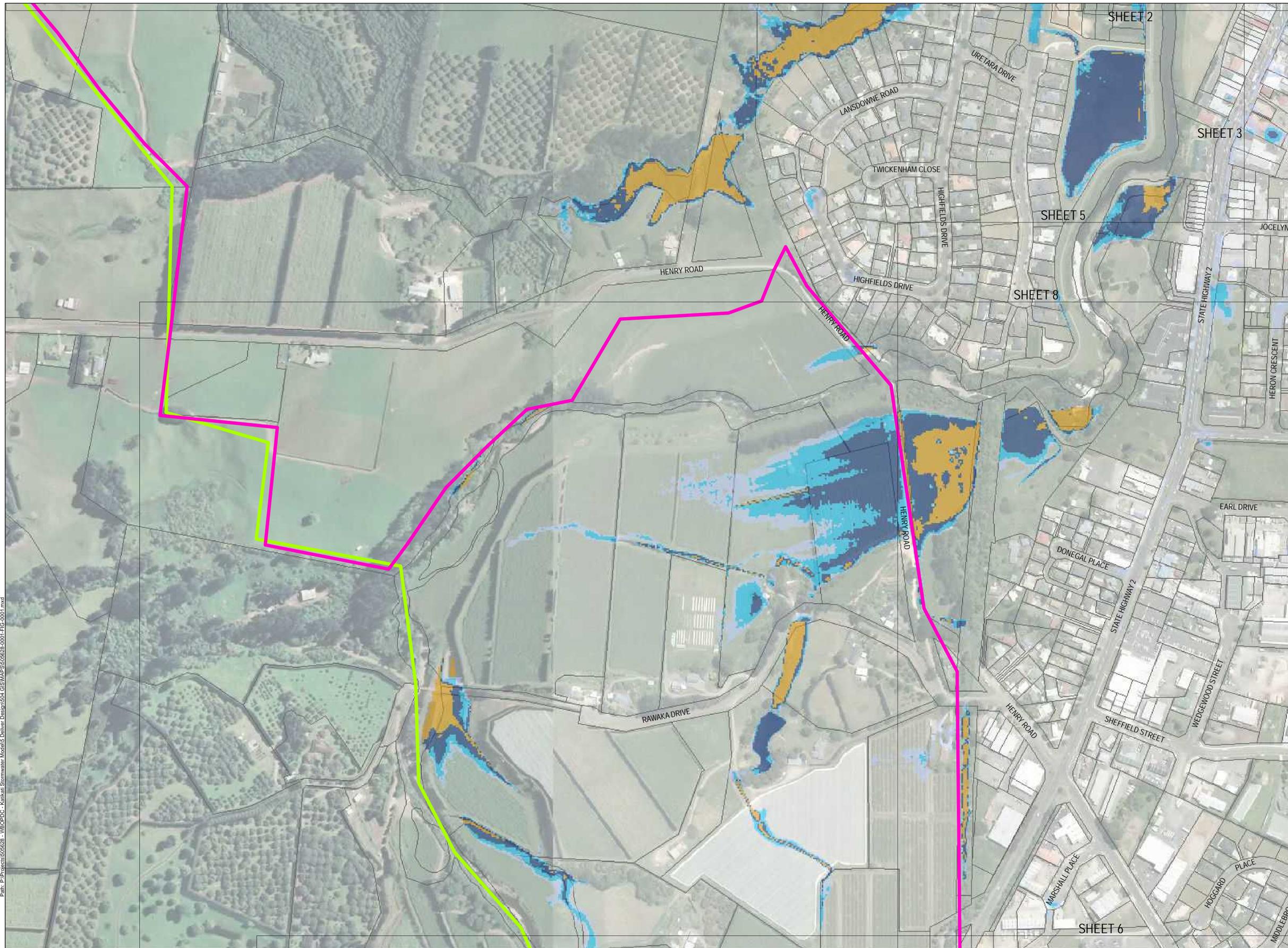
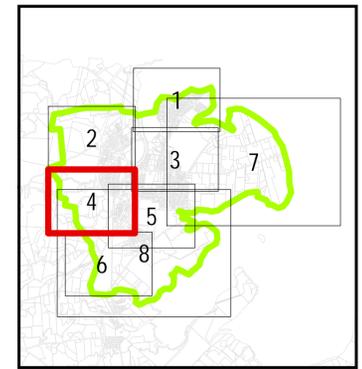


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 3 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

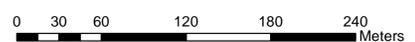
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



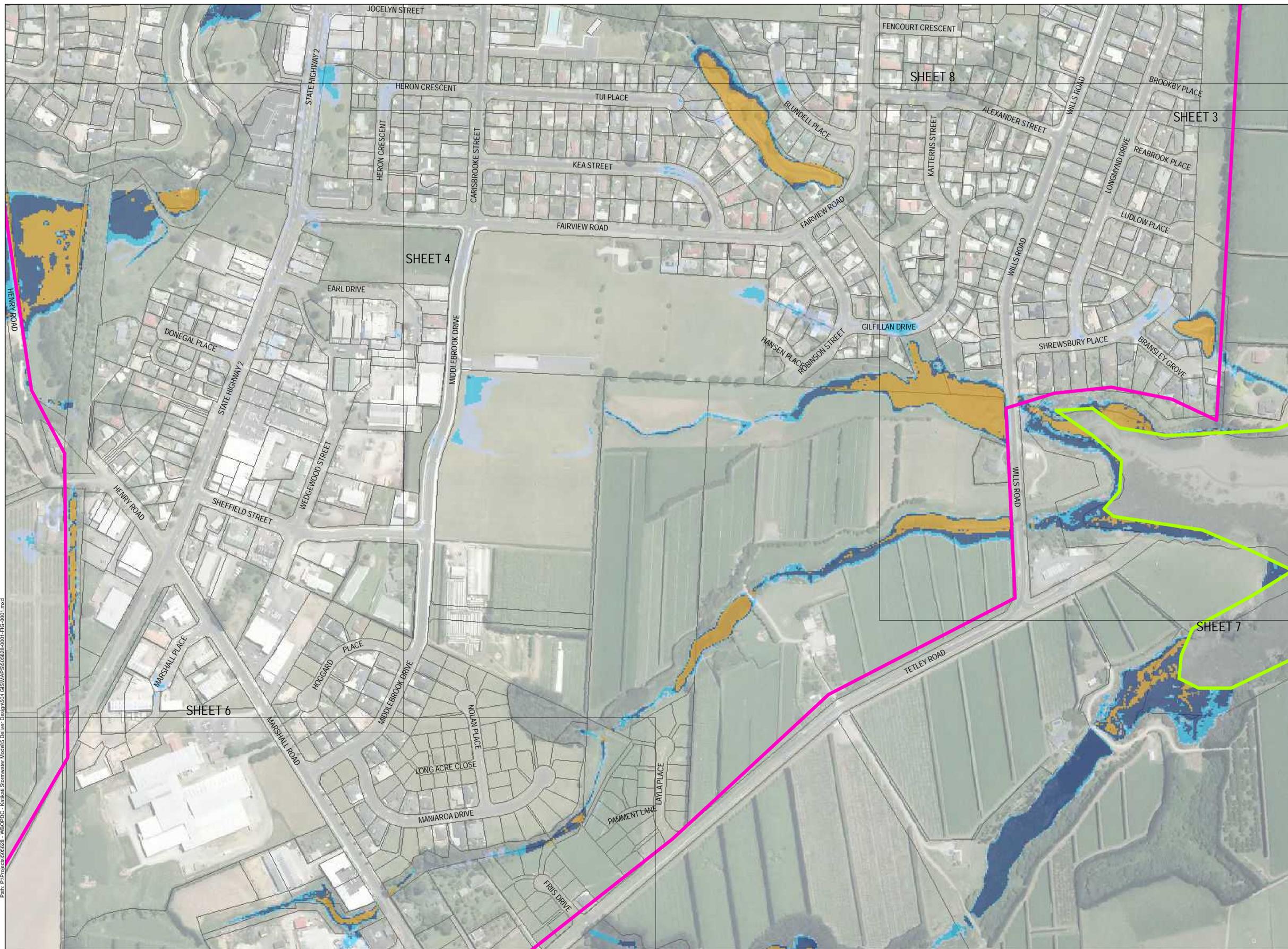
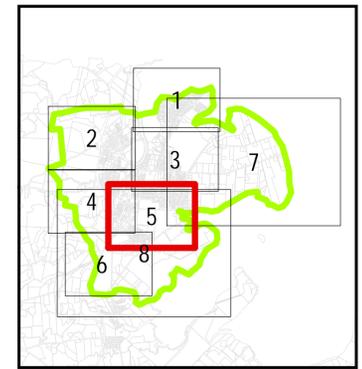
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-001-FIG-0001.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

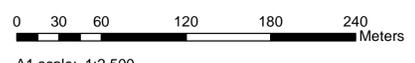
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



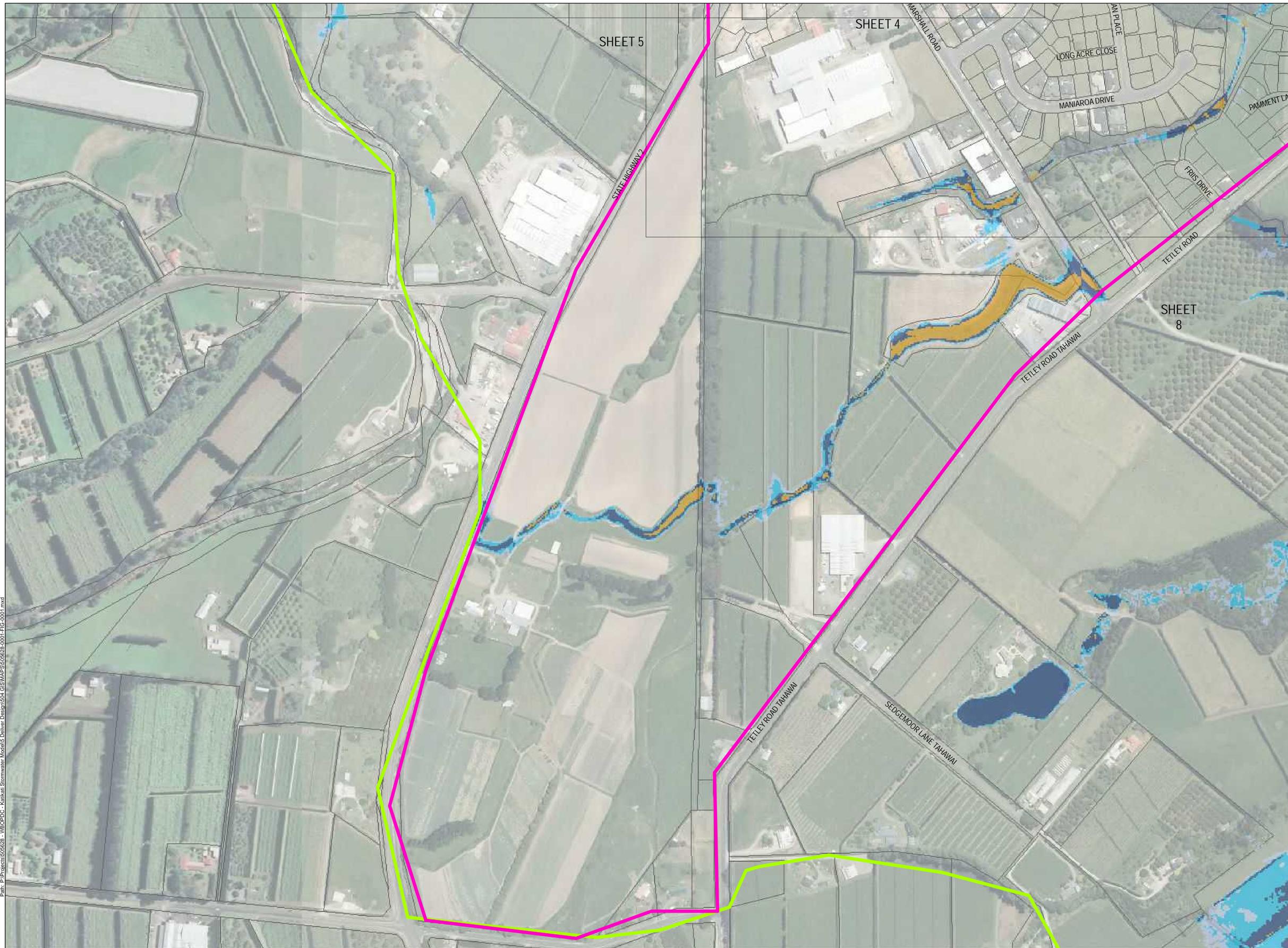
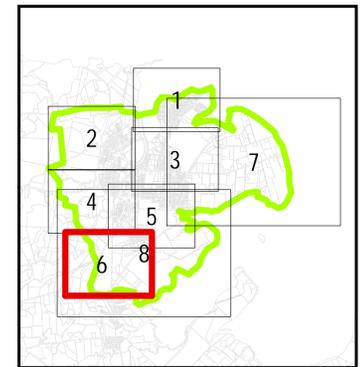
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 5 RevB - July 2019

Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-001-FIG-0001.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

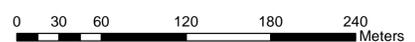
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
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3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



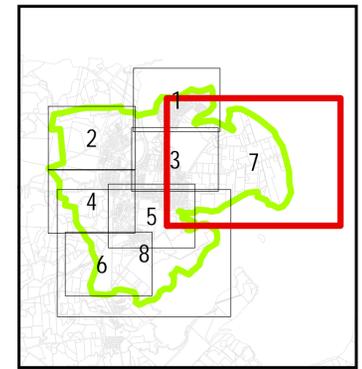
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 6 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-001-FIG-001.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
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  - Wave run up (eg. from passing vehicles).
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3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:5,000

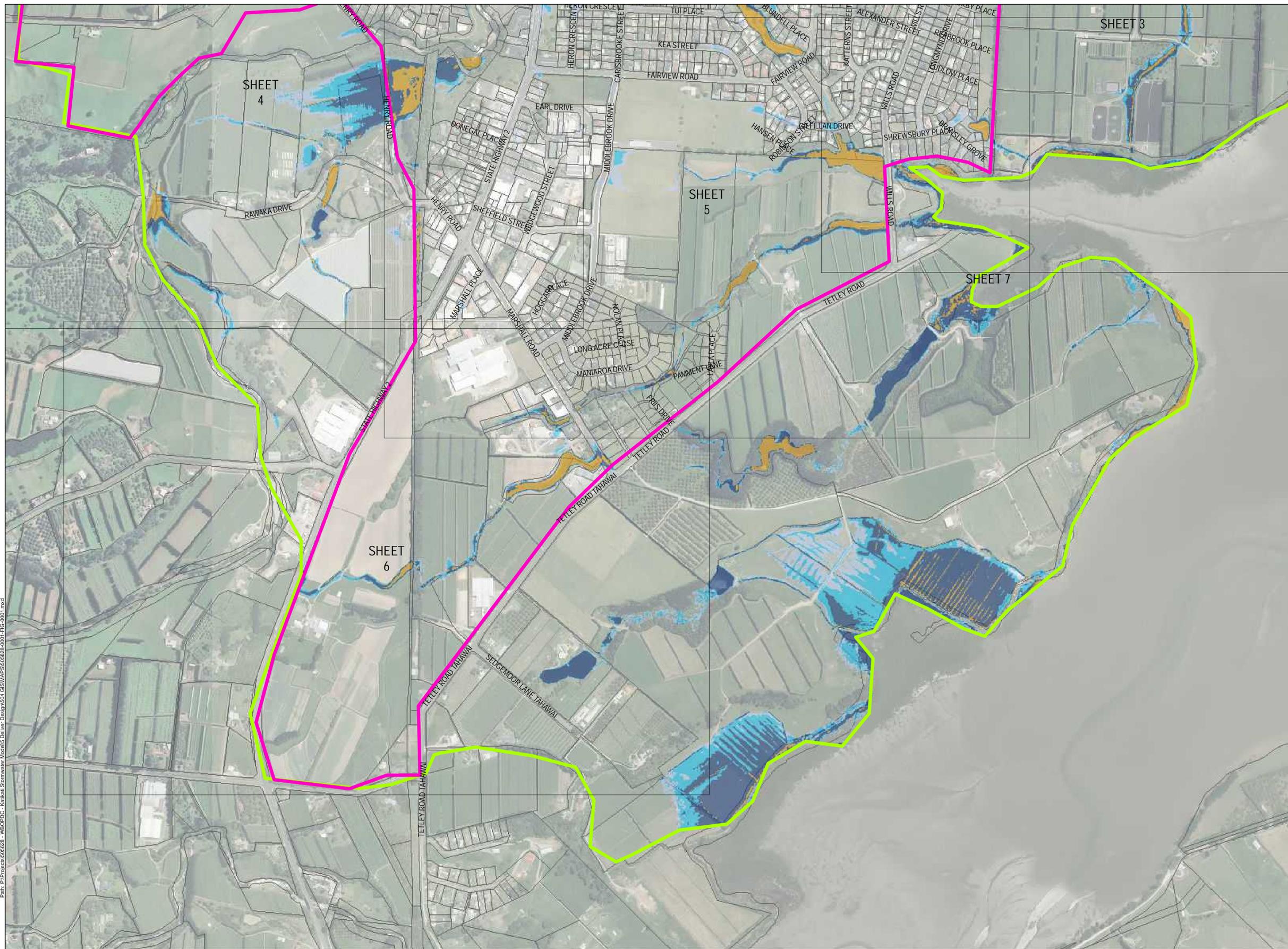
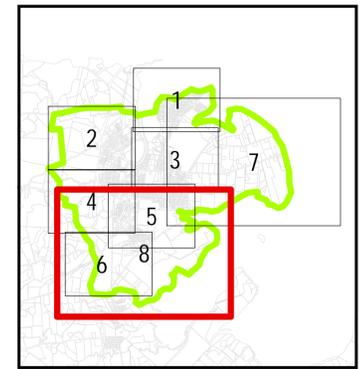


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:5,000



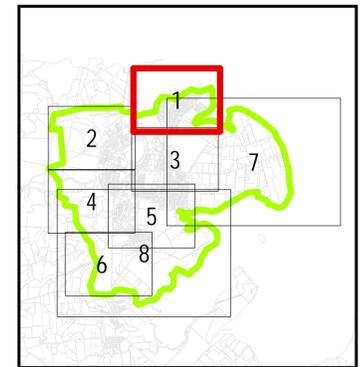
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 001: 10y ARI - Existing development - Maximum flood depth

SHEET: 8 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Driver Design\504 GIS\MAPS\505628-001-FIG-001.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

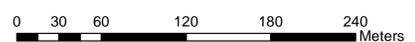
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500



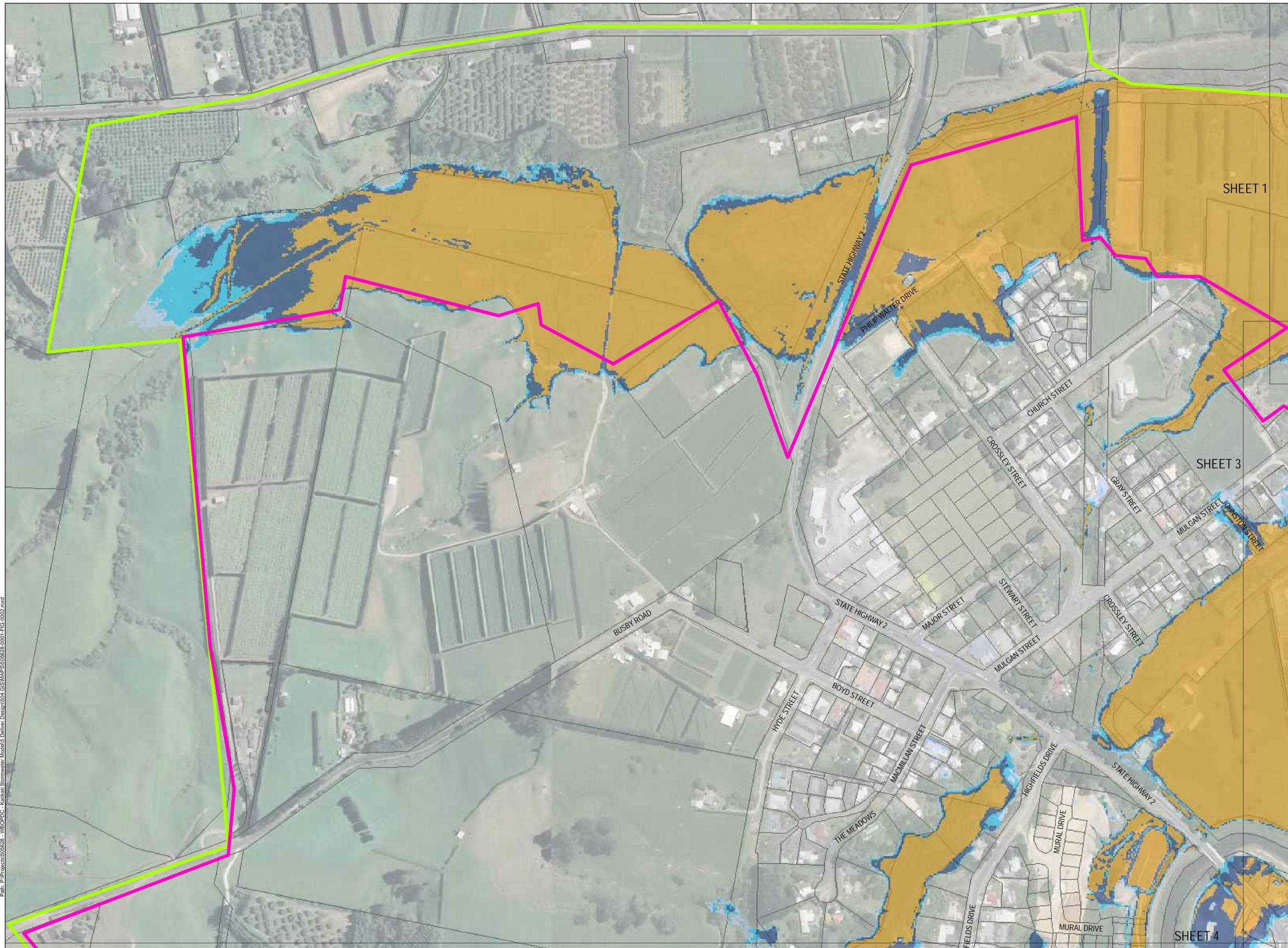
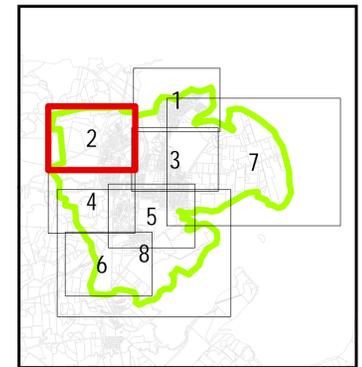
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-001-FIG-002.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

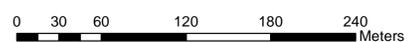
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:2,500



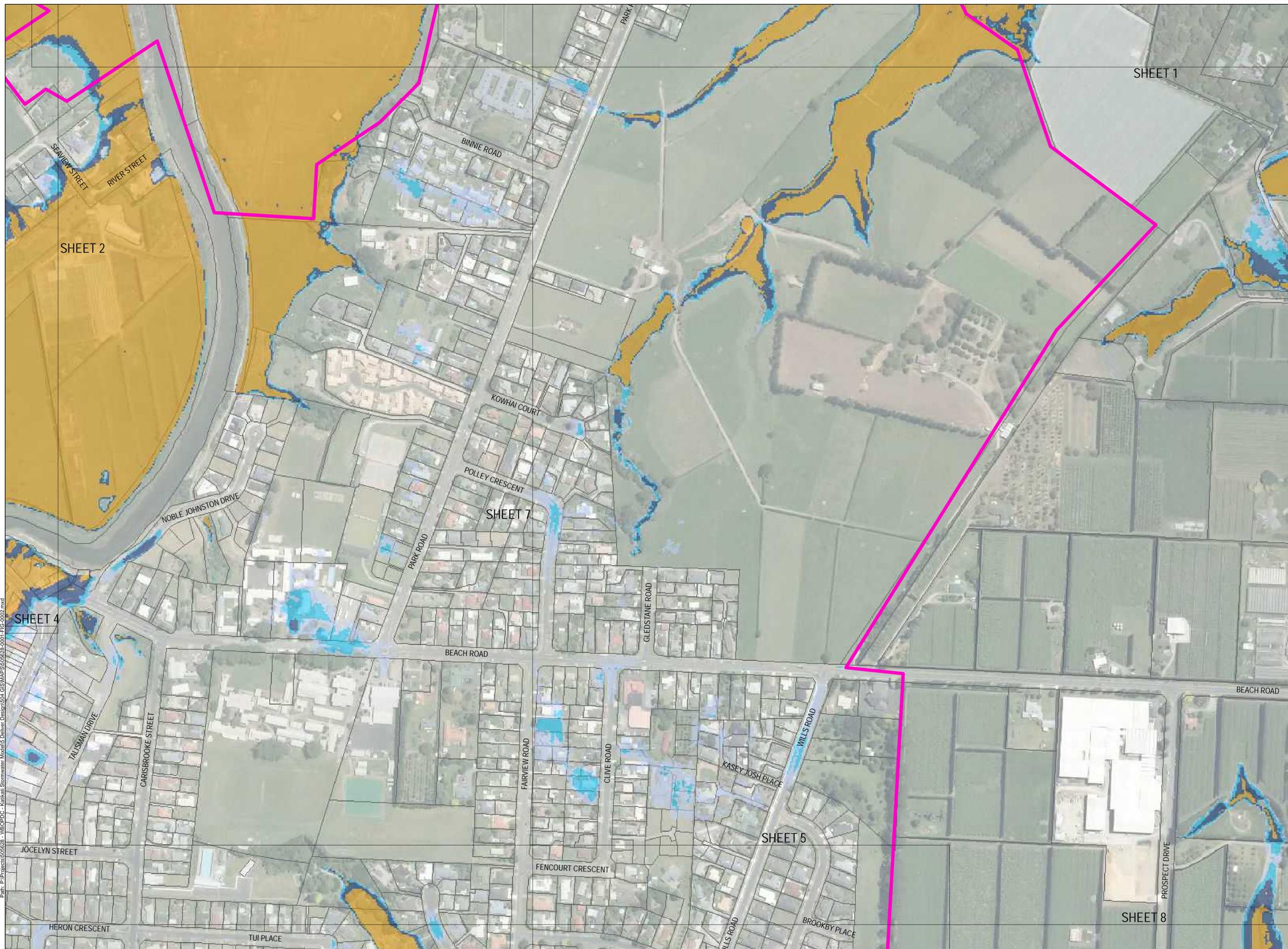
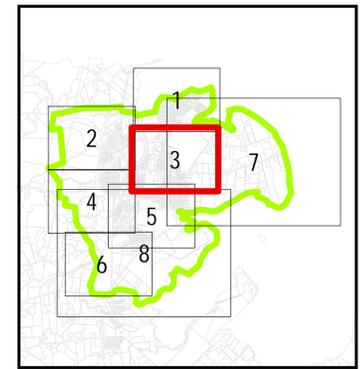
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-0001-FIG-0002.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

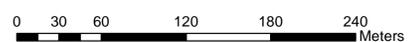
FLOOD DEPTHS <0.1m NOT SHOWN

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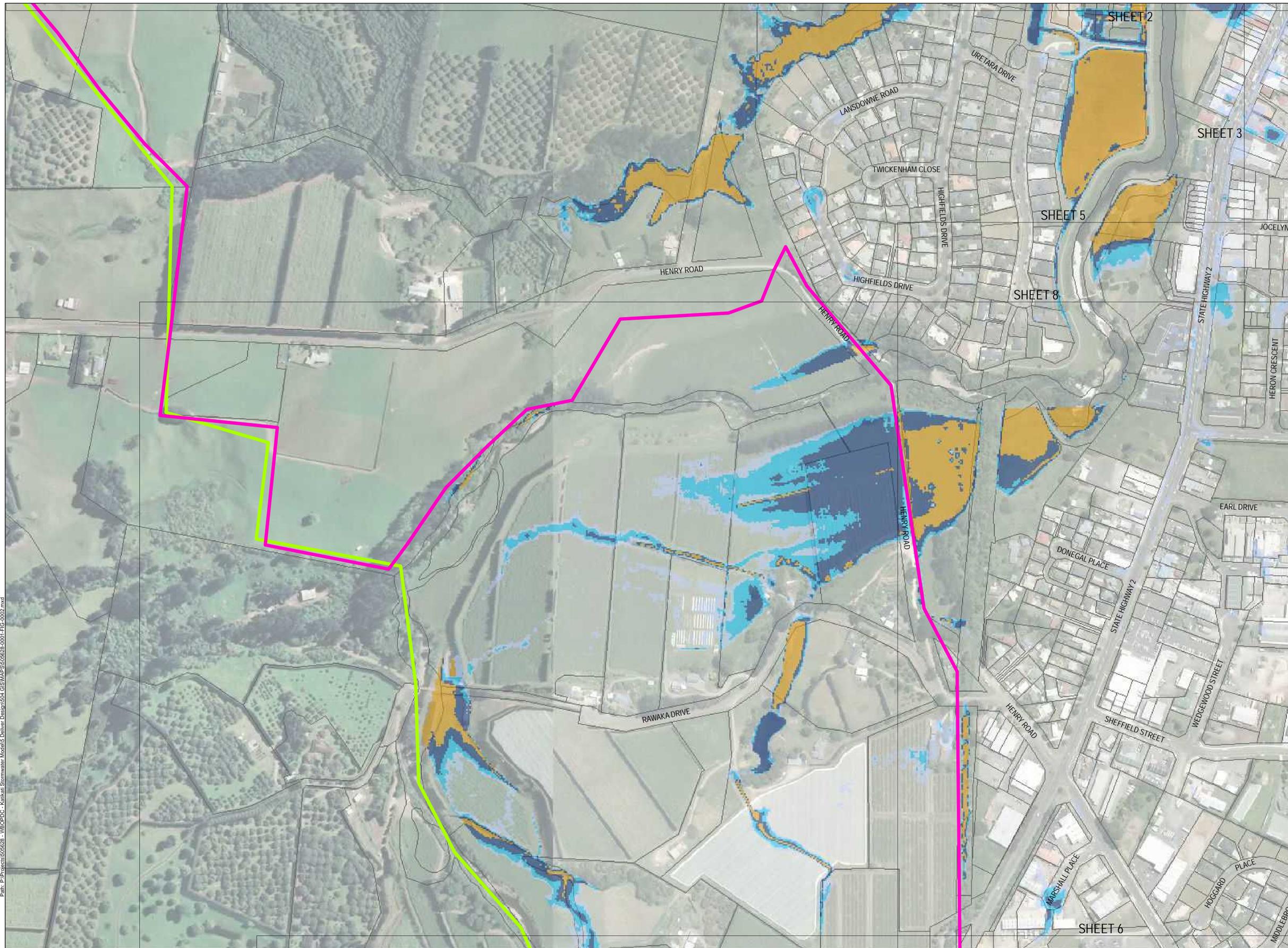
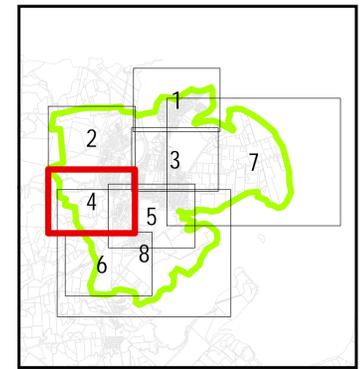


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 3 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

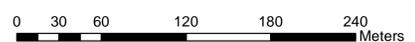
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

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A1 scale: 1:2,500



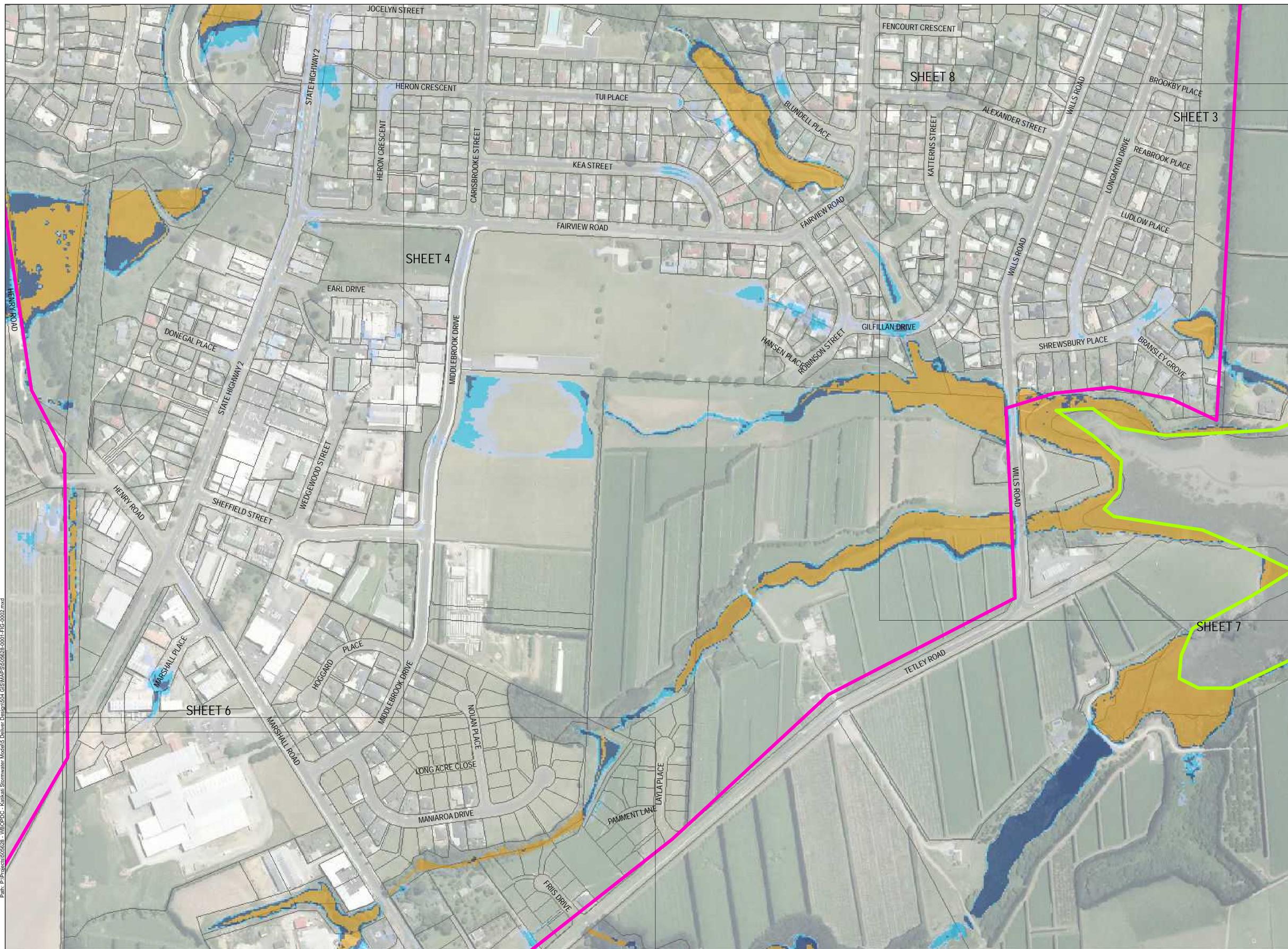
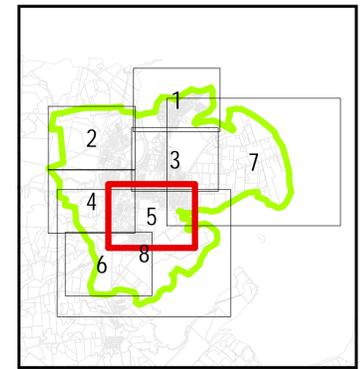
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0002.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

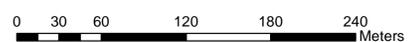
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A1 scale: 1:2,500



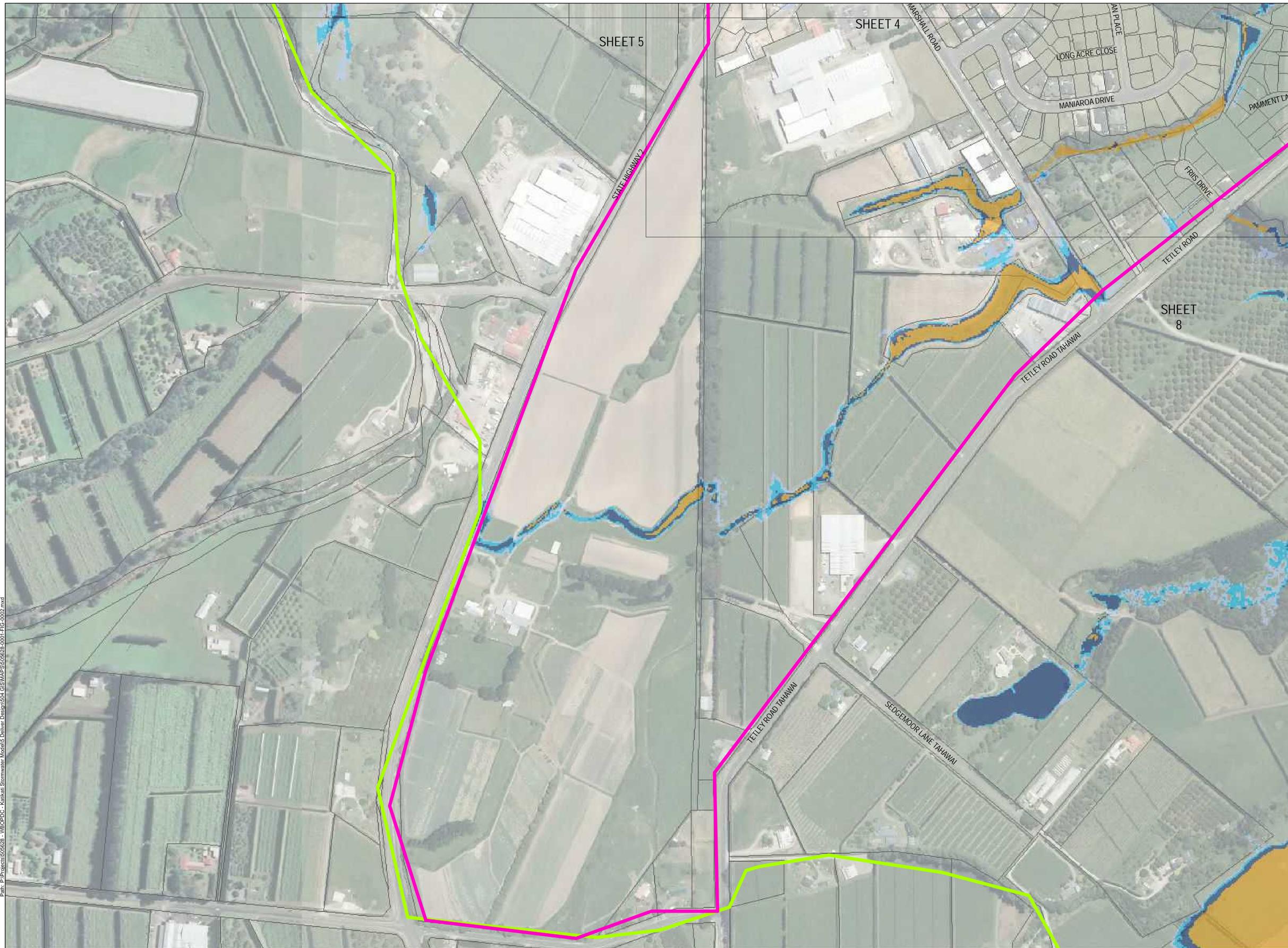
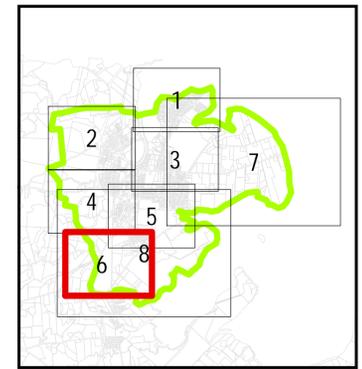
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 5 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-001-FIG-0002.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

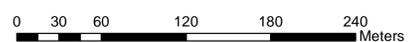
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A1 scale: 1:2,500



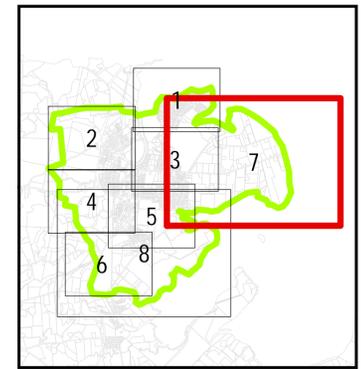
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 6 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-001-FIG-002.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

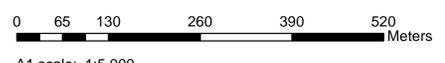
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A1 scale: 1:5,000

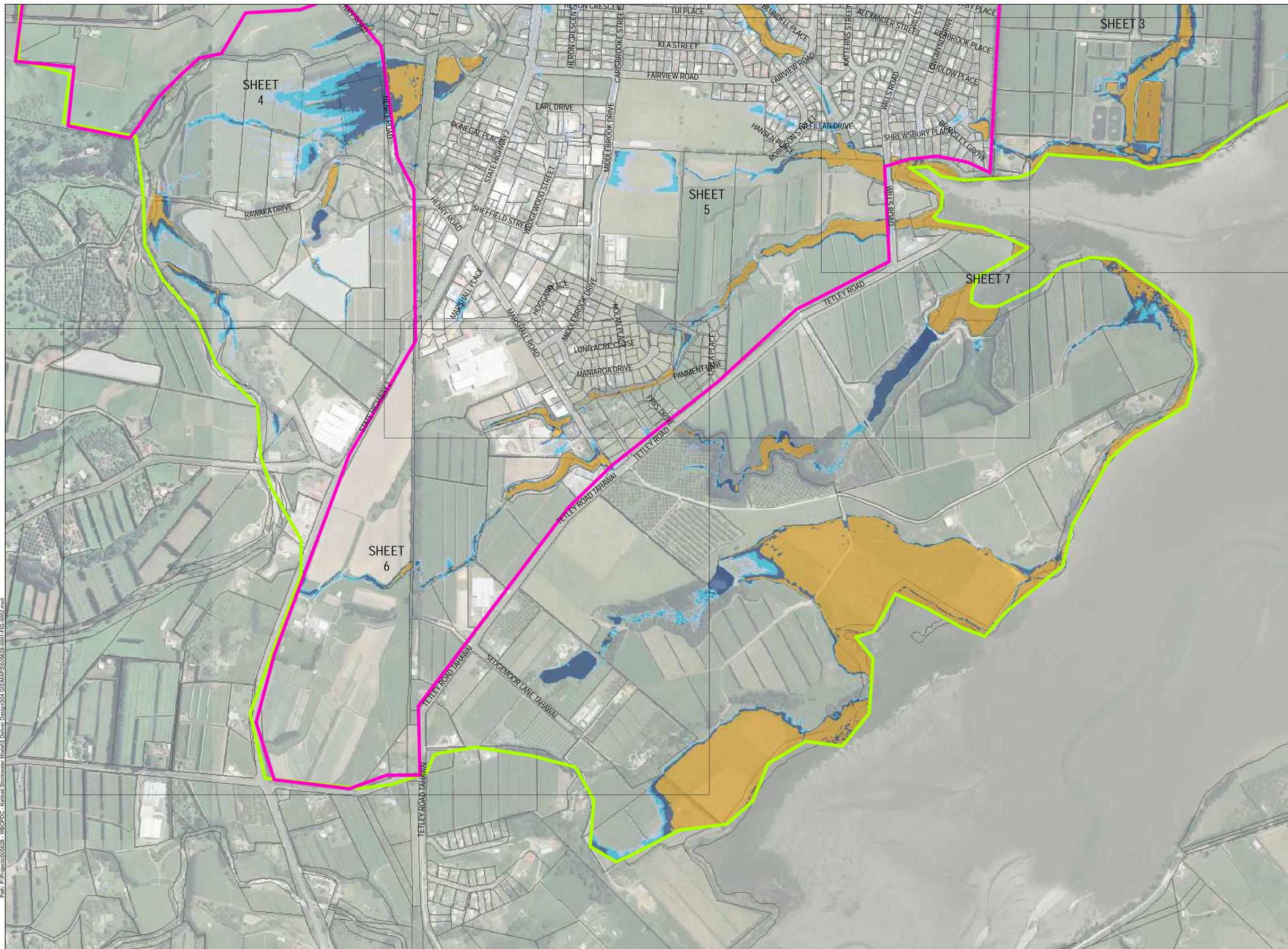
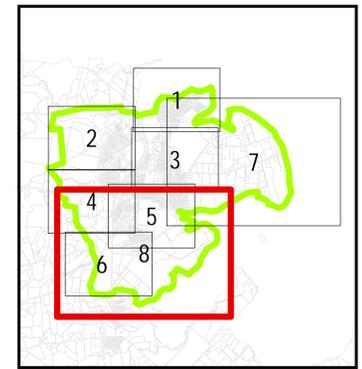


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

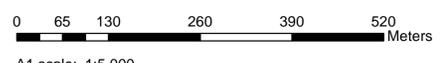
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A1 scale: 1:5,000



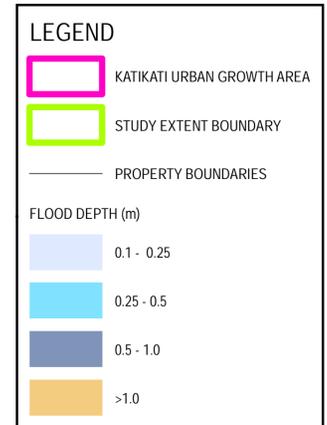
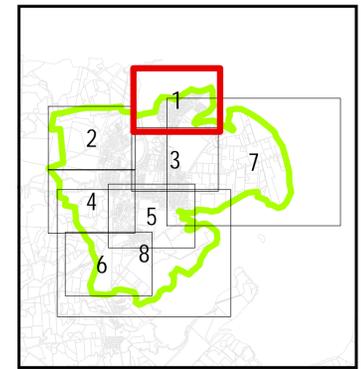
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 002: 10y ARI - Maximum probable development - Maximum flood depth

SHEET: 8 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Driver Design\04 GIS\MAPS\505628-0001-FIG-0002.mxd



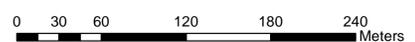
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



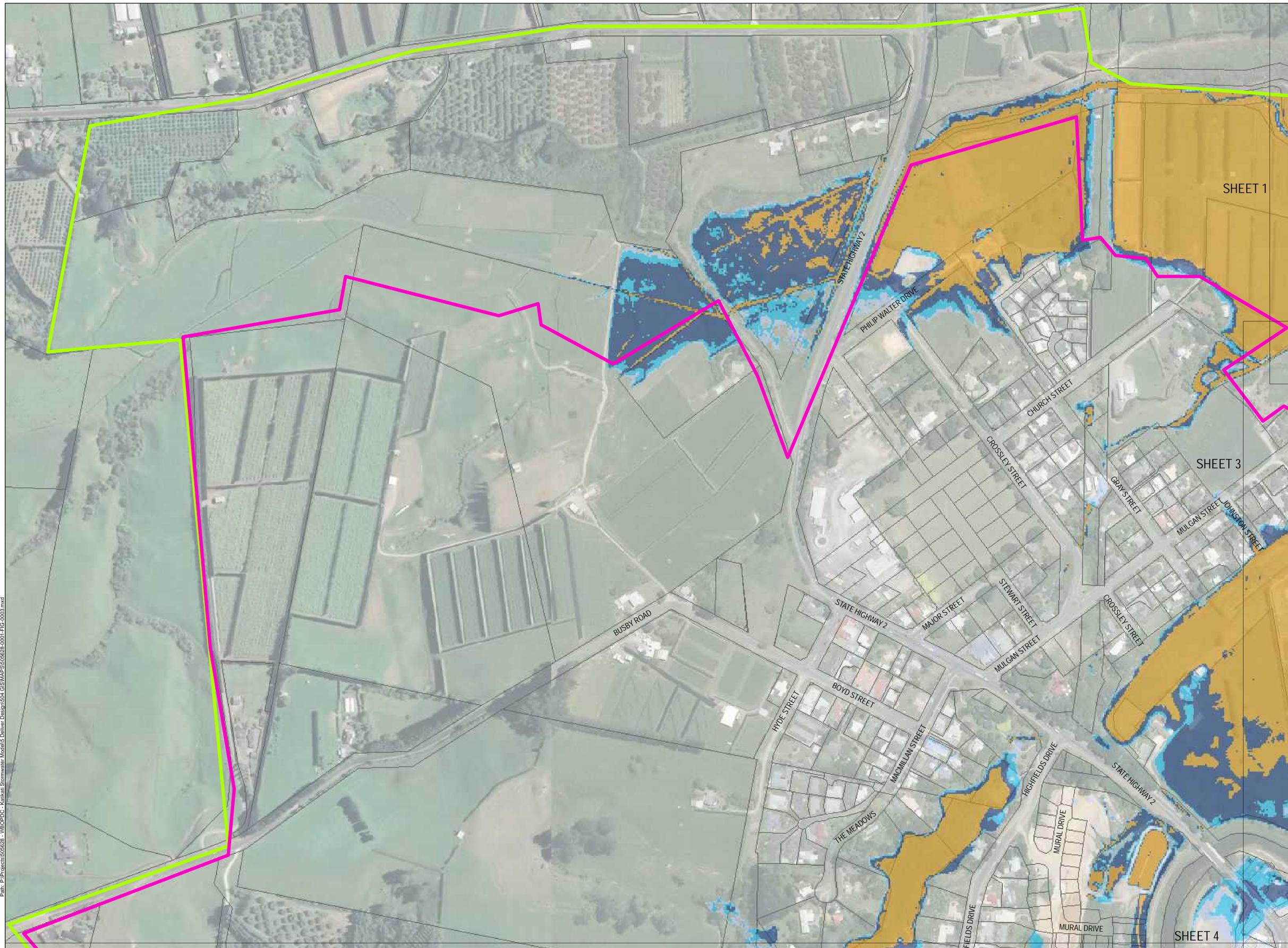
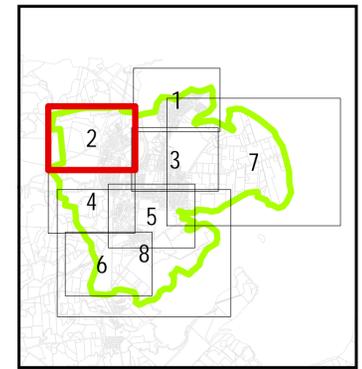
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-003-FIG-003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

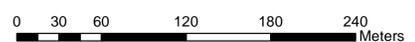
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



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A1 scale: 1:2,500



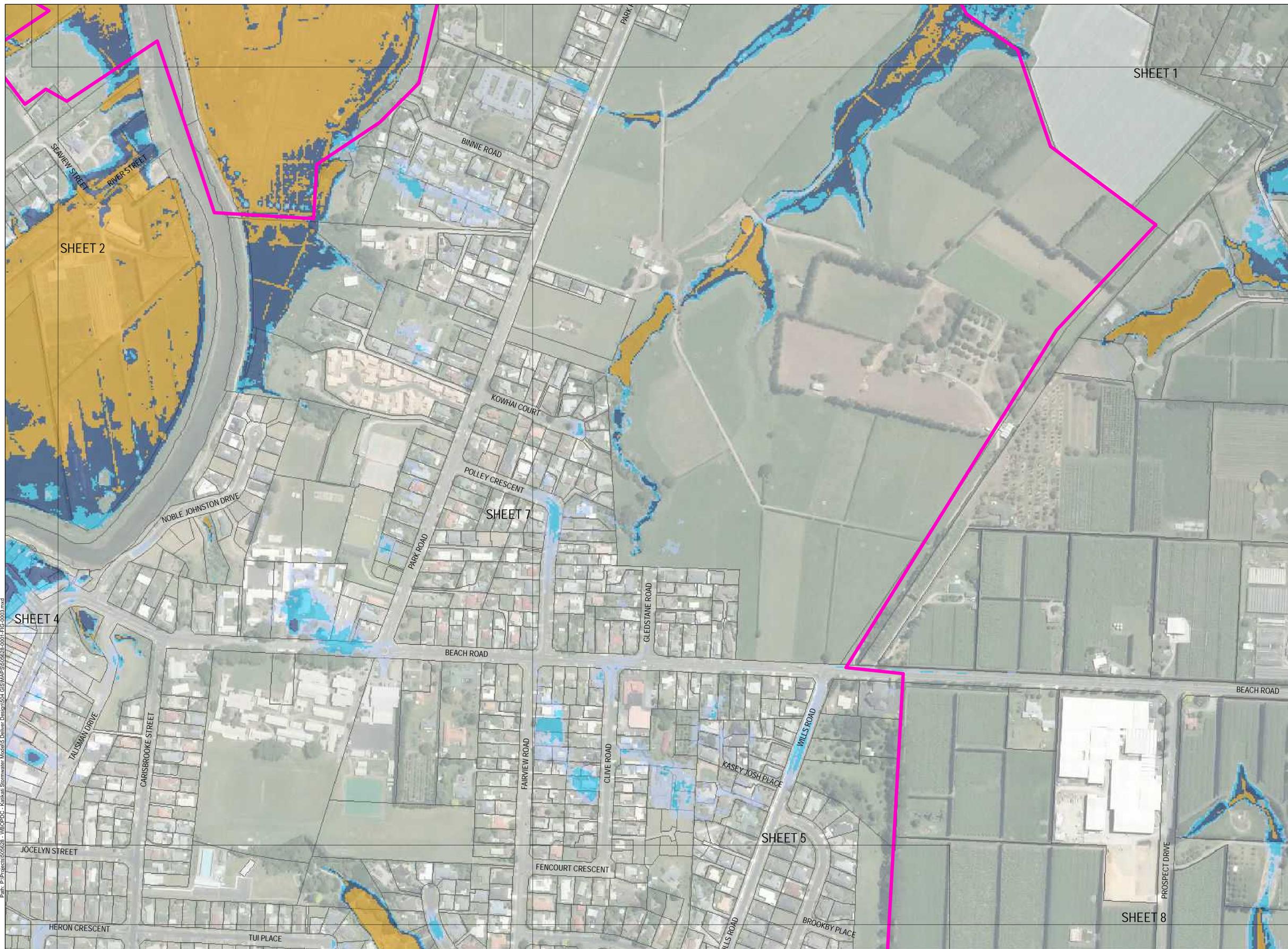
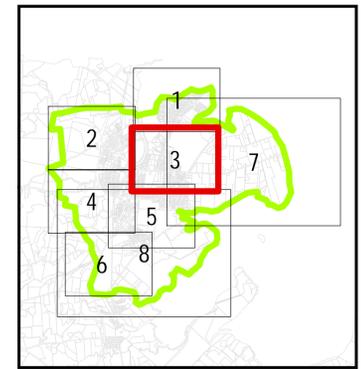
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 Deliver Design\04 GIS\MAPS\505628-003r-FIG-0003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

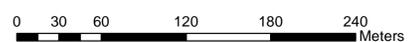
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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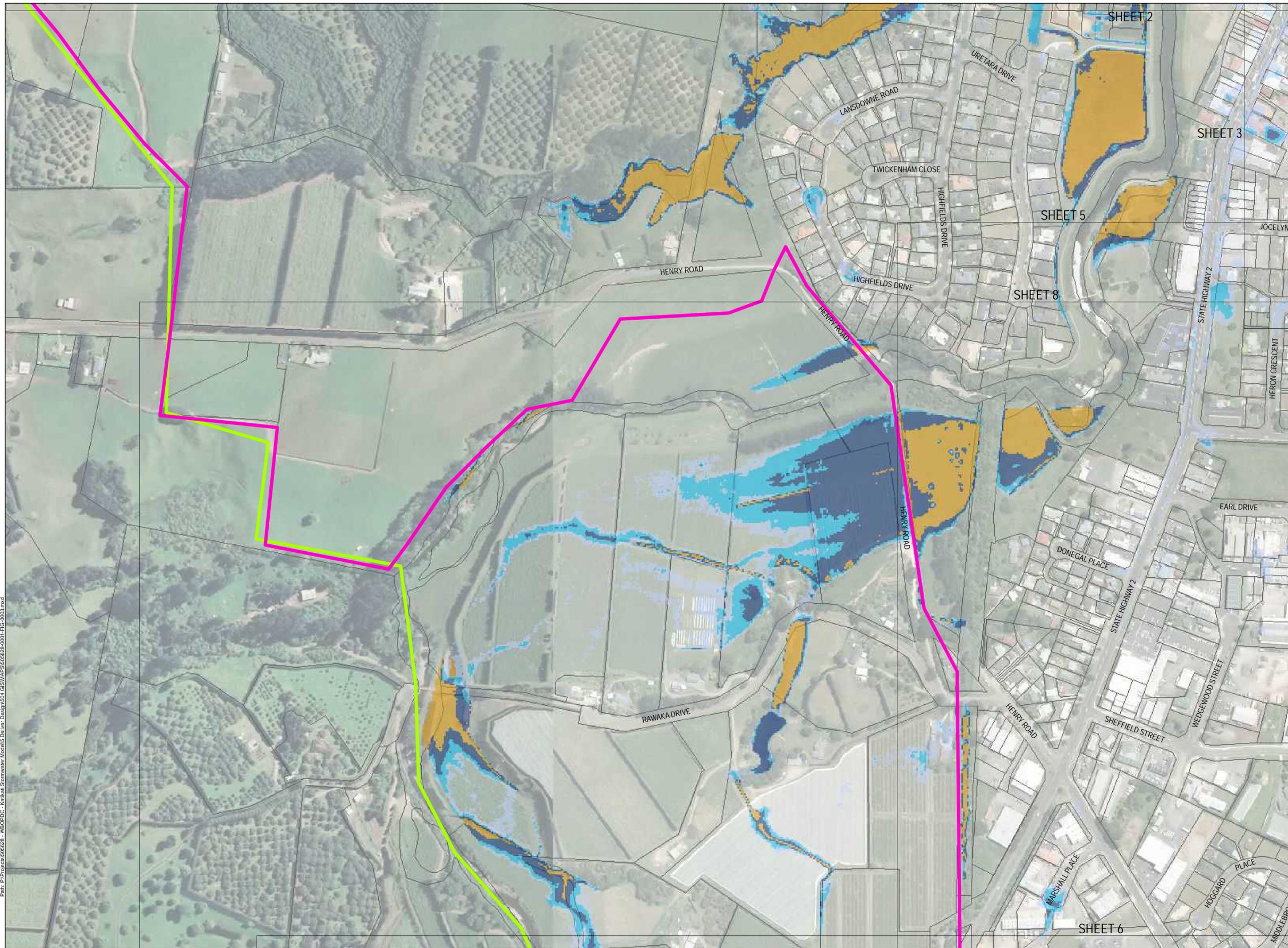
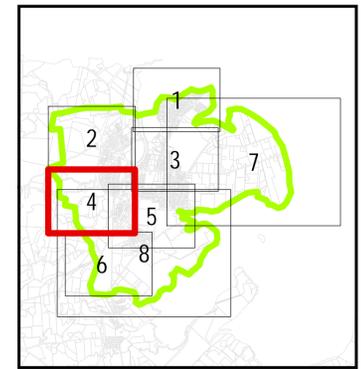


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 3 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

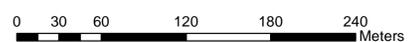
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:2,500



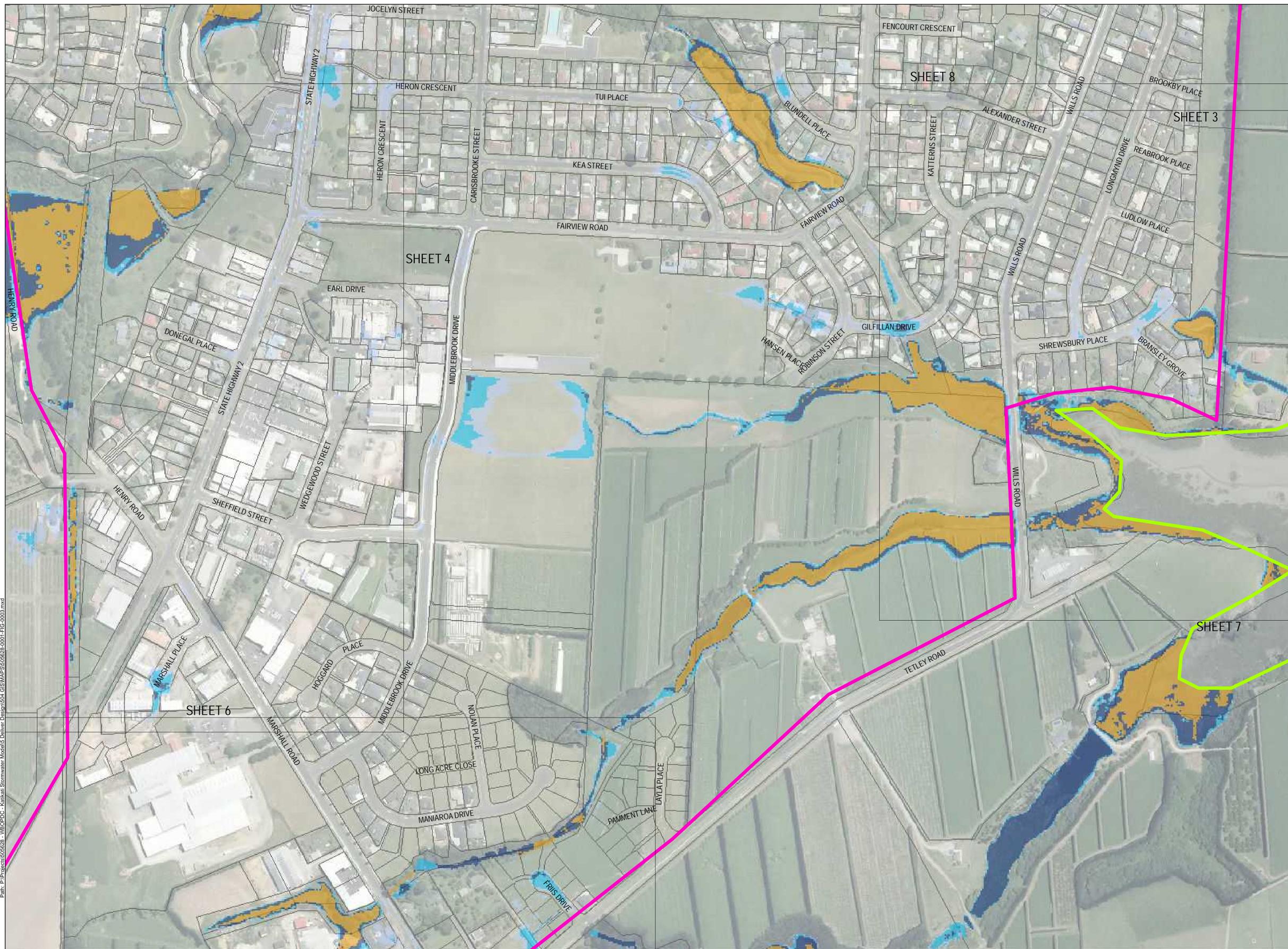
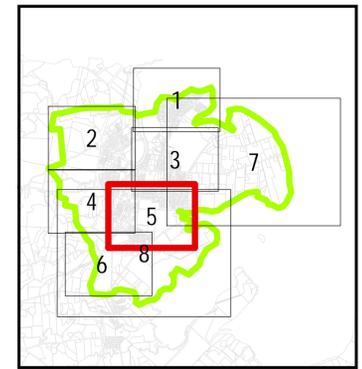
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

## WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\03 GIS\MAPS\505628-003r-FIG-0003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

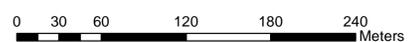
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



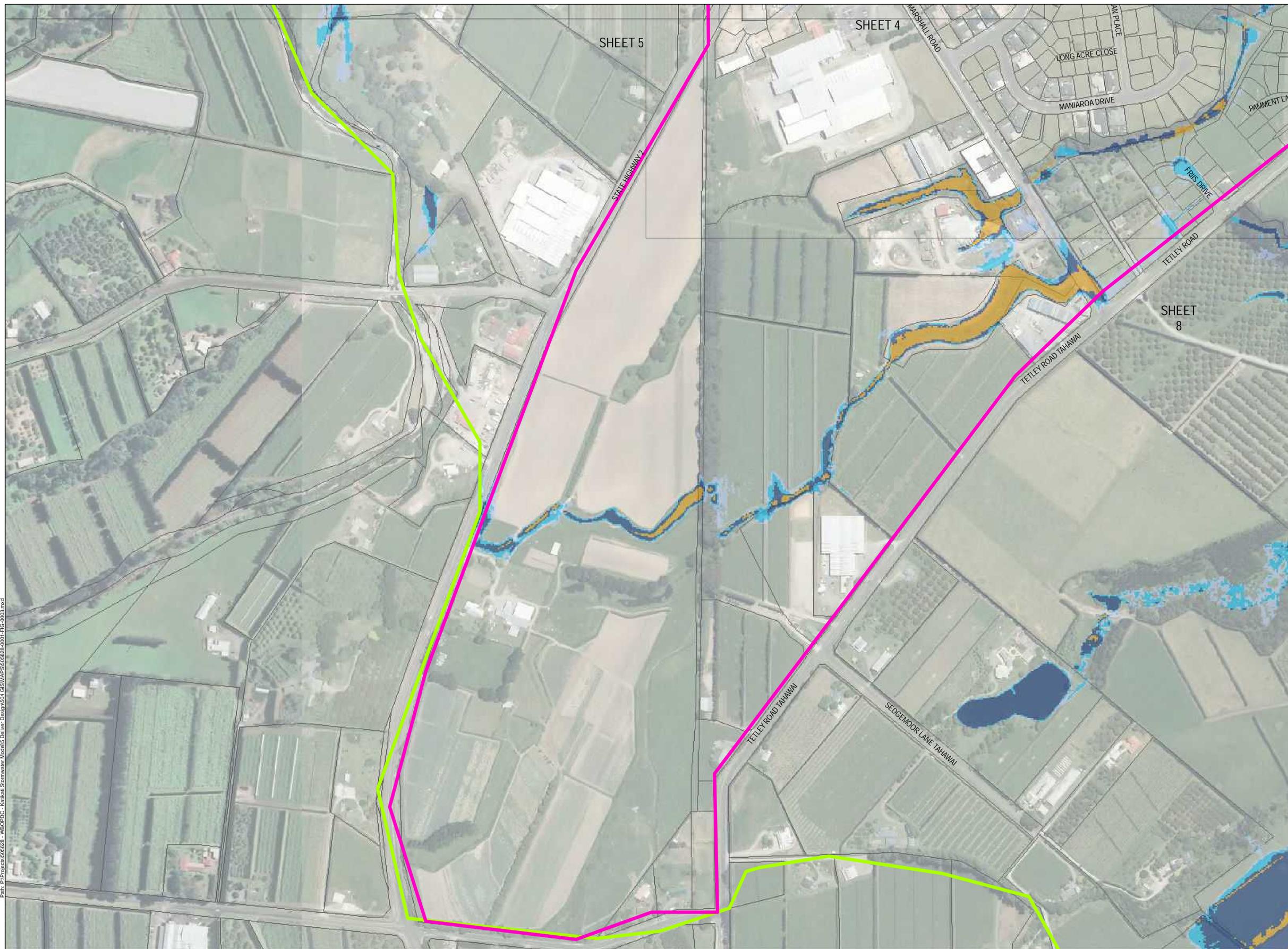
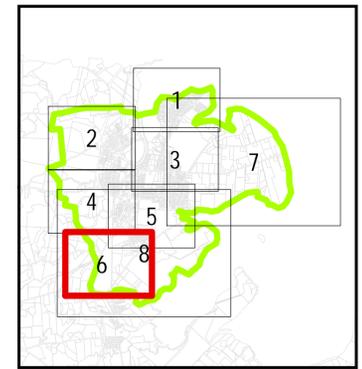
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 5 RevB - July 2019

Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 Deliver\Design\03 GIS\MAPS\505628-003-FIG-003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

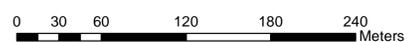
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:2,500



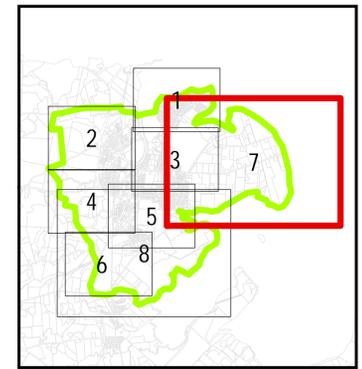
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 6 RevB - July 2019

Path: P:\projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver Design\505628-003-FIG-003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:5,000

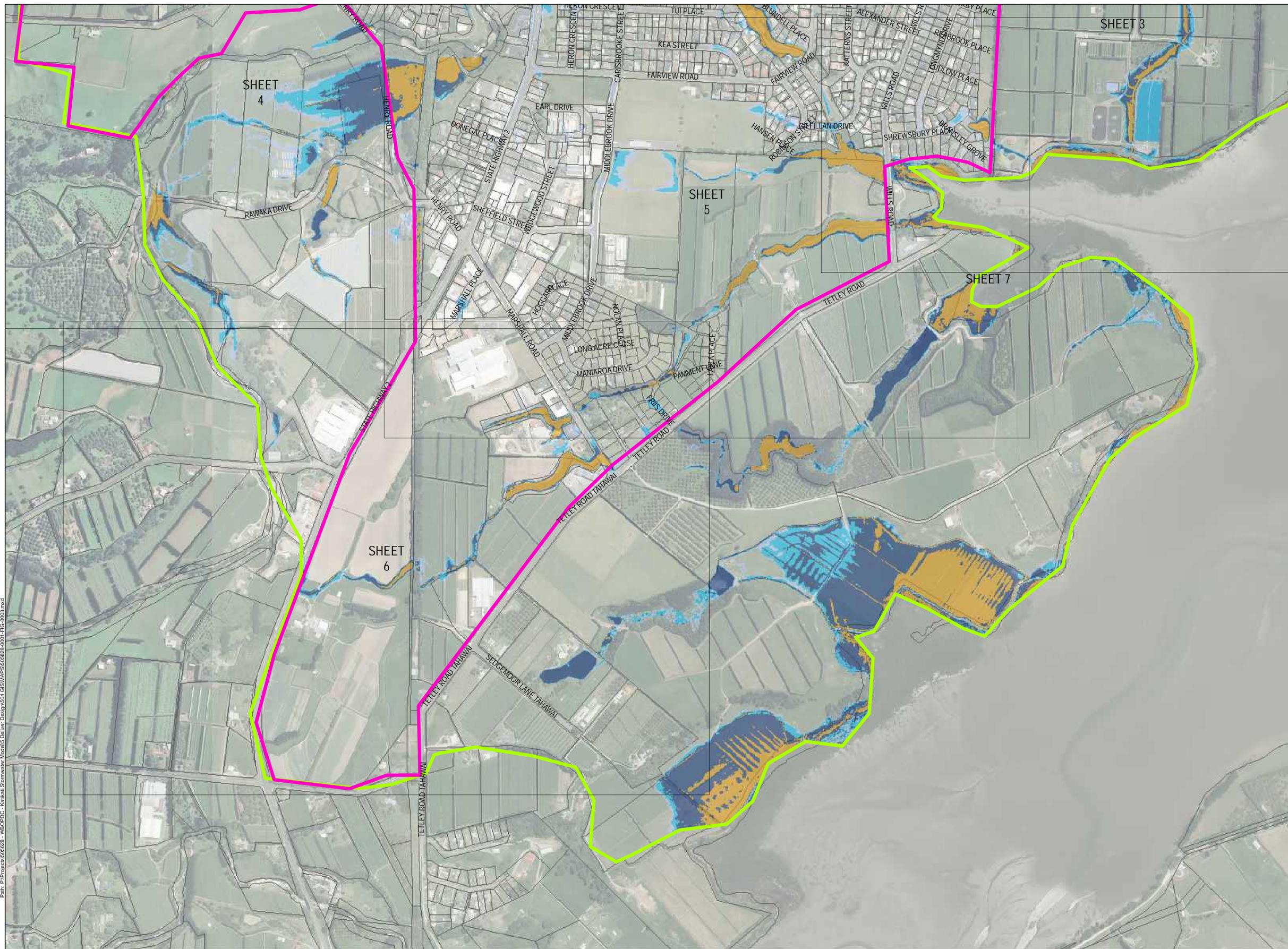
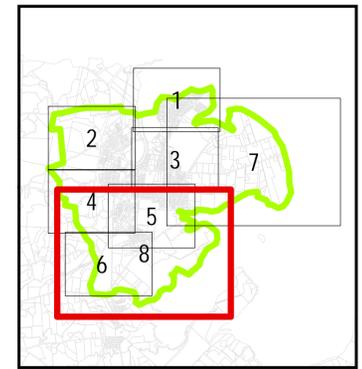


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

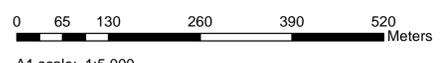
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:5,000



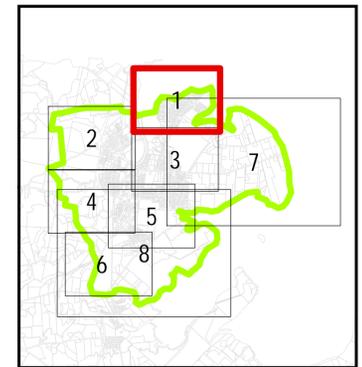
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 003: 50y ARI - Existing development - Maximum flood depth

SHEET: 8 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver Design\504 GIS\MAPS\505628-003-FIG-003.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

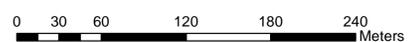
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500



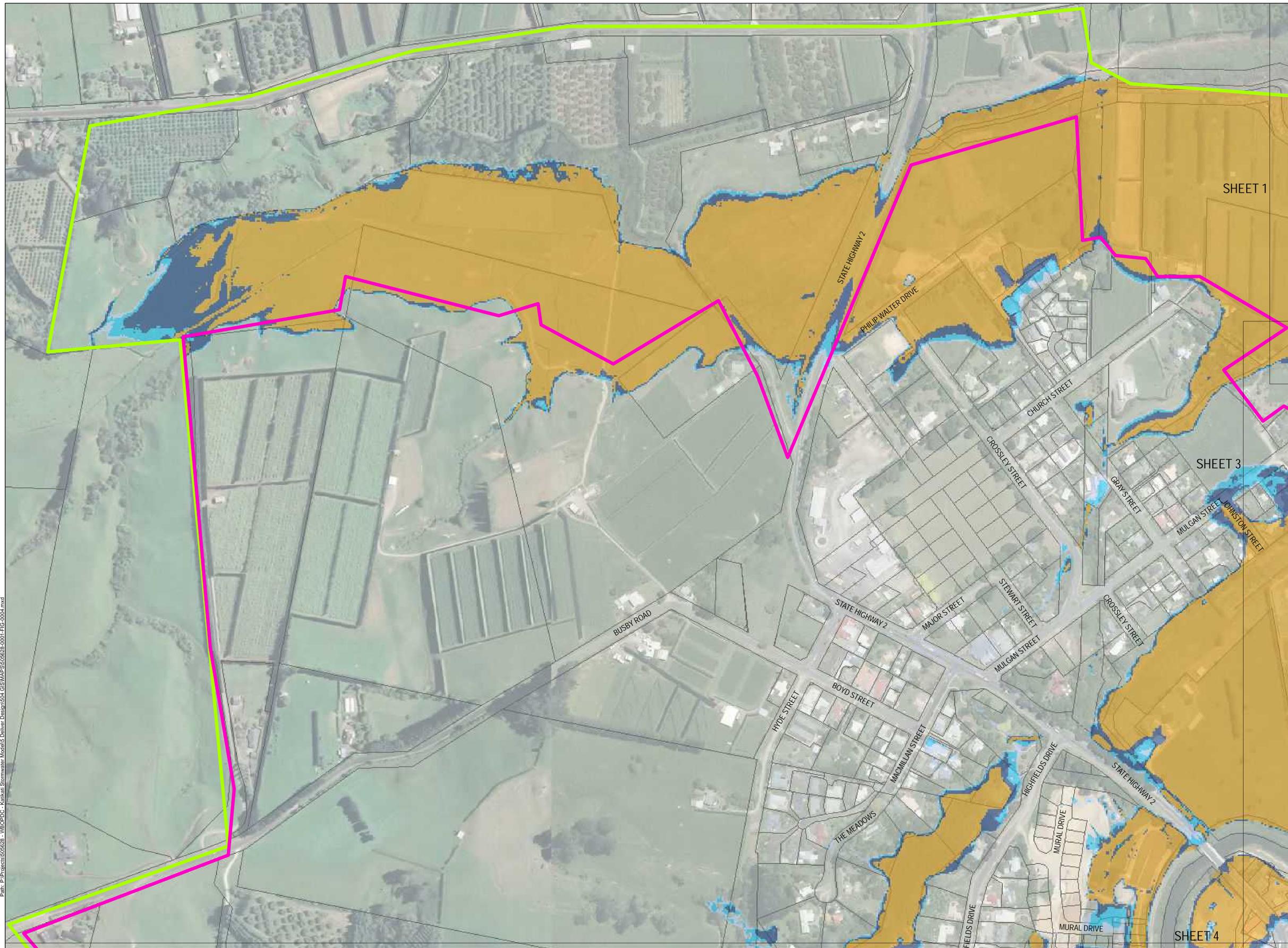
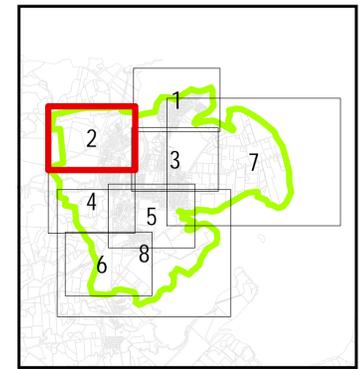
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-004-FIG-004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

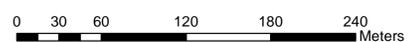
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A1 scale: 1:2,500



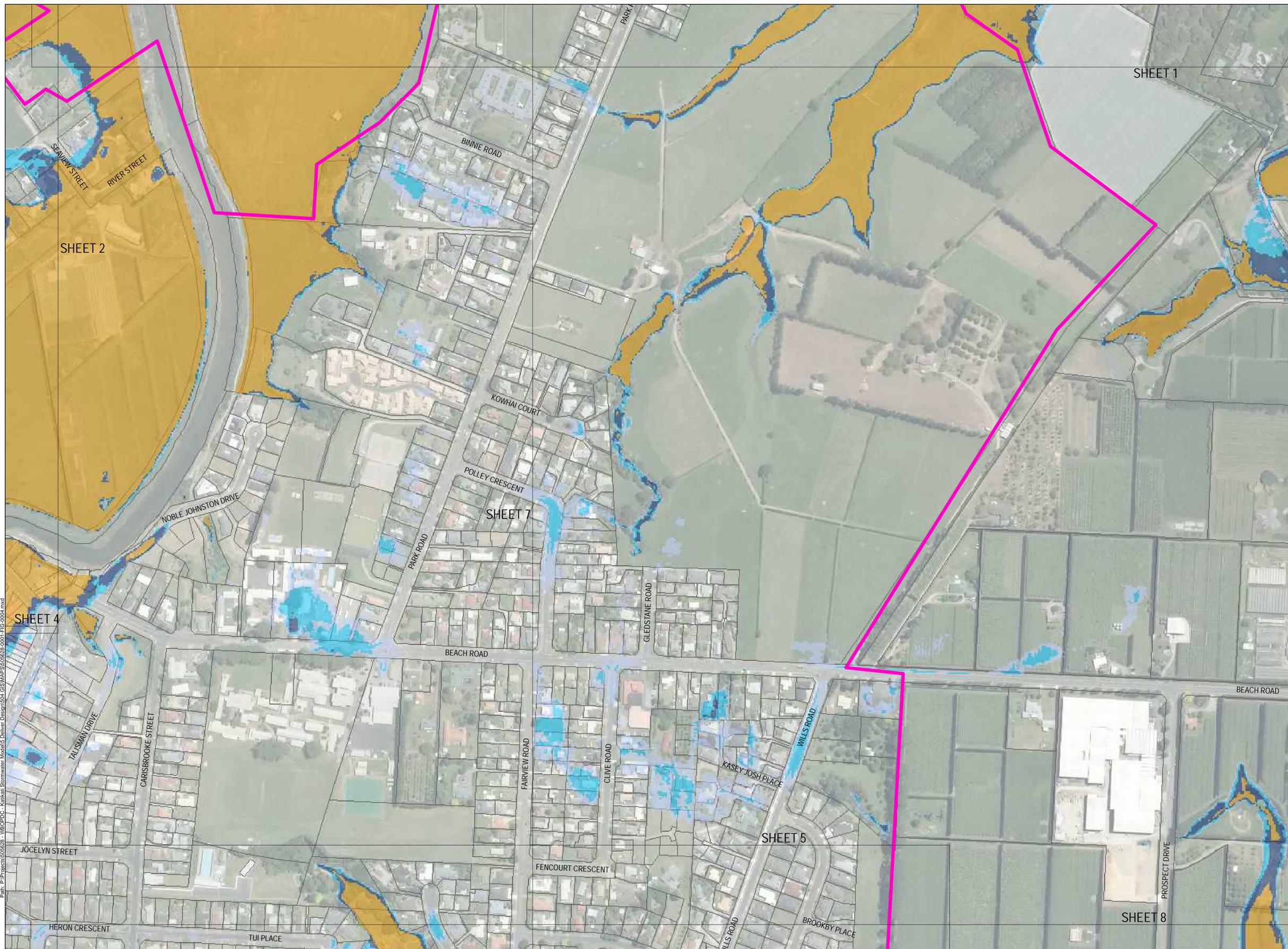
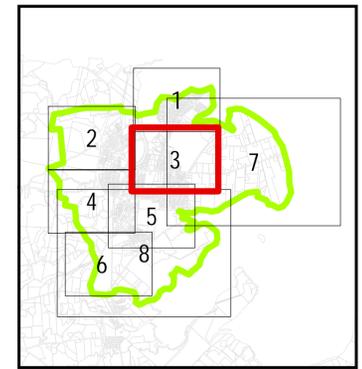
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-004-FIG-004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

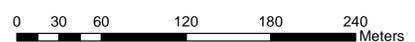
FLOOD DEPTHS <0.1m NOT SHOWN

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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500

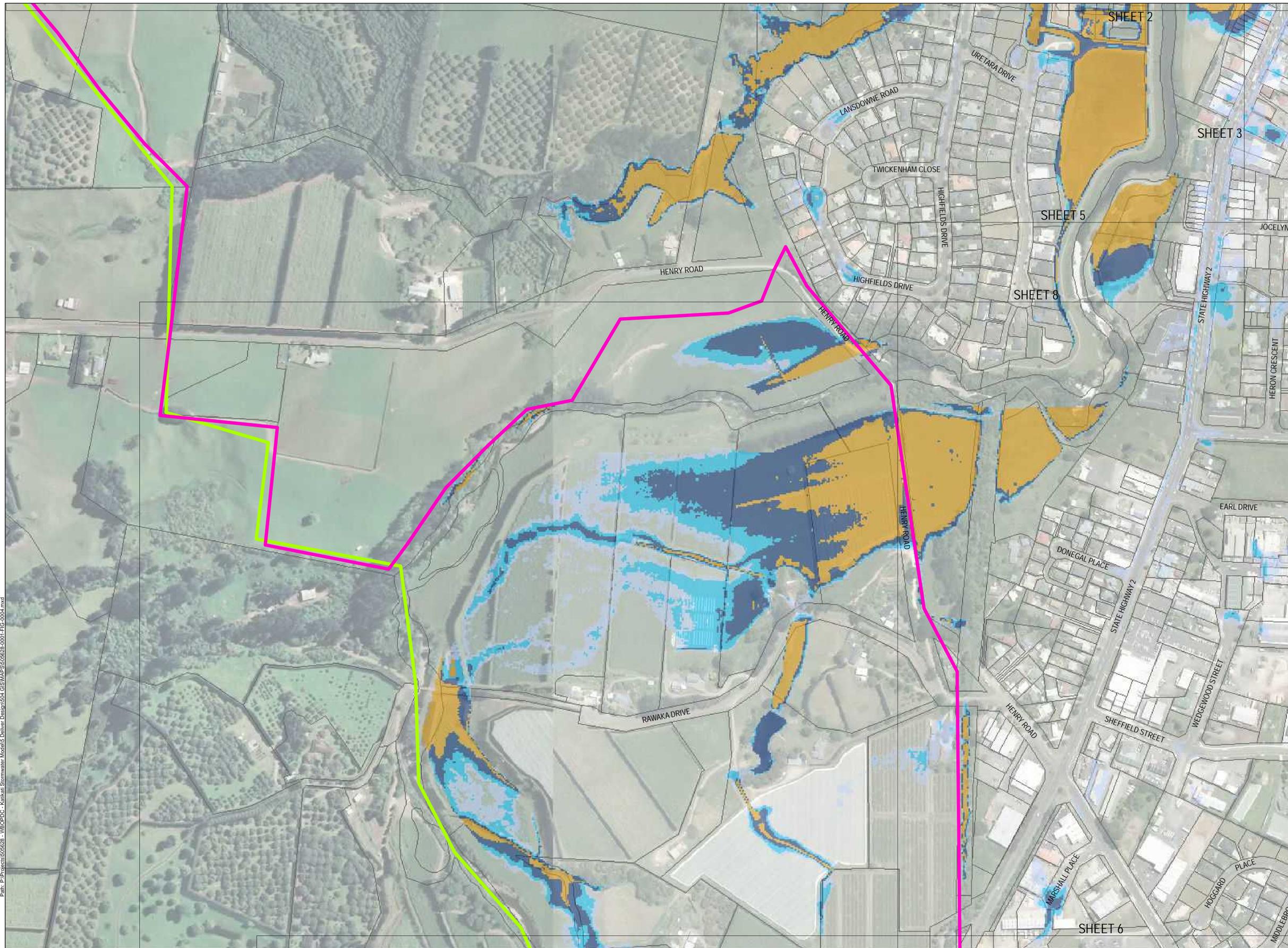
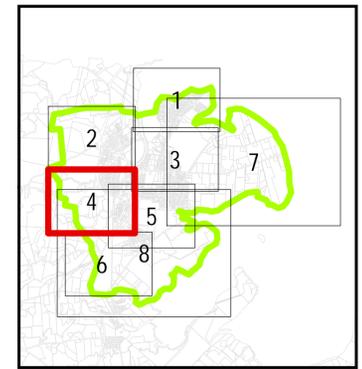


JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 3 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

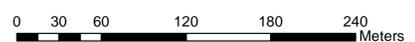
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



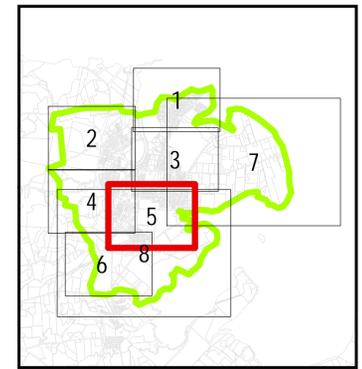
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-004-FIG-0004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

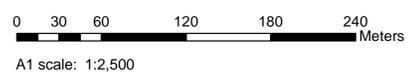
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

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  - Localised variances in ground levels.
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 Maximum flood depths should therefore be used with caution.
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JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

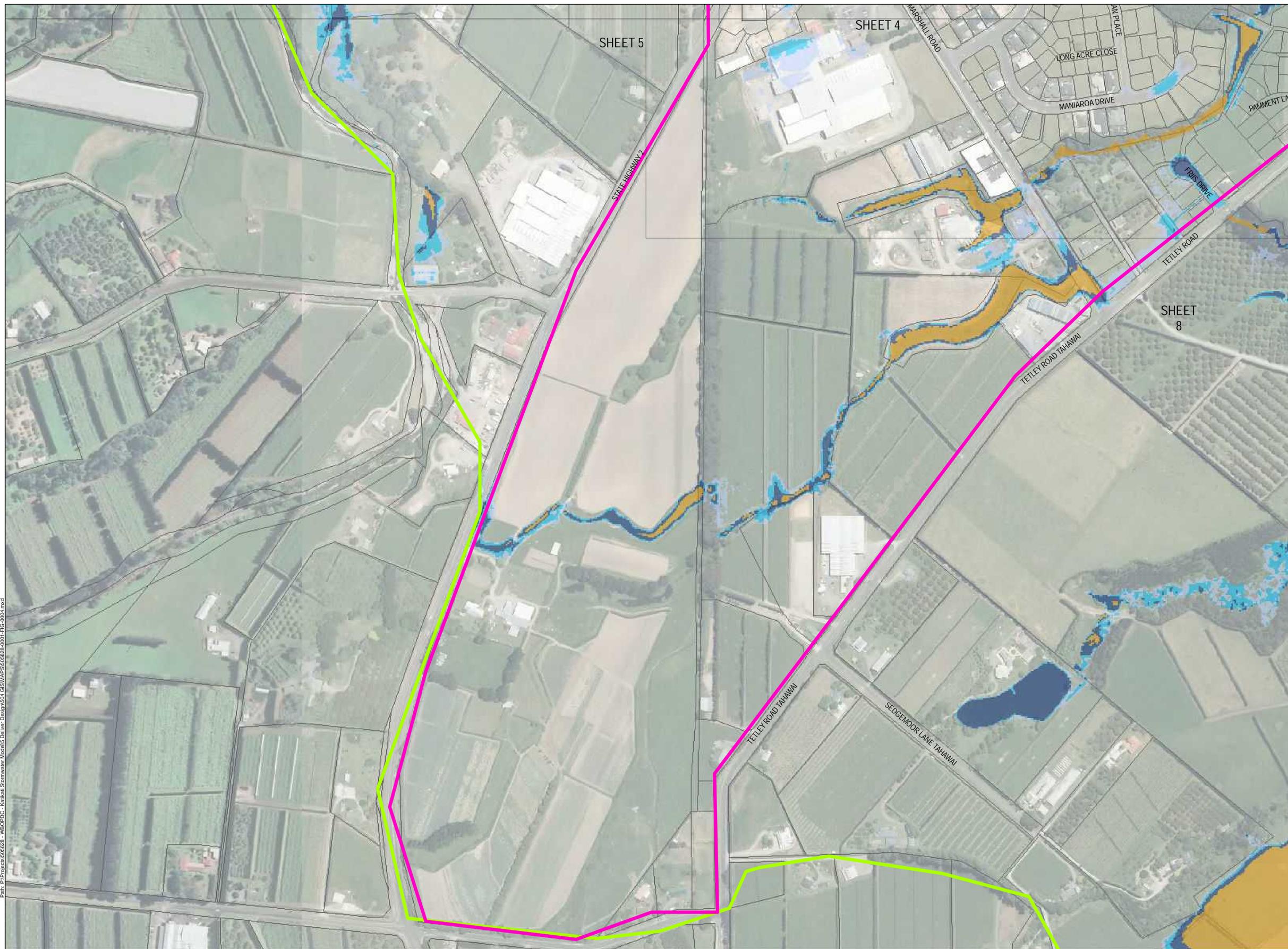
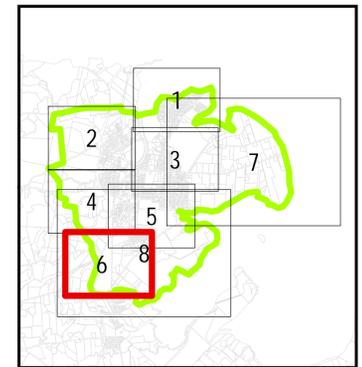
WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 5 RevB - July 2019



Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-004-FIG-004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

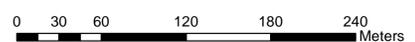
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:2,500



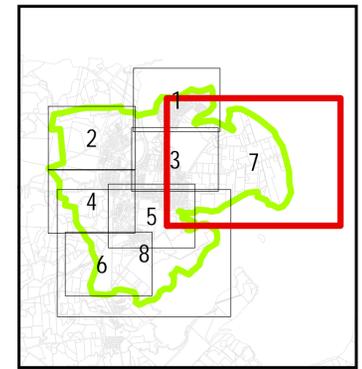
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 6 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-004-FIG-004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

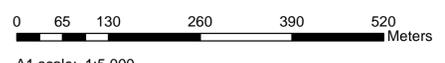
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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 Maximum flood depths should therefore be used with caution.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:5,000

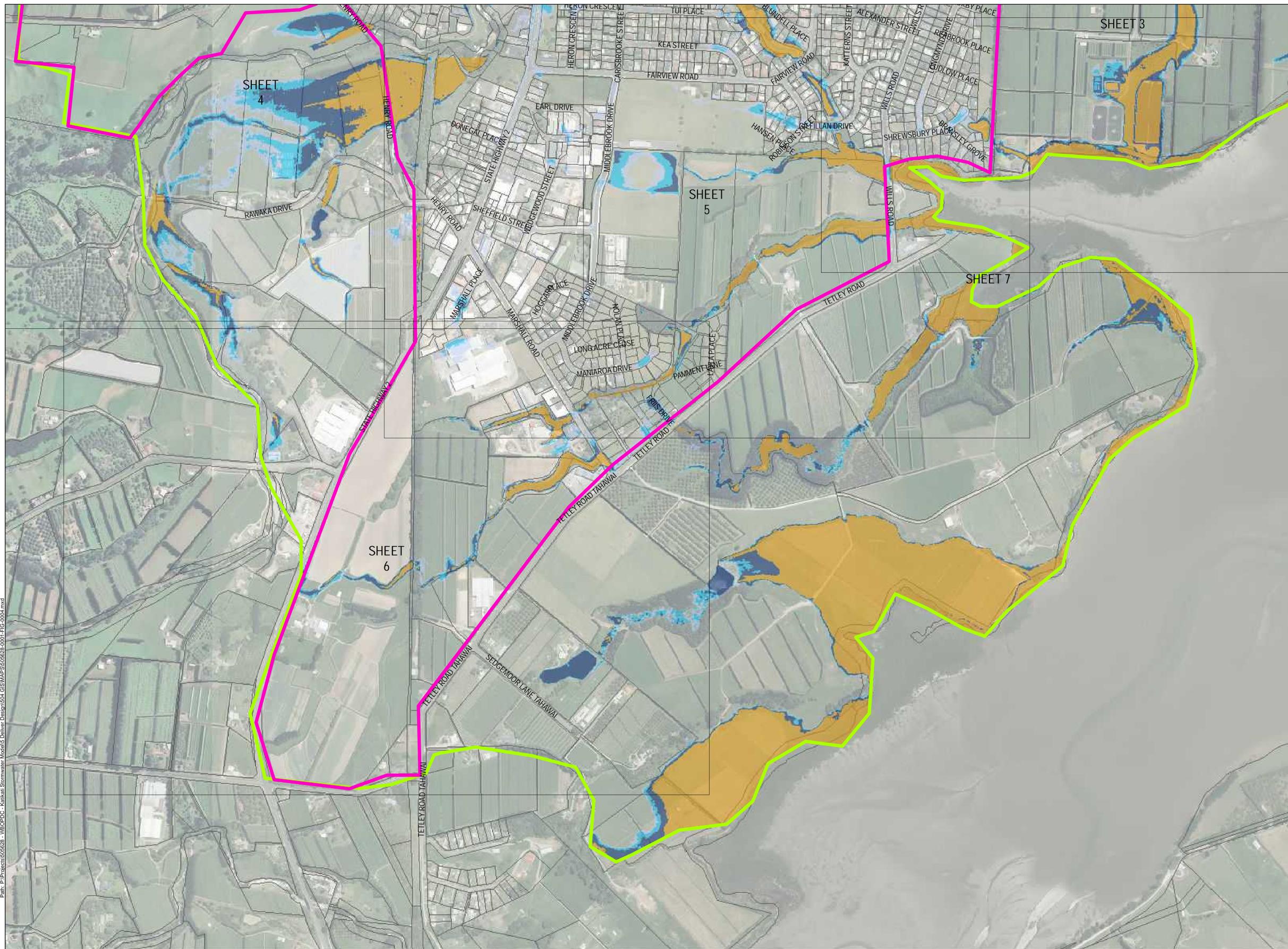
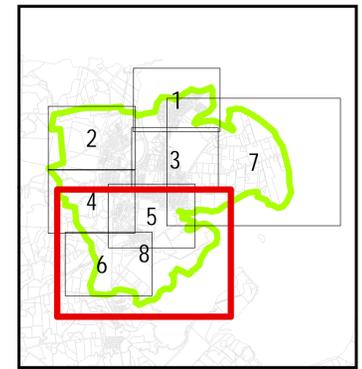


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

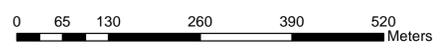
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:5,000



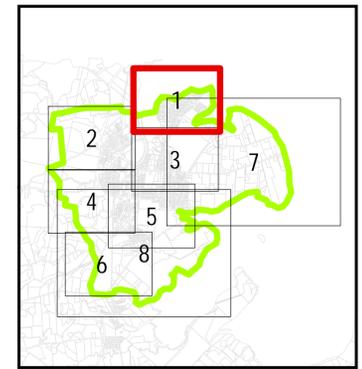
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 004: 50y ARI Maximum probable development - Maximum flood depth

SHEET: 8 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver Design\04 GIS\MAPS\505628-004-FIG-004.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

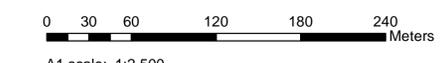
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500



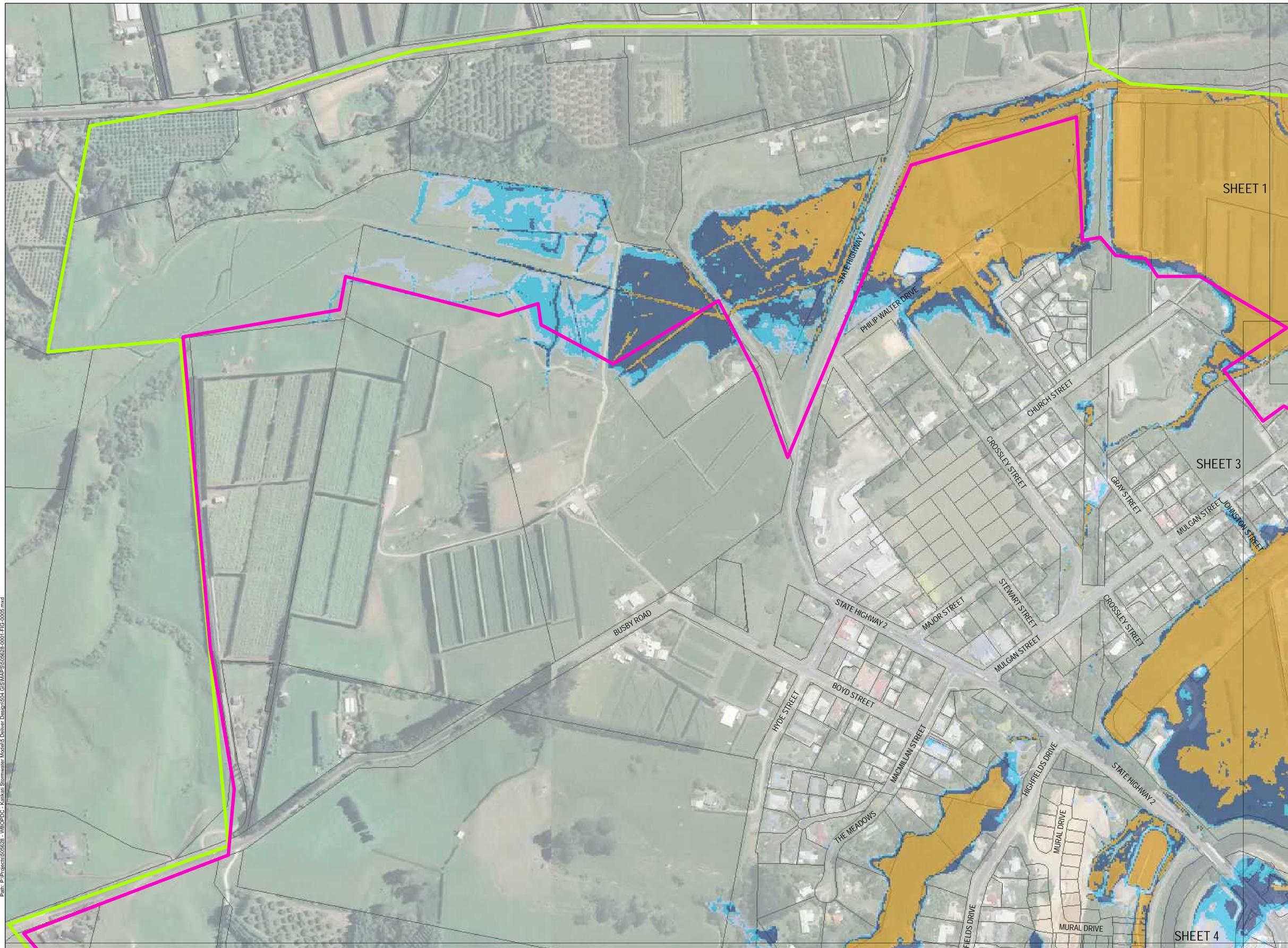
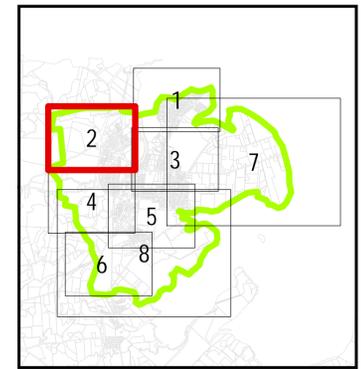
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628\_0051-FIG\_005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

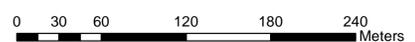
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500



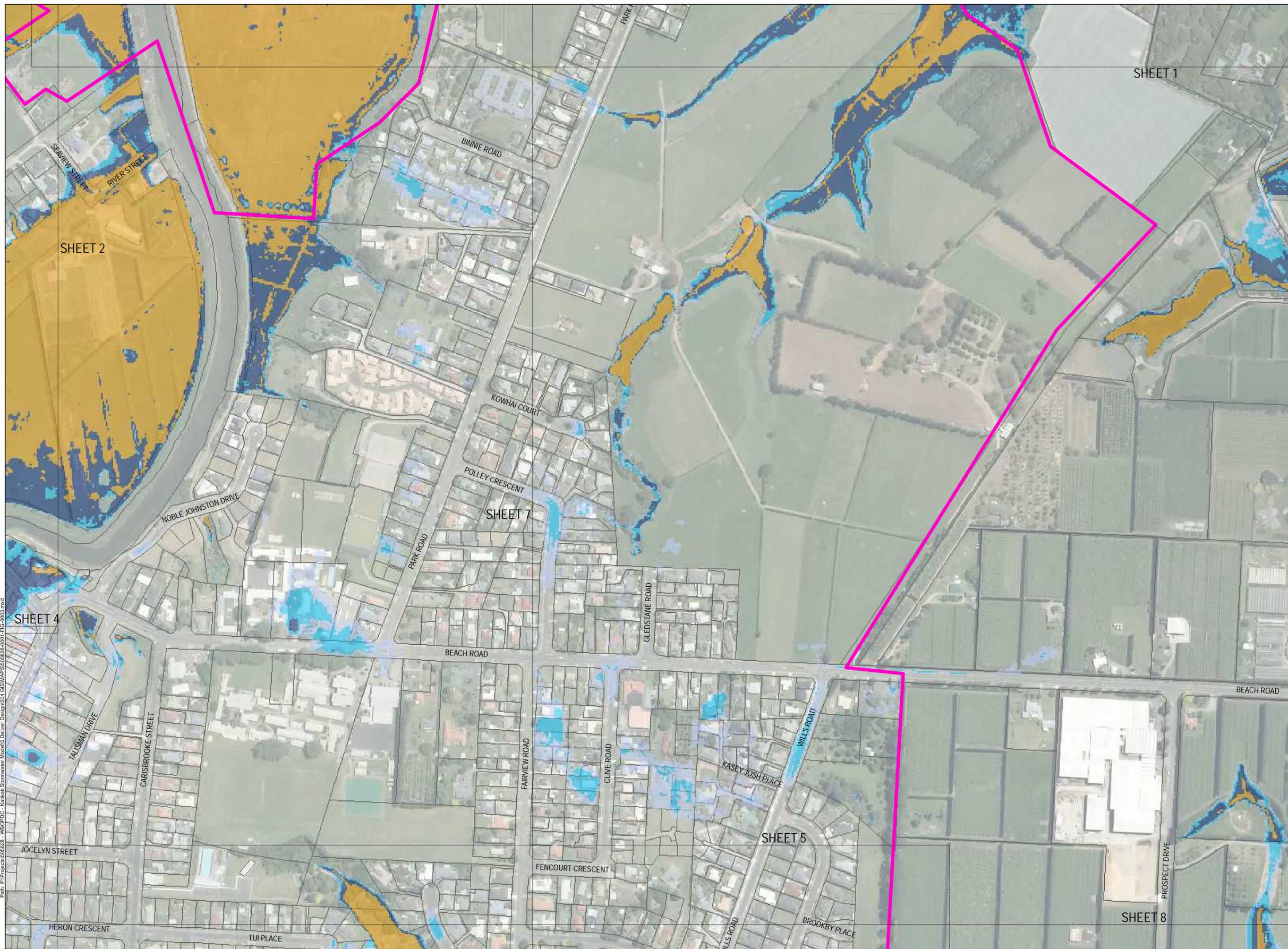
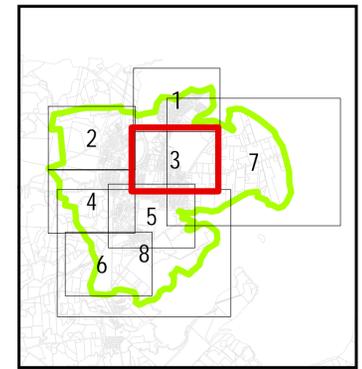
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

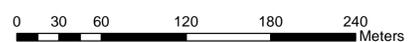
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500

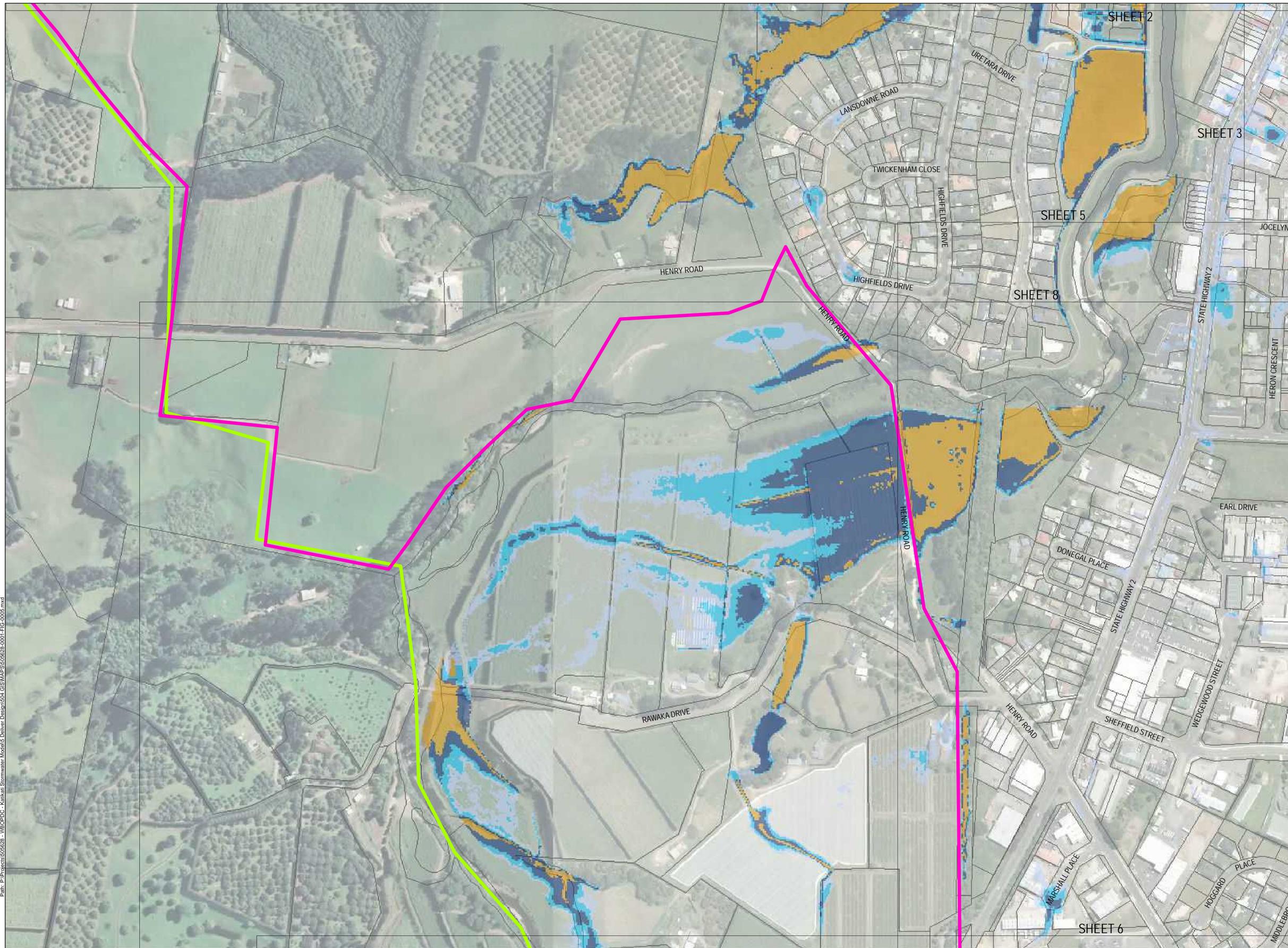
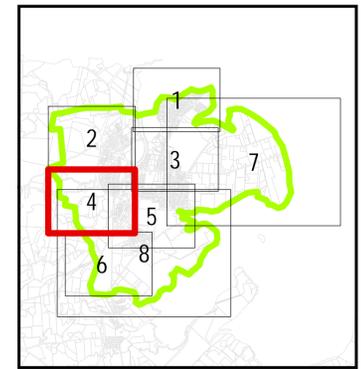


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 3 Rev B - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

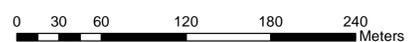
FLOOD DEPTHS <0.1m NOT SHOWN

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A1 scale: 1:2,500



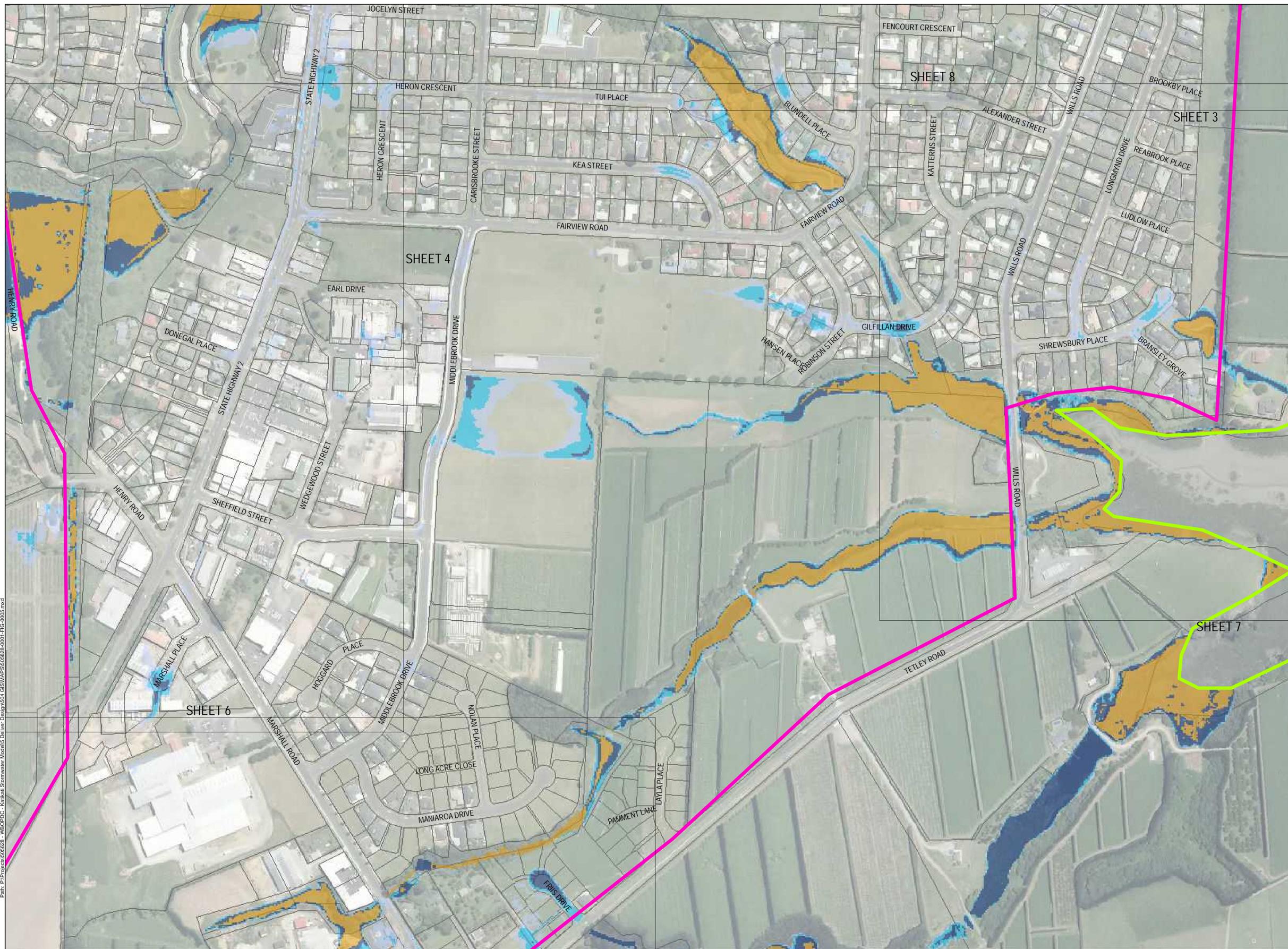
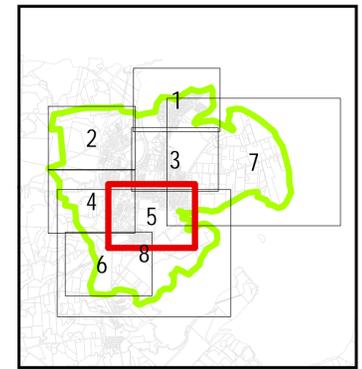
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

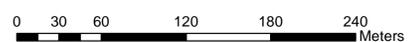
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A1 scale: 1:2,500



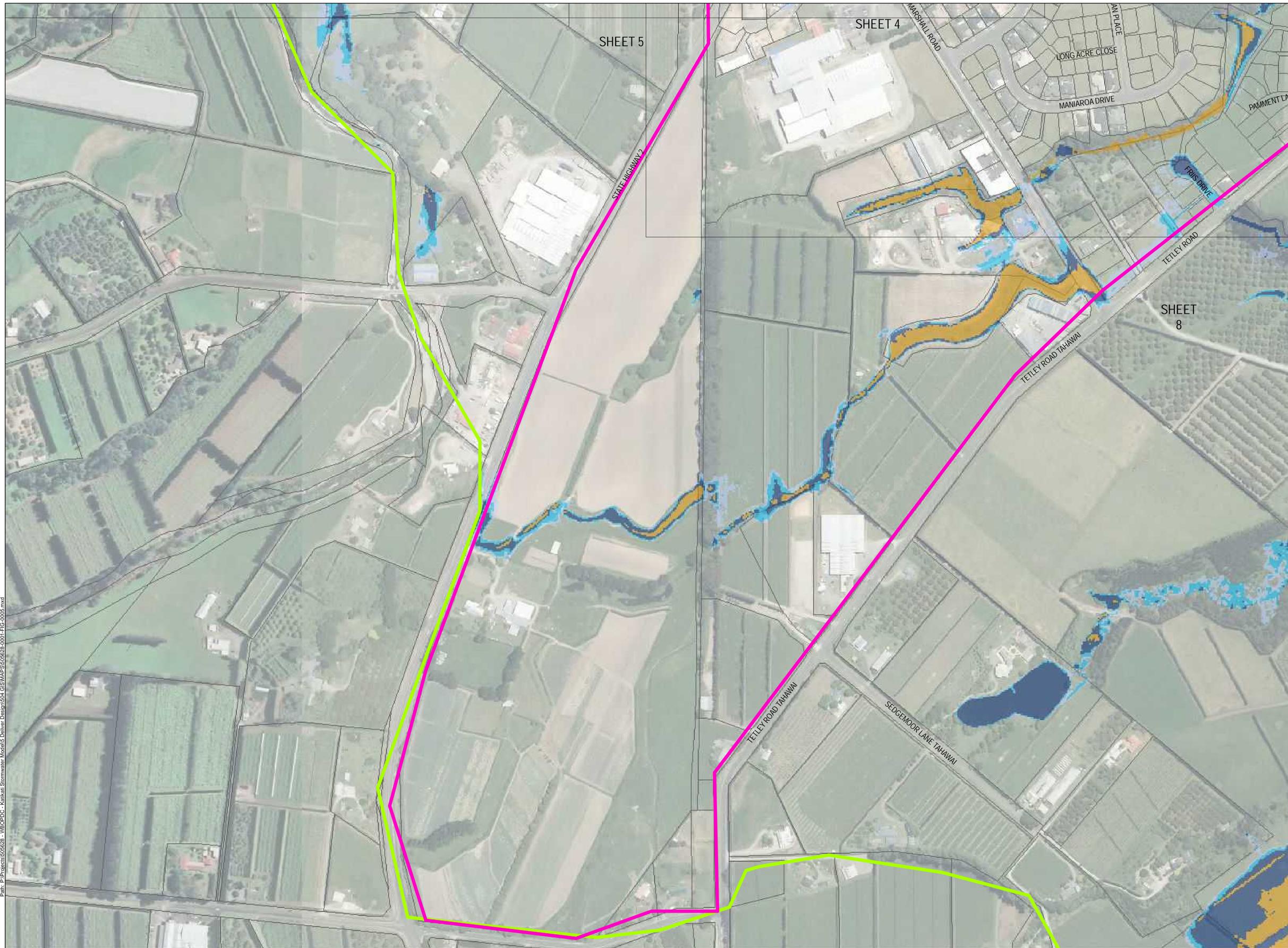
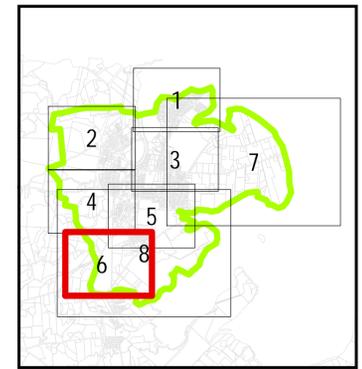
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 5 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-005-FIG-005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

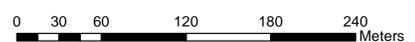
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



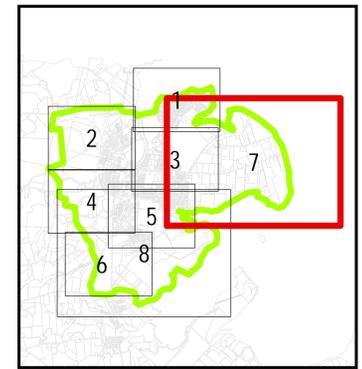
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 6 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-005-FIG-005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
  - Localised ponding where overland flow is blocked or diverted by garden walls, sheds etc.
  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:5,000

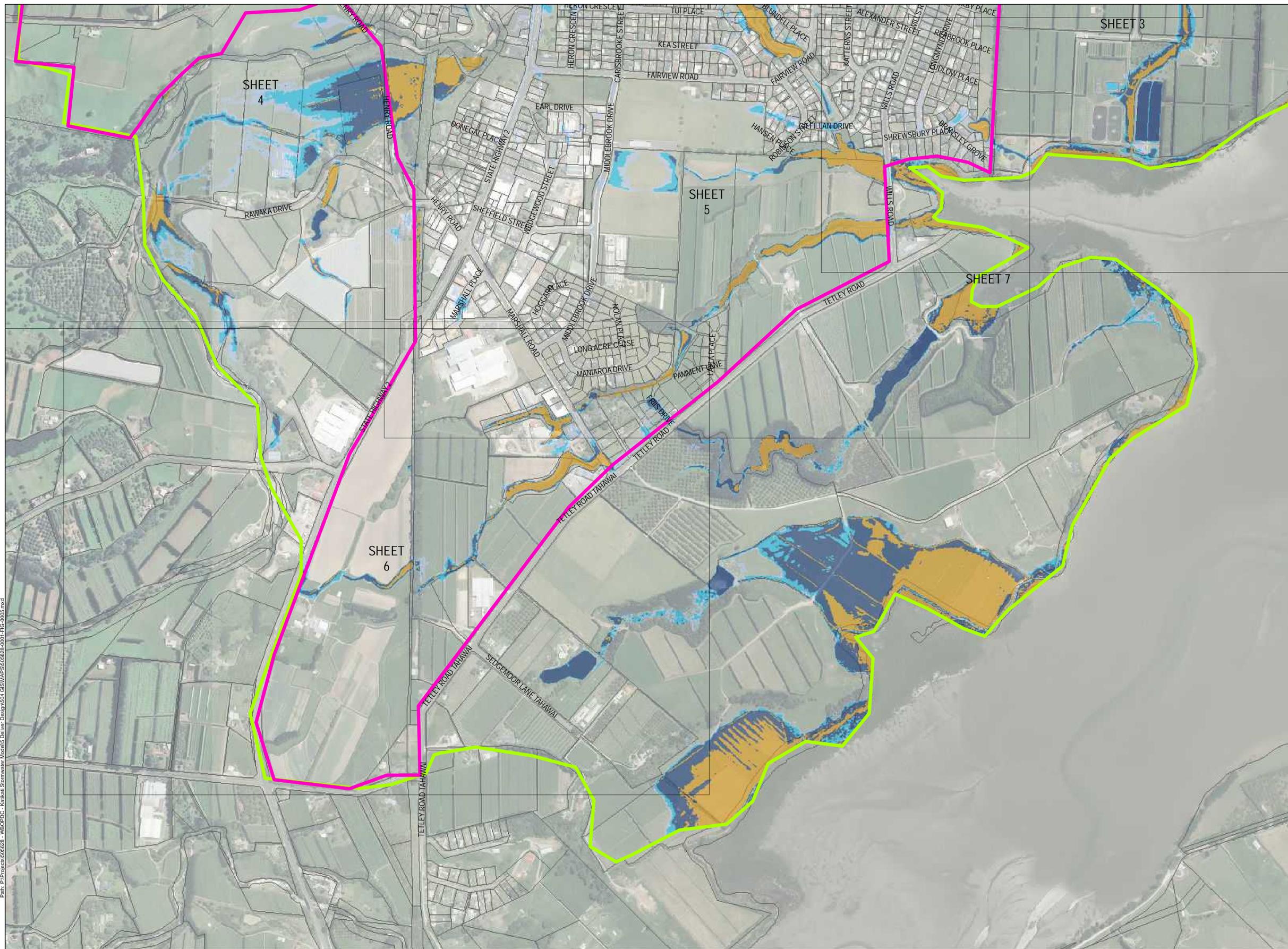
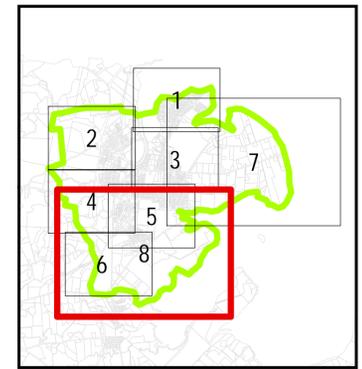


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

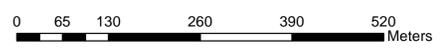
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
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 Maximum flood depths should therefore be used with caution.
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A1 scale: 1:5,000



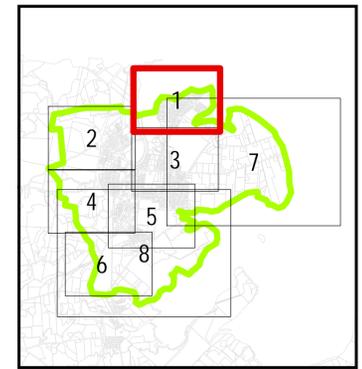
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 005: 100y ARI - Existing development - Maximum flood depth

SHEET: 8 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Driver Design\04 GIS\MAPS\505628-0001-FIG-0005.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

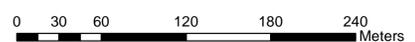
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



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A1 scale: 1:2,500



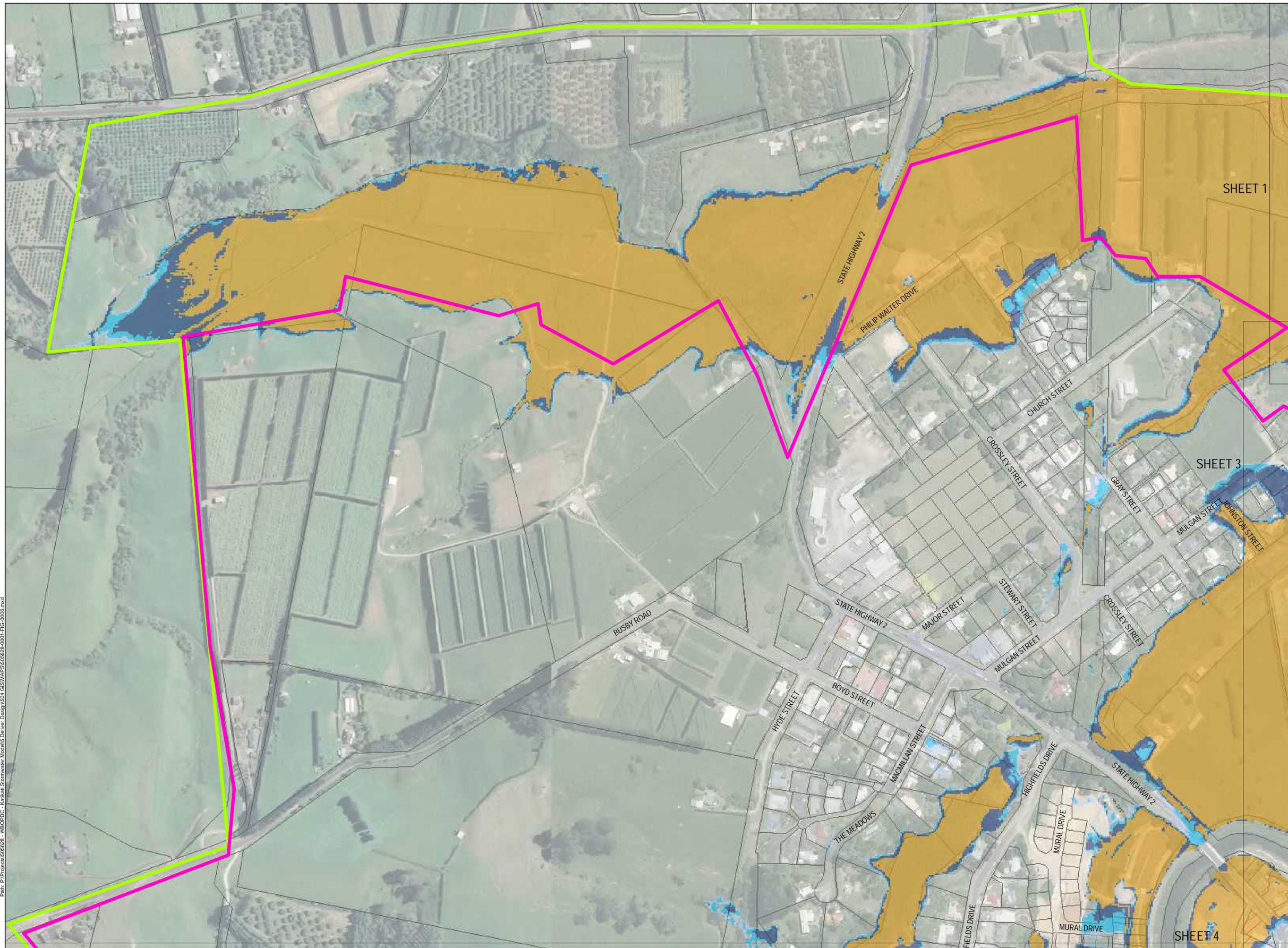
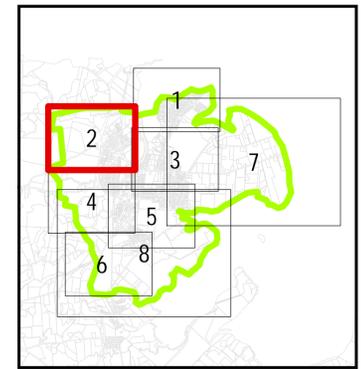
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-006-FIG-006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

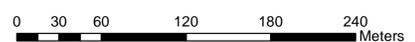
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:2,500



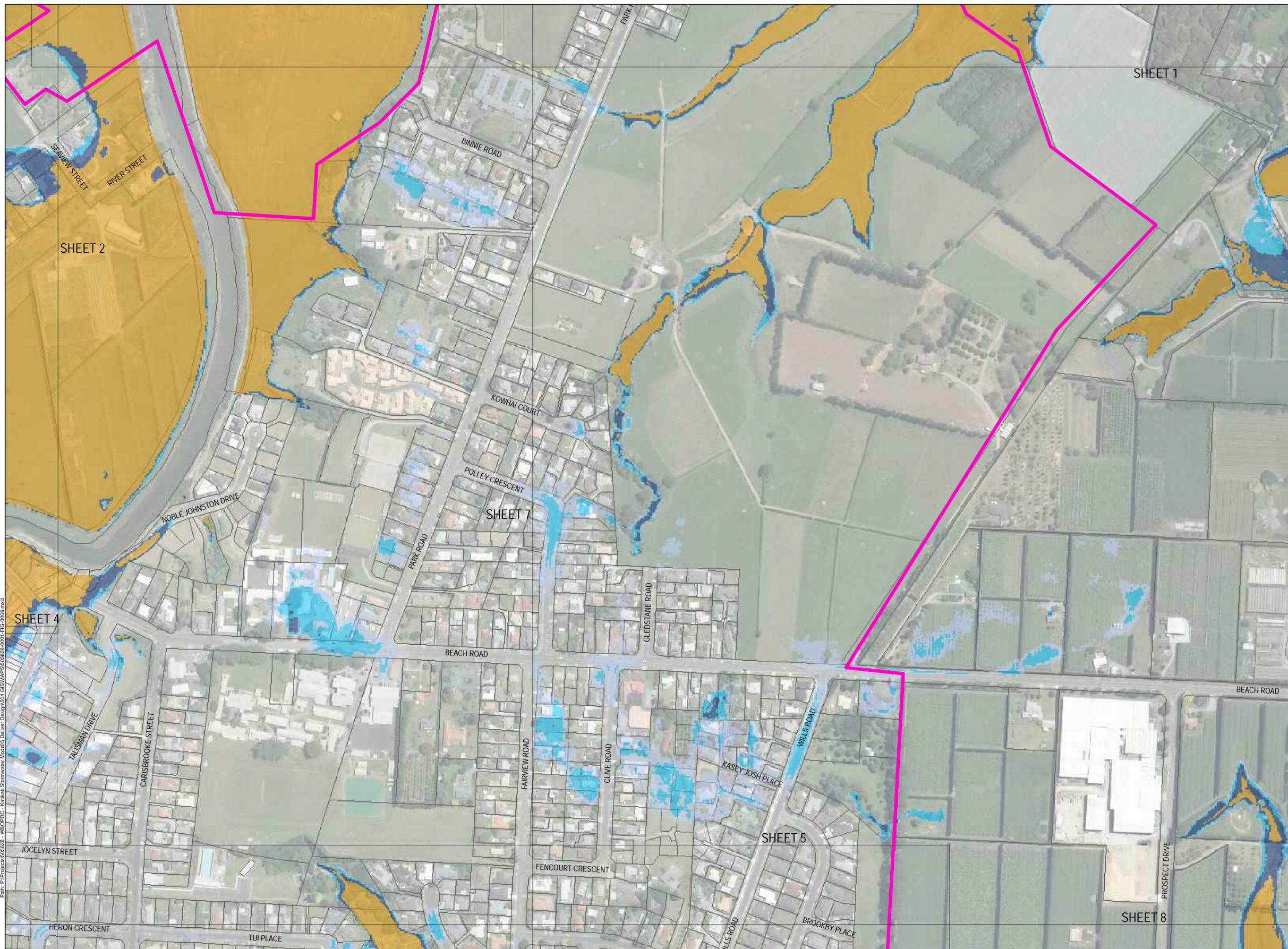
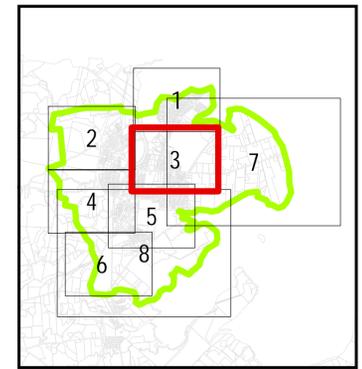
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 2 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-0001-FIG-0006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

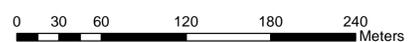
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
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A1 scale: 1:2,500

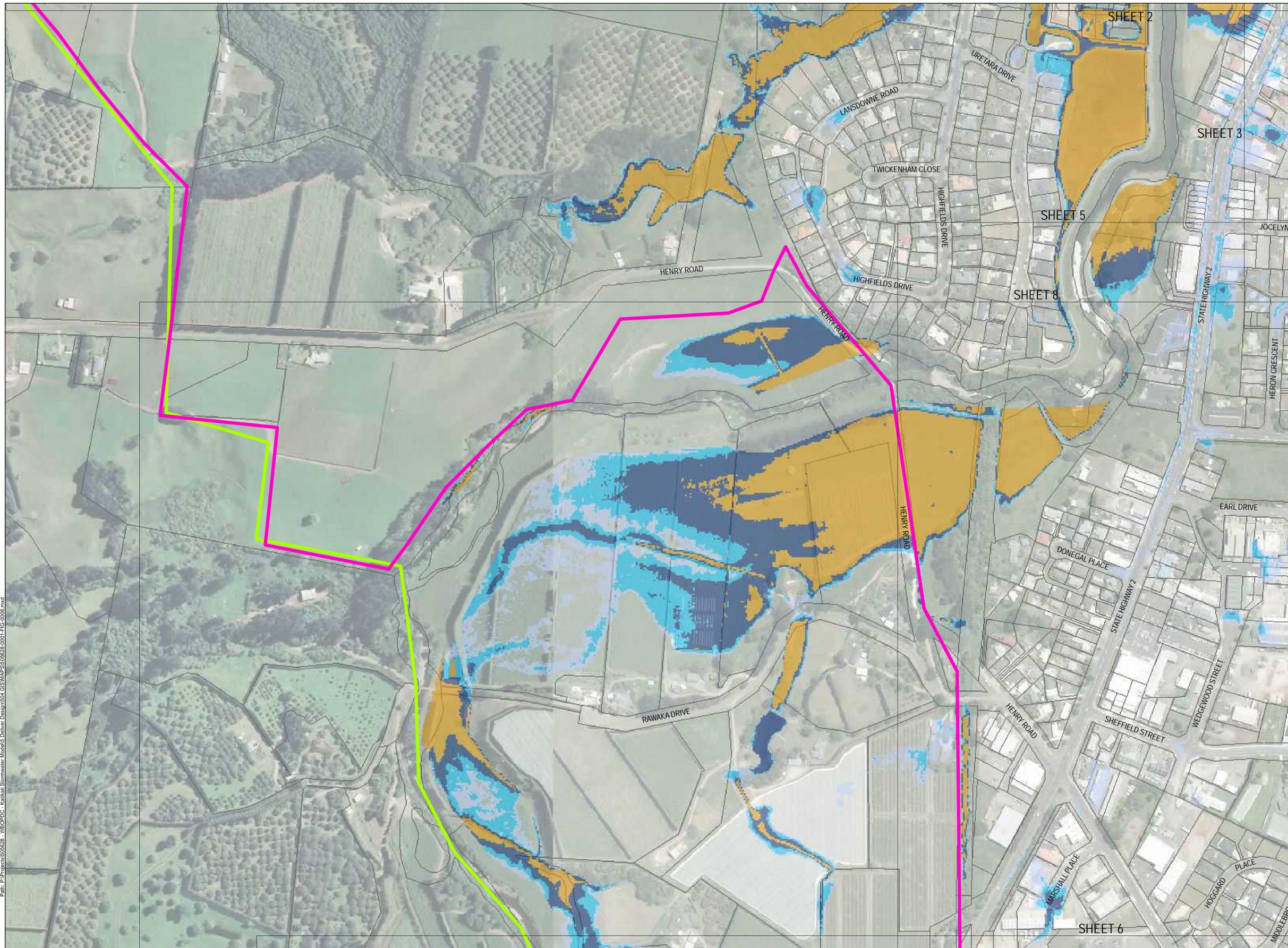
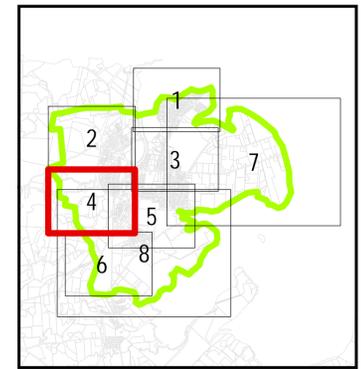


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 3 Rev B - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

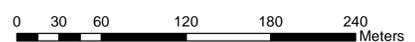
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:2,500



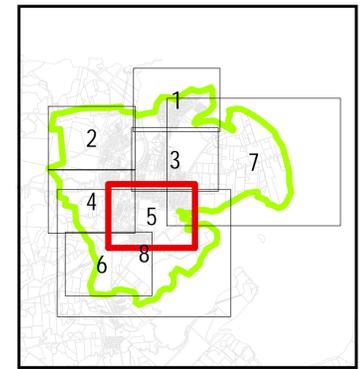
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-006-FIG-006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

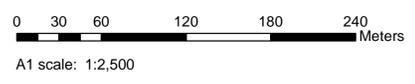
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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  - Wave run up (eg. from passing vehicles).
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3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

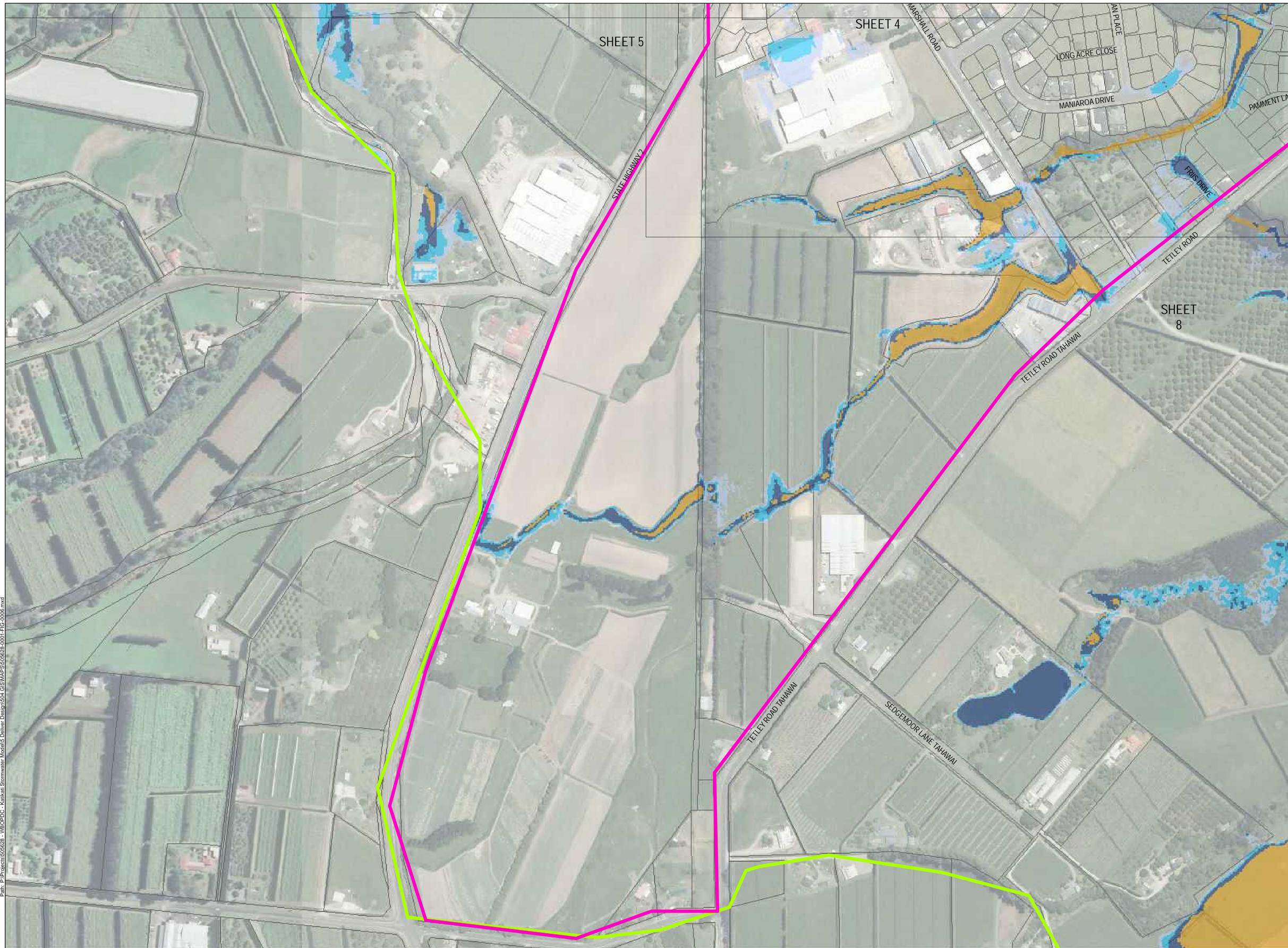
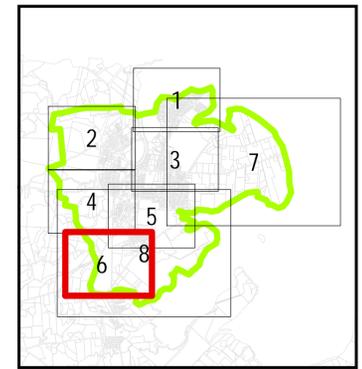
WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 5 RevB - July 2019



Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-006-FIG-006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

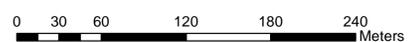
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:2,500



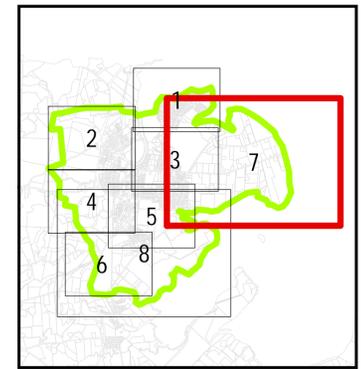
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 6 Rev B - July 2019

Path: P:\projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-006-FIG-006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:5,000

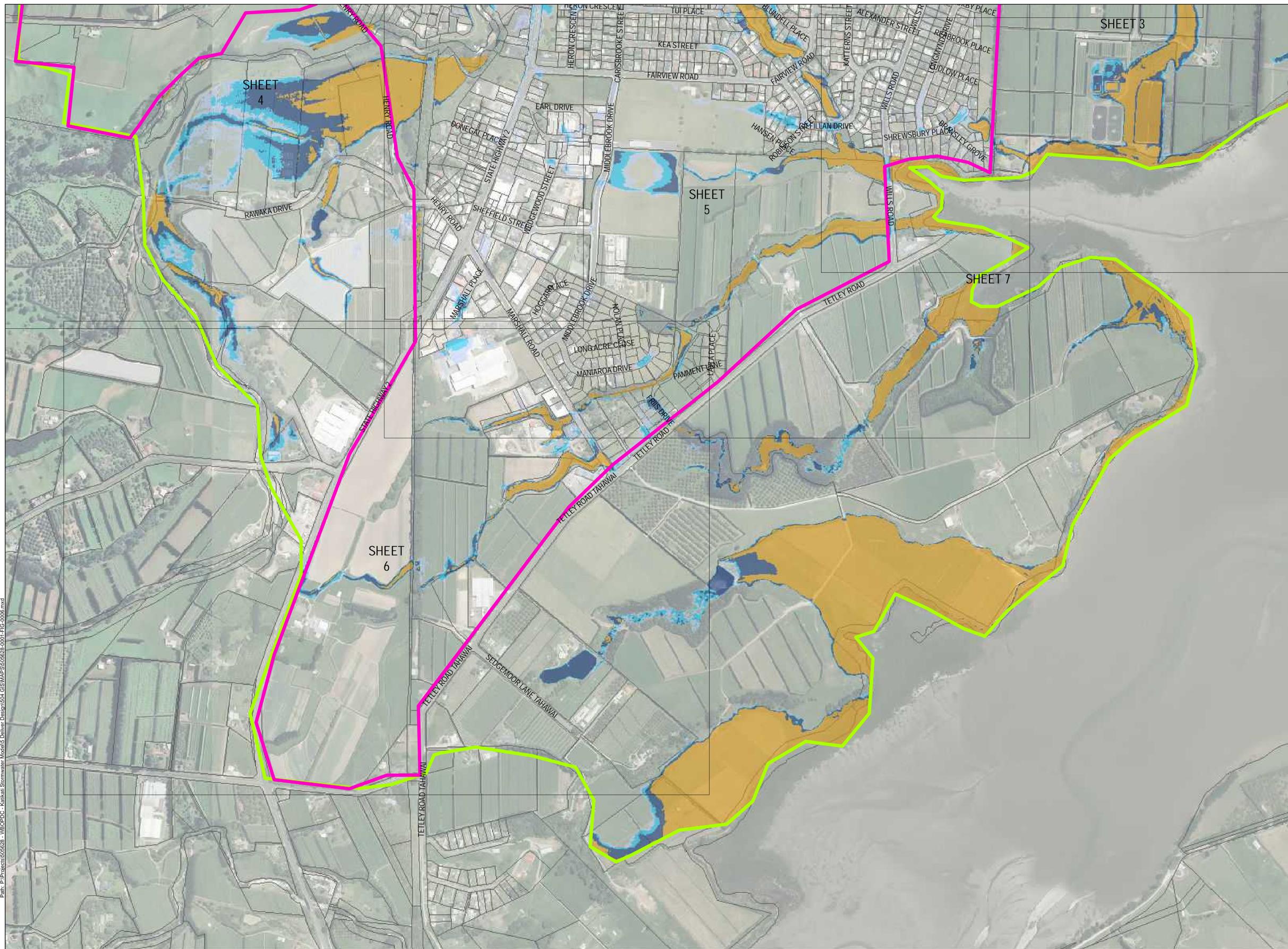
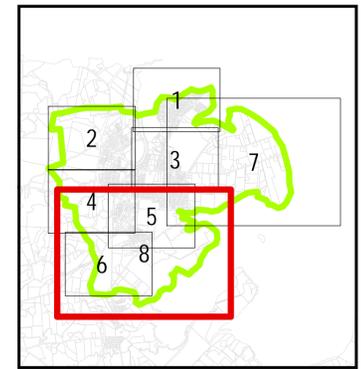


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 7 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH AREA
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



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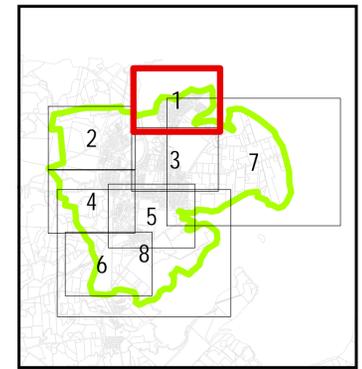
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 006: 100y ARI - Maximum probable development - Maximum flood depth

SHEET: 8 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver Design\504 GIS\MAPS\505628-006-FIG-006.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

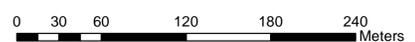
FLOOD DEPTHS <0.1m NOT SHOWN

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 Maximum flood depths should therefore be used with caution.
3. Existing development - assumes current development, climate and sea level. Maximum probable development - assumes urban growth area completely developed, future climate (RCP8.5) and sea level (+1.25m).



Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



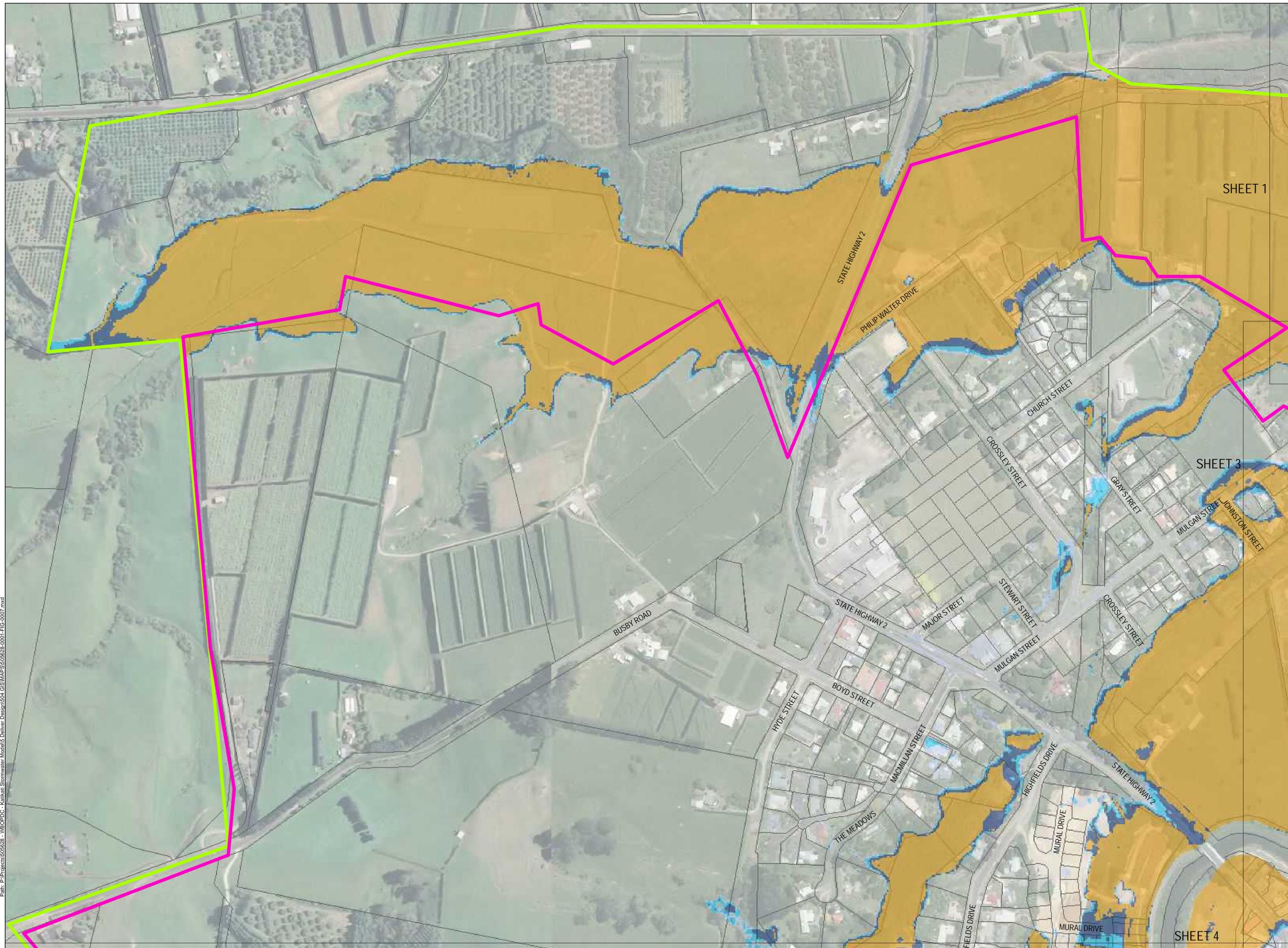
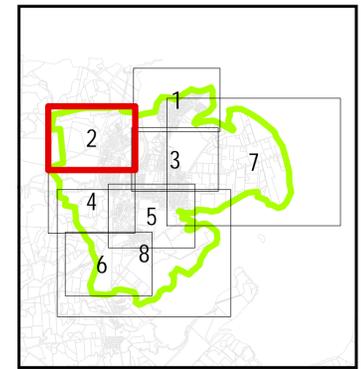
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 1 RevB July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-007-FIG-0007.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

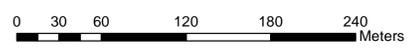
**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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  - Wave run up (eg. from passing vehicles).
 Maximum flood depths should therefore be used with caution.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Path: P:\Projects\505628 - WBOPDC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0007.mxd



A1 scale: 1:2,500

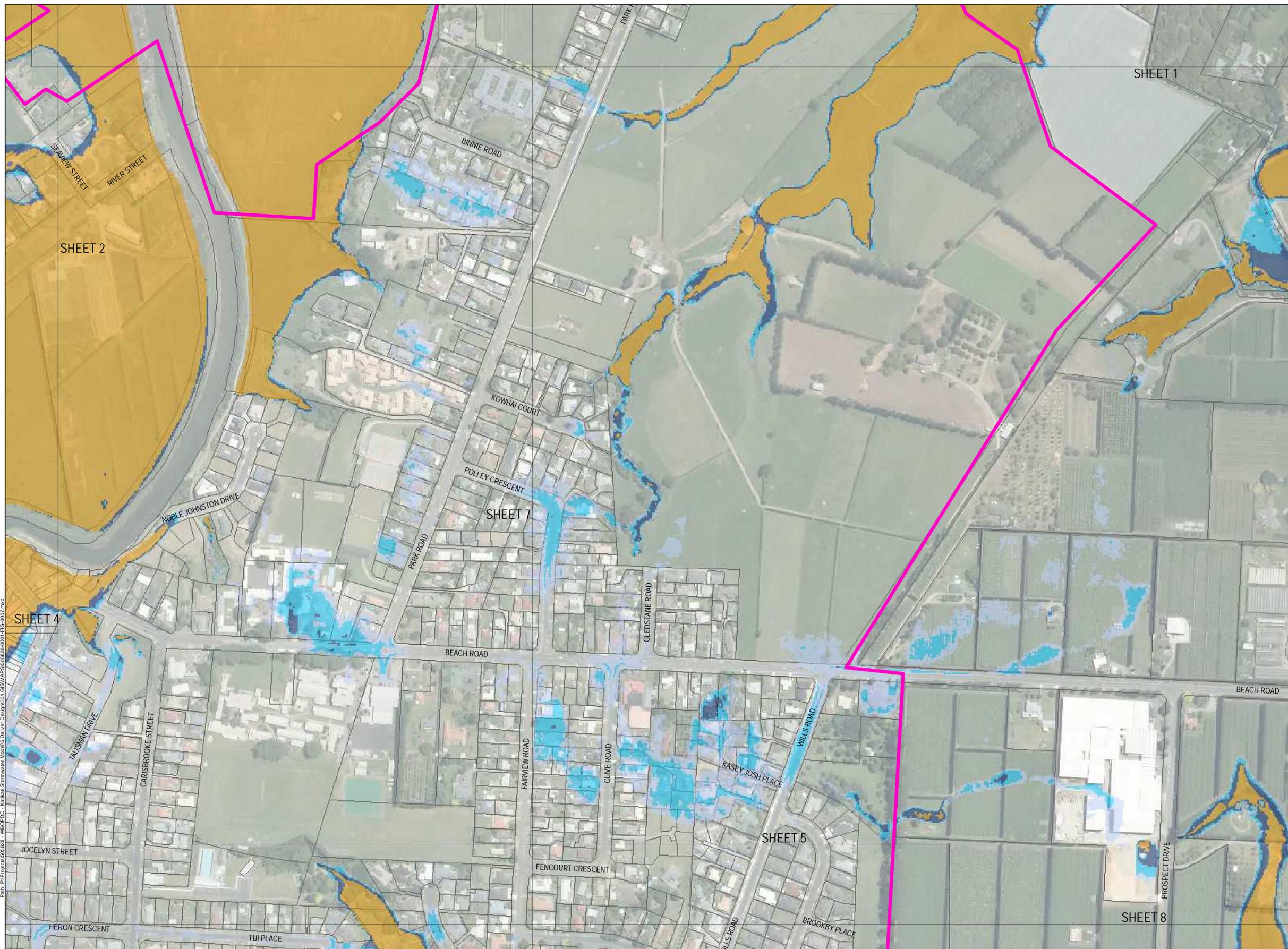
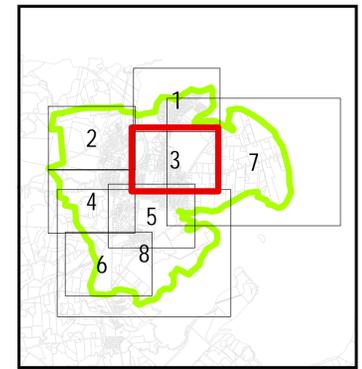


JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 2 RevB July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

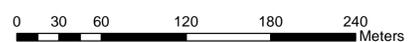
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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  - Localised variances in ground levels.
  - Wave run up (eg. from passing vehicles).
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500

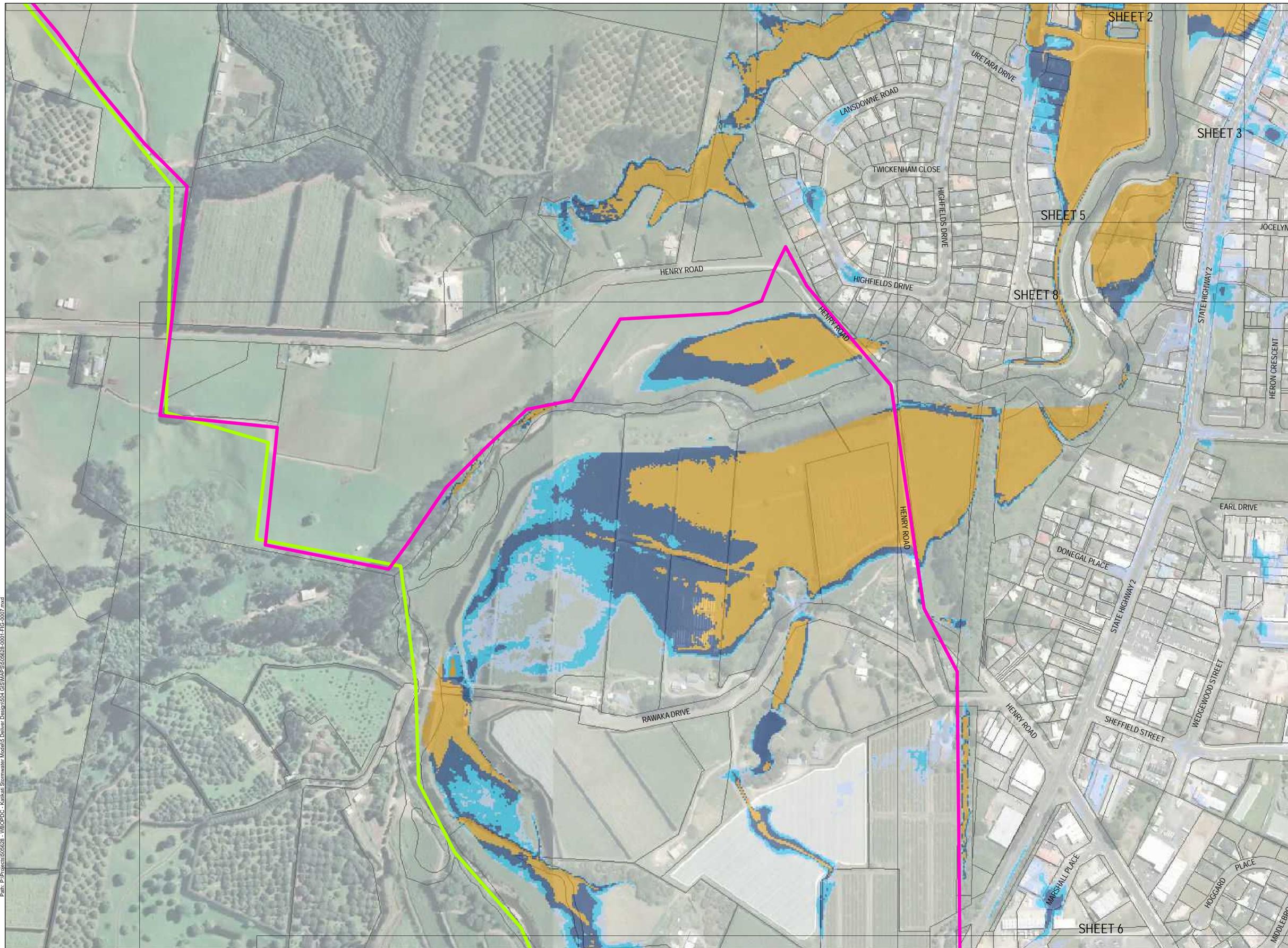
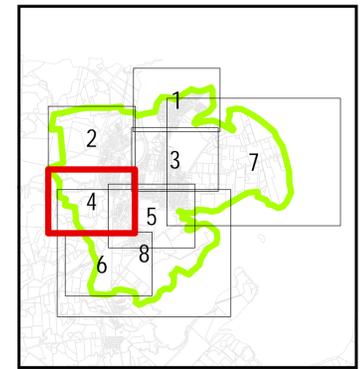


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 3 RevB July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

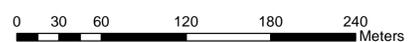
Notes:

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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Path: P:\Projects\505628 - WBCPDC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0007.mxd



A1 scale: 1:2,500

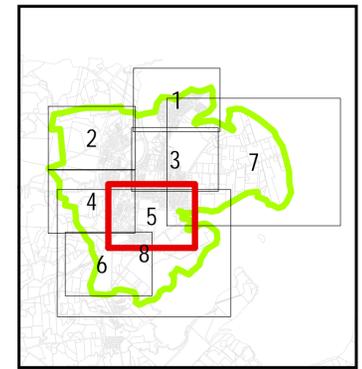


JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 4 RevB July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

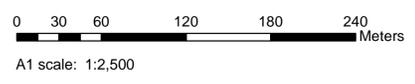
Notes:

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
2. Flood depths show best practice estimate of flood risk but do not include allowances for modelling uncertainties and other factors such as:
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\GIS\MAPS\505628-007-FIG-0007.mxd



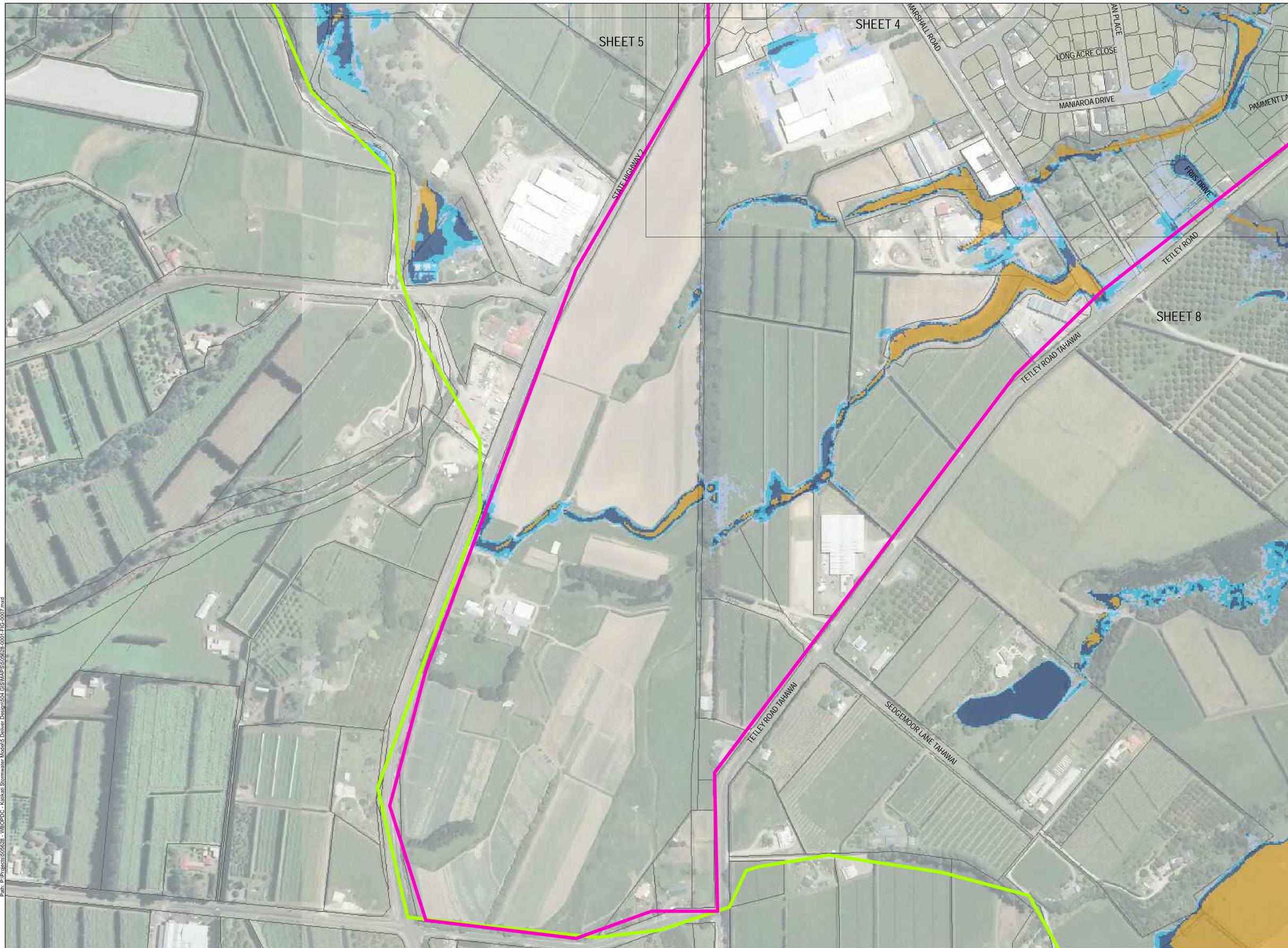
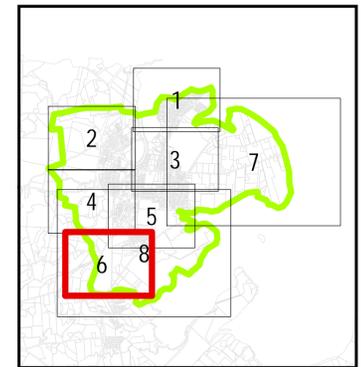
JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 5 RevB July 2019





**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

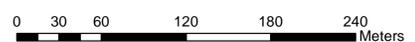
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:2,500



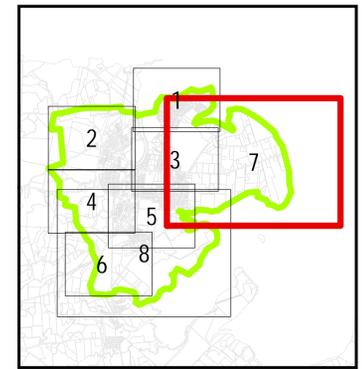
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 6 RevB July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-007-FIG-0007.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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A1 scale: 1:5,000

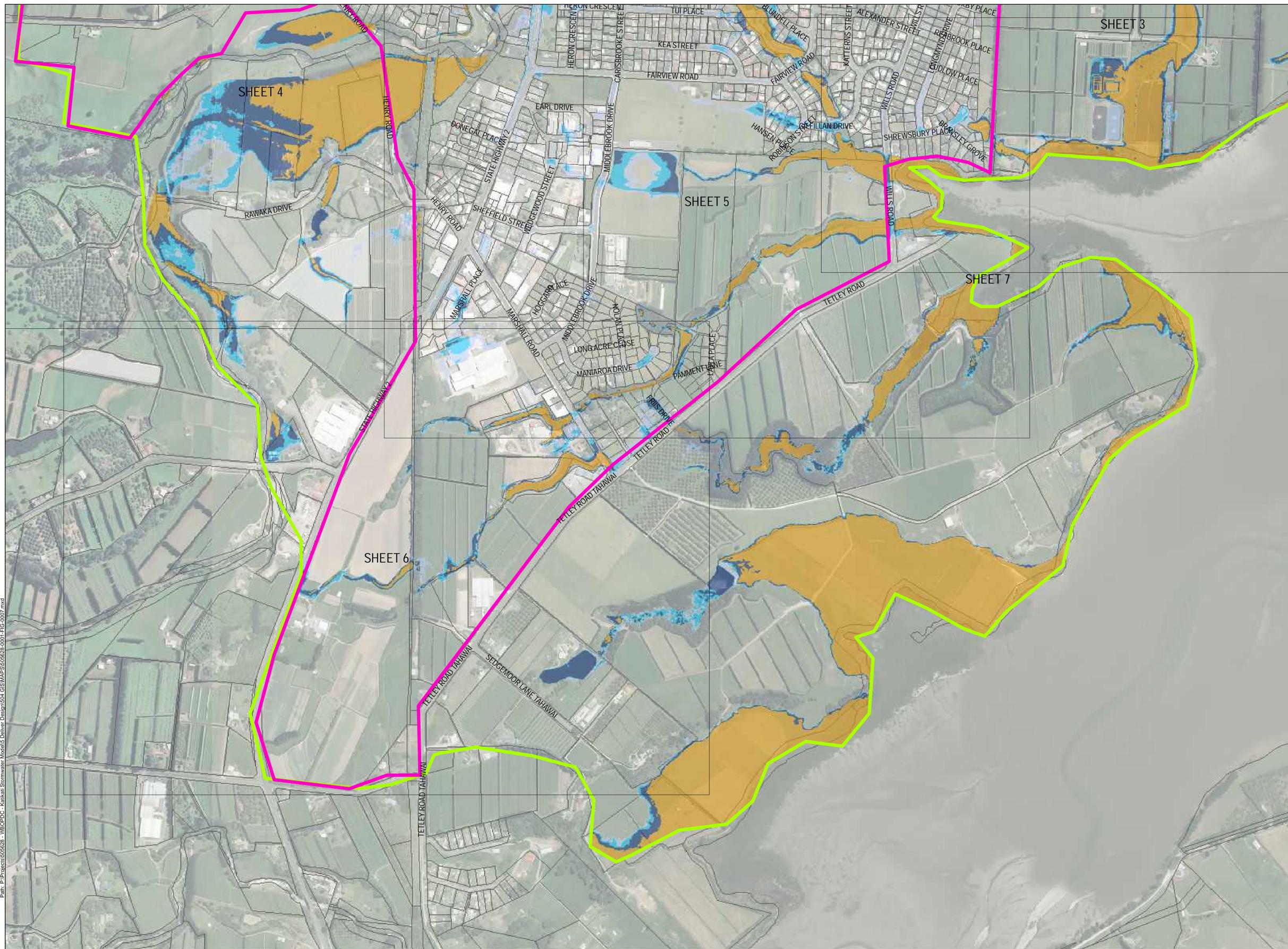
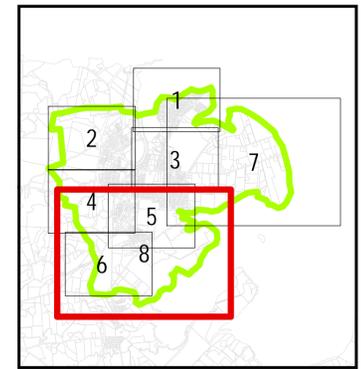


JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 7 RevB July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

1. Surface flooding has been modelled using 2x2m grid cell resolution based on latest available aerial survey. This is considered adequate for predicting inundation depths and extents for broad-scale planning measures.
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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



A1 scale: 1:5,000



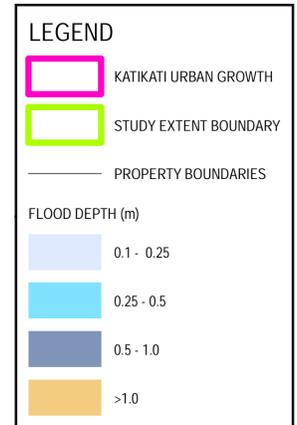
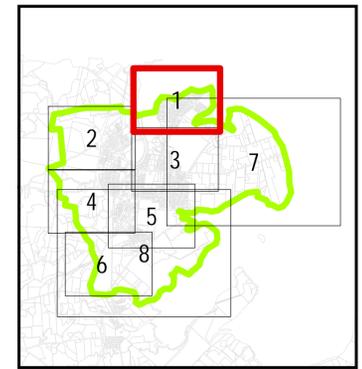
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 007: 500y ARI Maximum probable development - Maximum flood depth

SHEET: 8 RevB July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver Design\504 GIS\MAPS\505628-007-FIG-0007.mxd



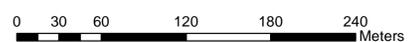
FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:2,500



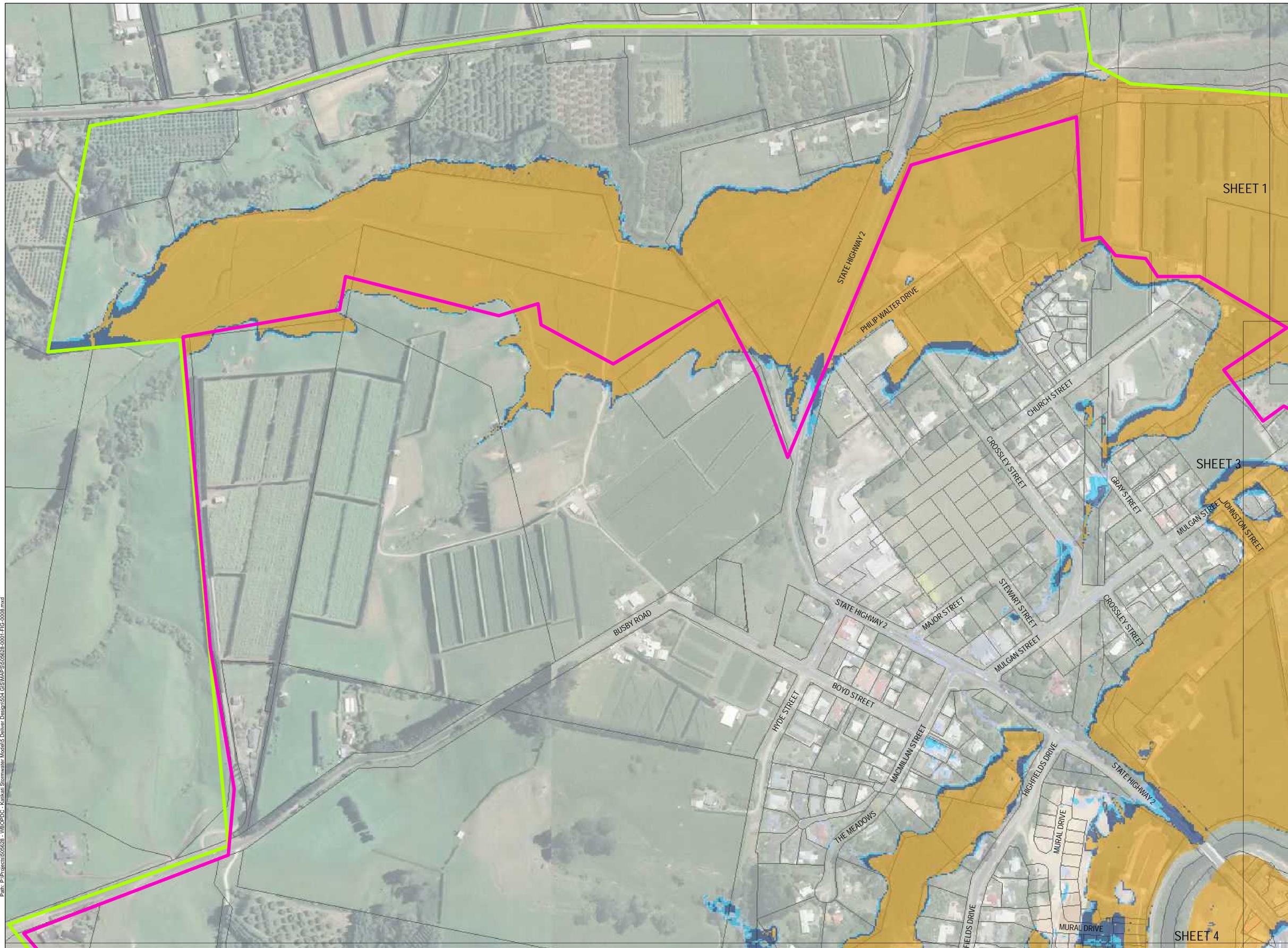
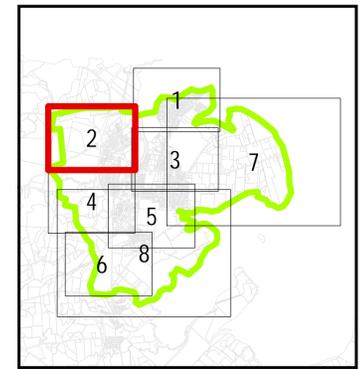
JOB No: 505628 REVB - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 1 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0008.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

**FLOOD DEPTH (m)**

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

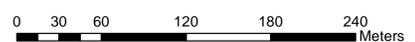
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Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 - Deliver\Design\04 GIS\MAPS\505628-0001-FIG-0008.mxd



A1 scale: 1:2,500

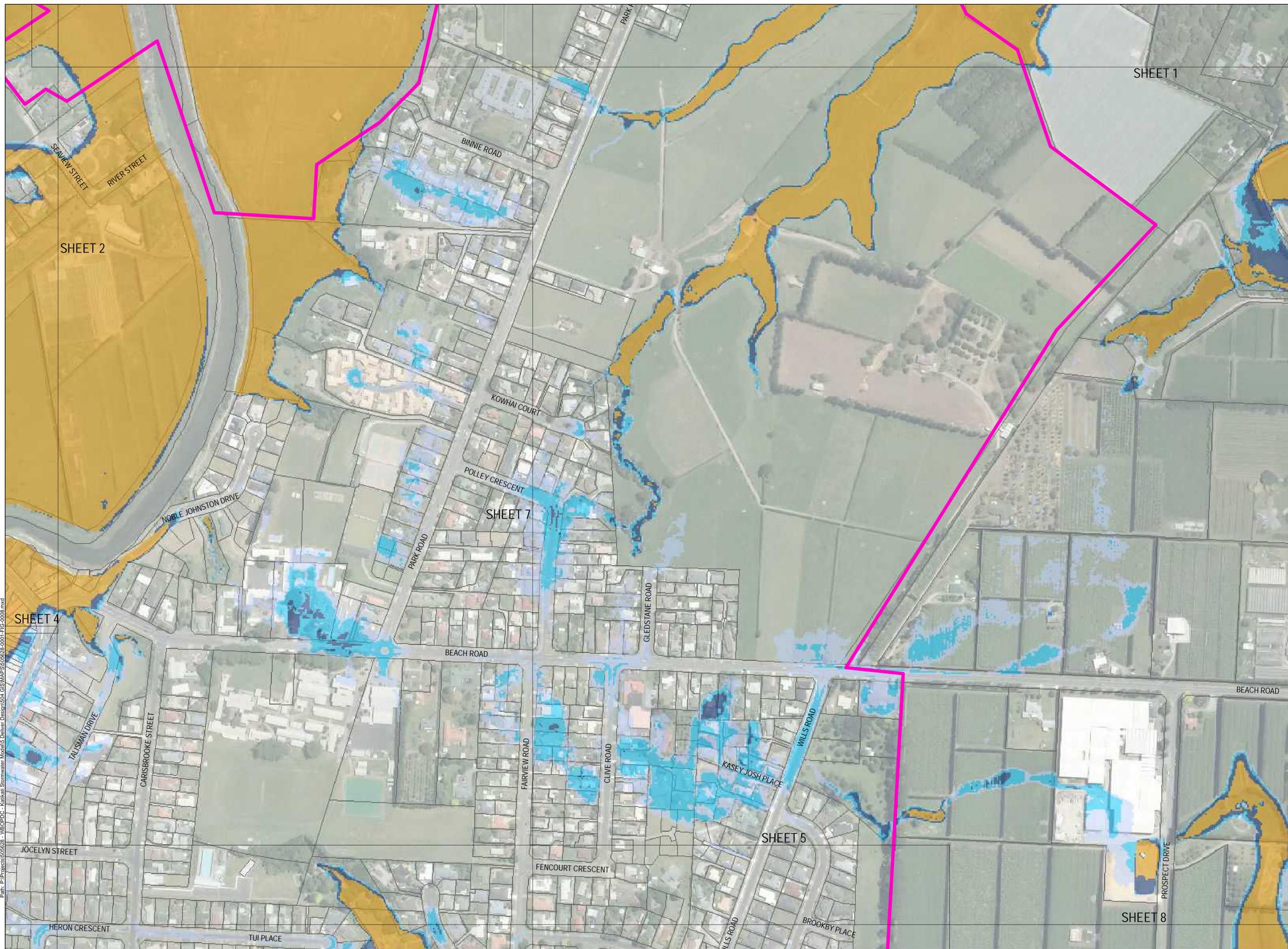
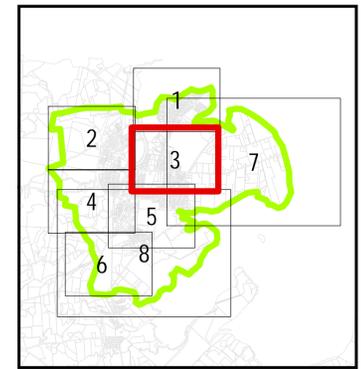


JOB No: 505628 REV B - UPDATED RESULTS  
COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 2 RevB - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

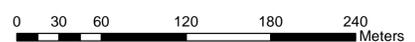
FLOOD DEPTHS <0.1m NOT SHOWN

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Aerial image sourced from <https://data.linz.govt.nz/layer/95550-bay-of-plenty-03m-rural-aerial-photos-2016-2017> and <https://data.linz.govt.nz/layer/88127-bay-of-plenty-0125m-urban-aerial-photos-2014-2015> licensed by BOPLASS 2011 for re-use under the Creative Commons Attribution 4.0 New Zealand licence.



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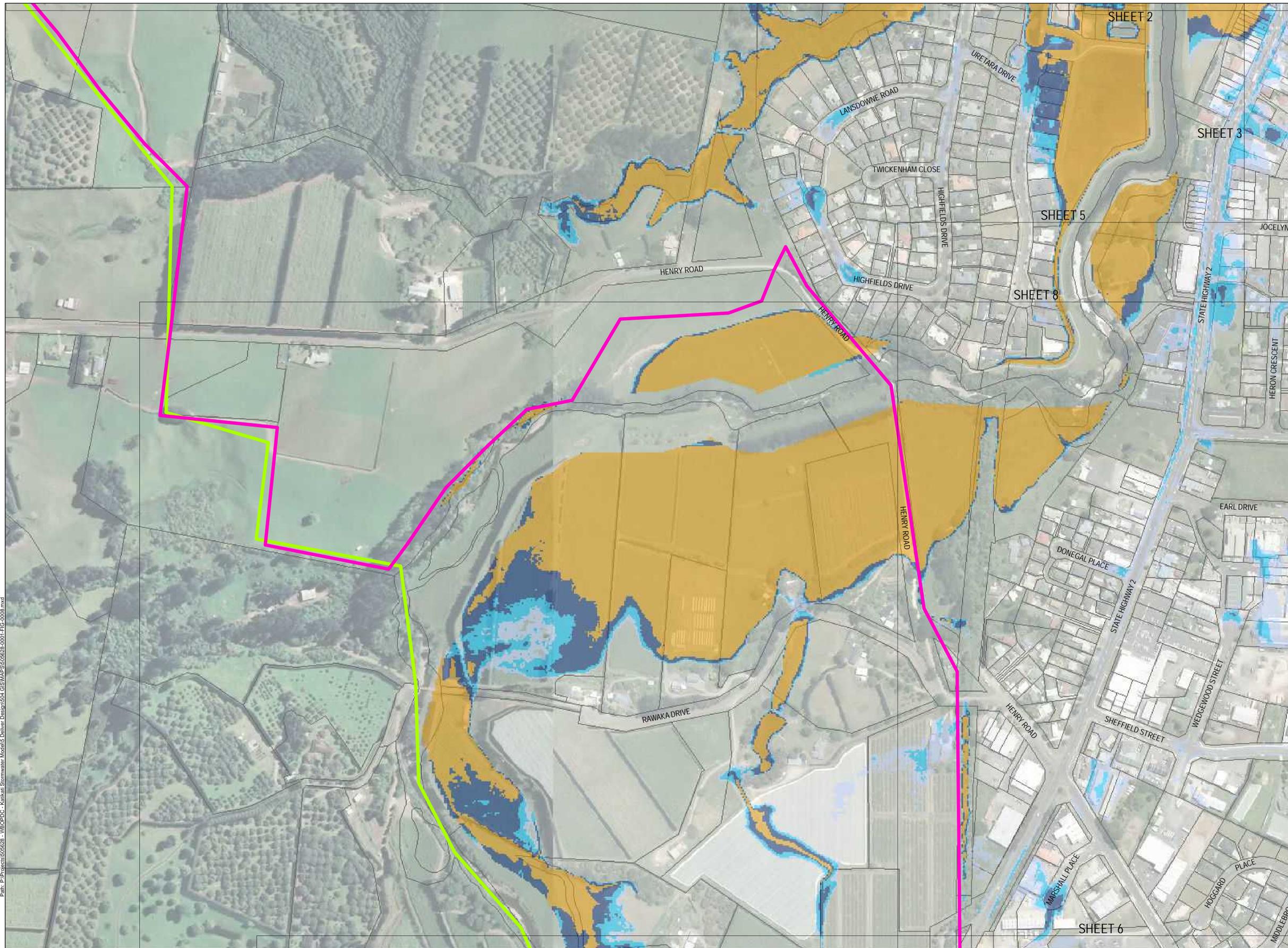
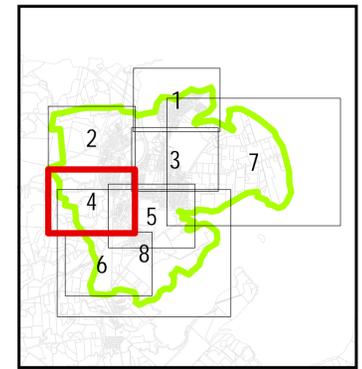


JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 3 Rev B - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

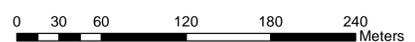
FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

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A1 scale: 1:2,500



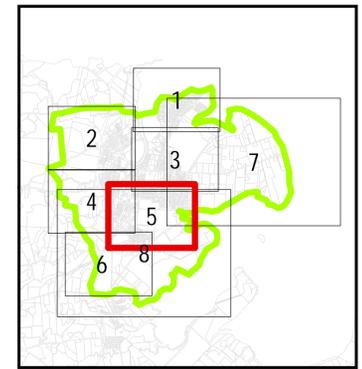
JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 4 Rev B - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\04 GIS\MAPS\505628-008-FIG-008.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

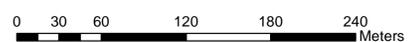
FLOOD DEPTHS <0.1m NOT SHOWN

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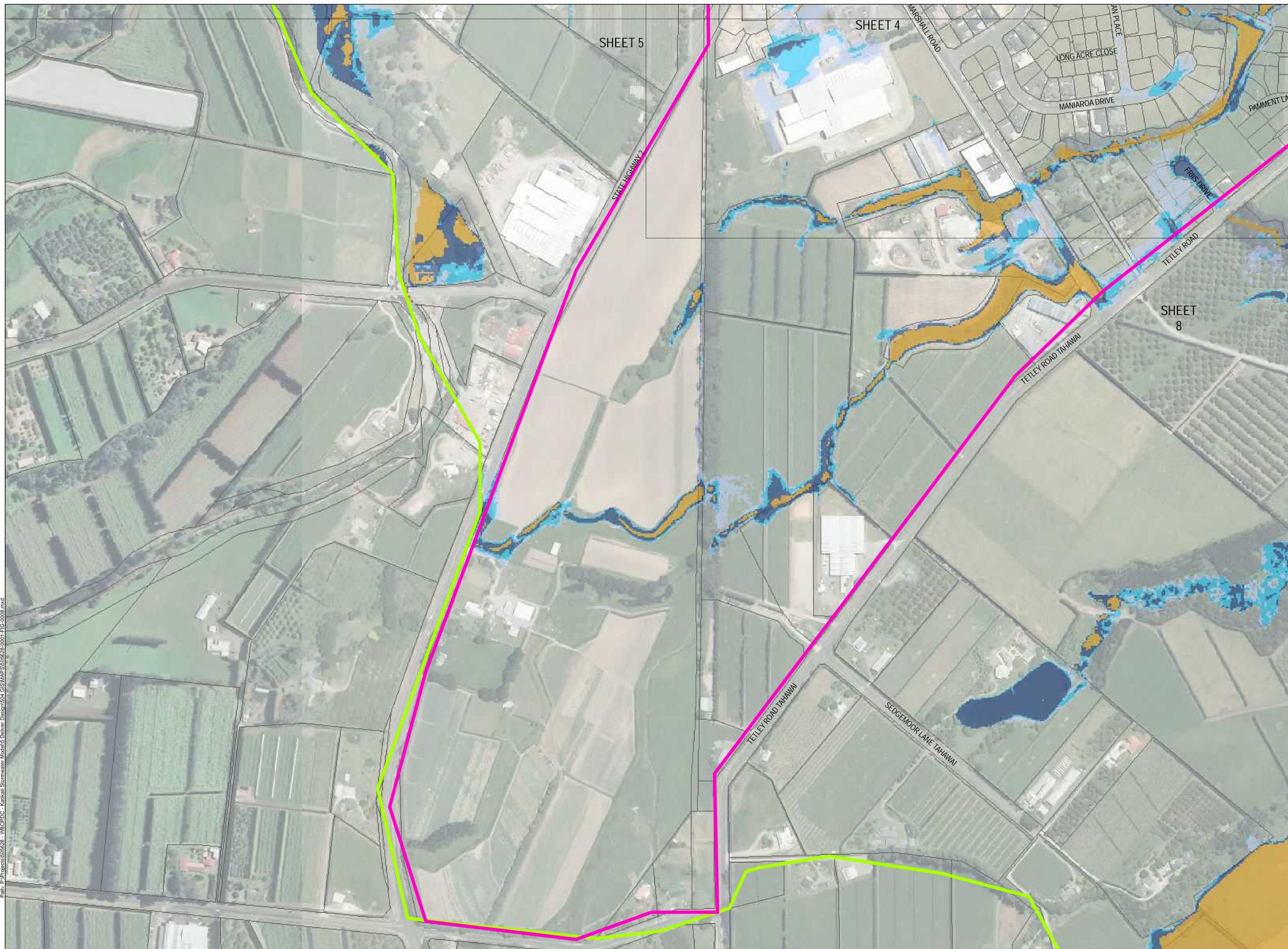
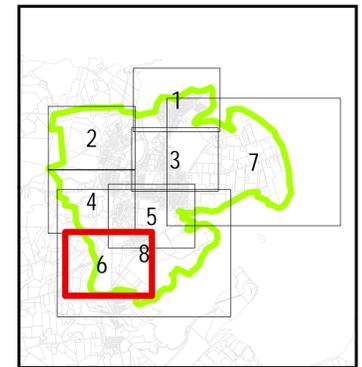
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JOB No: 505628 REV B - UPDATED RESULTS  
 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

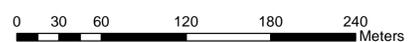
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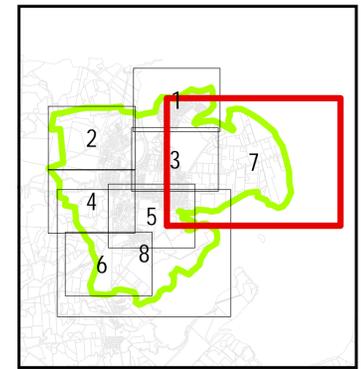
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WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 6 RevB - July 2019

Path: P:\Projects\505628 - WBC\PC - Katikati Stormwater Model\5 Deliver\Design\GIS\MAPS\505628-008-FIG-008.mxd



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

Notes:

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A1 scale: 1:5,000

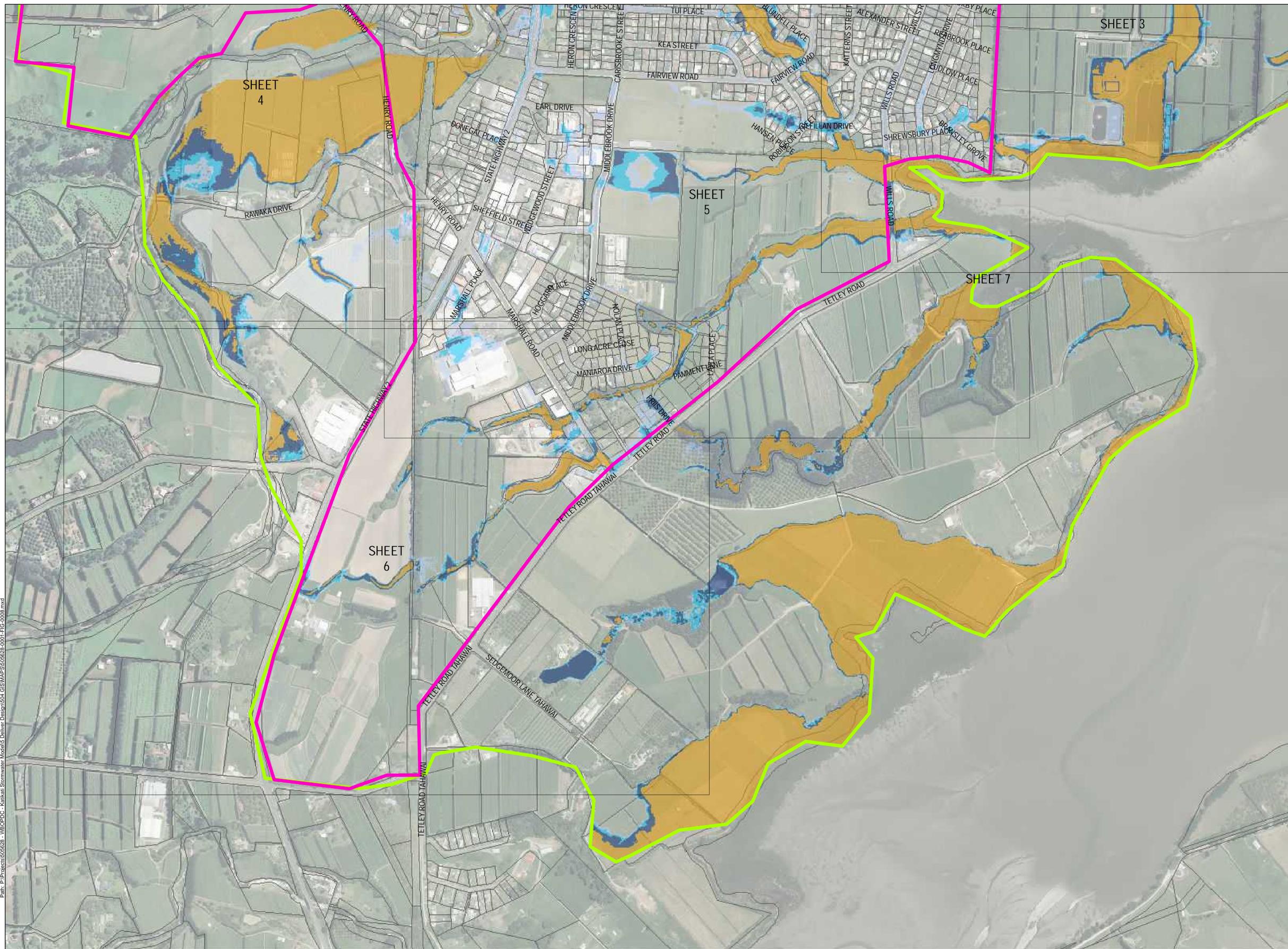
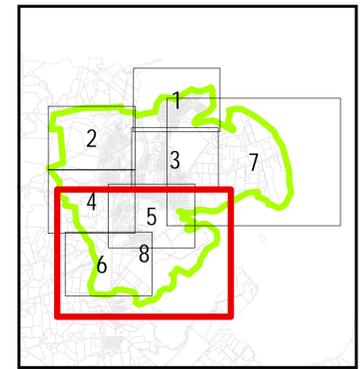


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 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - KATIKATI STORMWATER MODELLING

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 7 Rev B - July 2019



**LEGEND**

- KATIKATI URBAN GROWTH
- STUDY EXTENT BOUNDARY
- PROPERTY BOUNDARIES

FLOOD DEPTH (m)

- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- >1.0

FLOOD DEPTHS <0.1m NOT SHOWN

**Notes:**

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A1 scale: 1:5,000



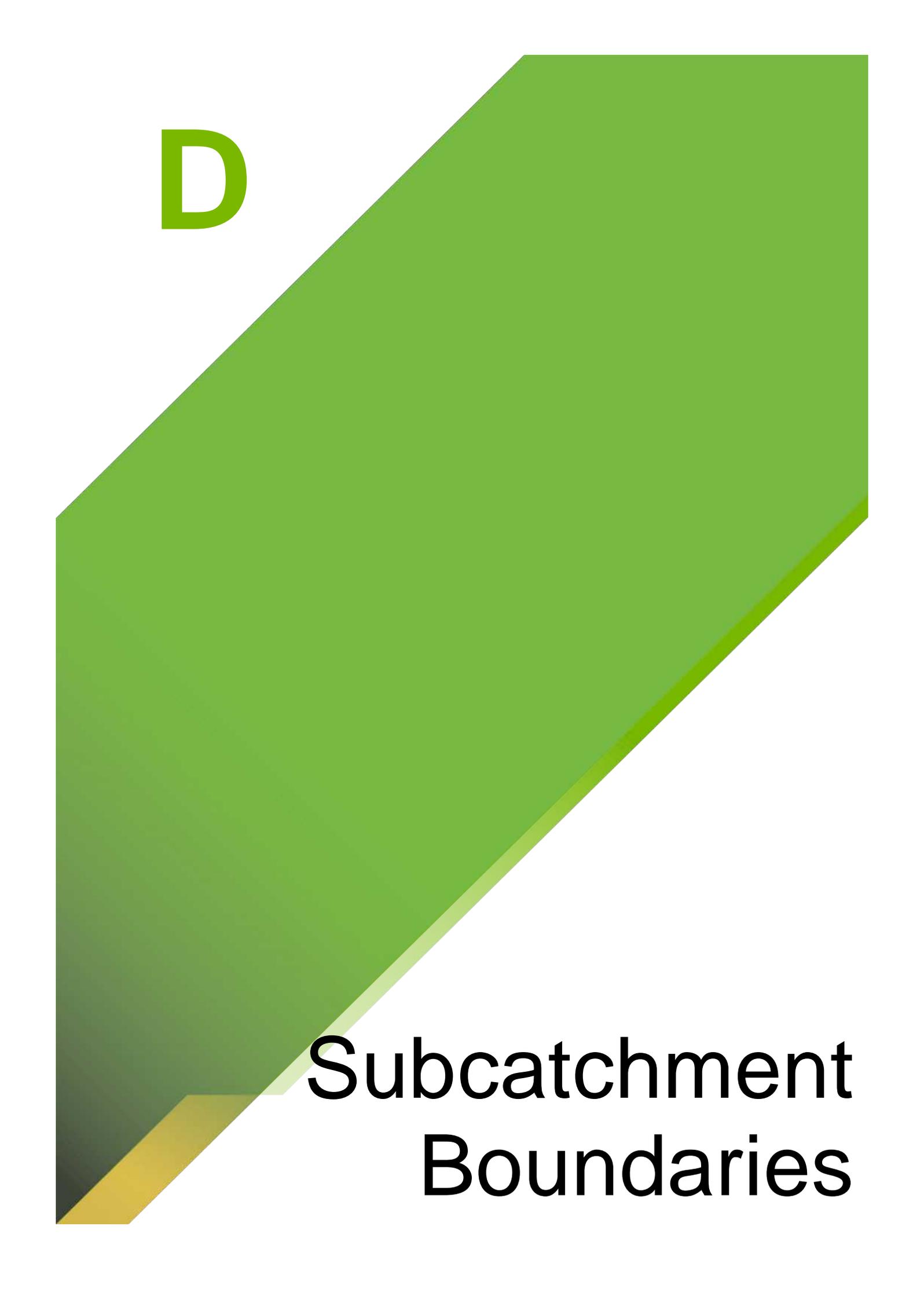
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 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

505628-FIGURE 008: Maximum credible event - Maximum probable development - Maximum flood depth

SHEET: 8 RevB - July 2019

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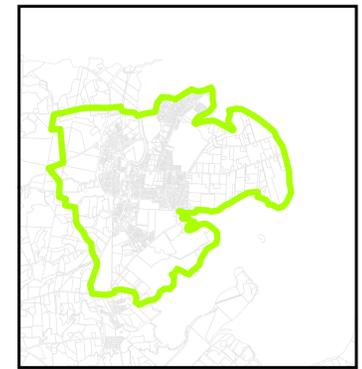


D

Subcatchment  
Boundaries

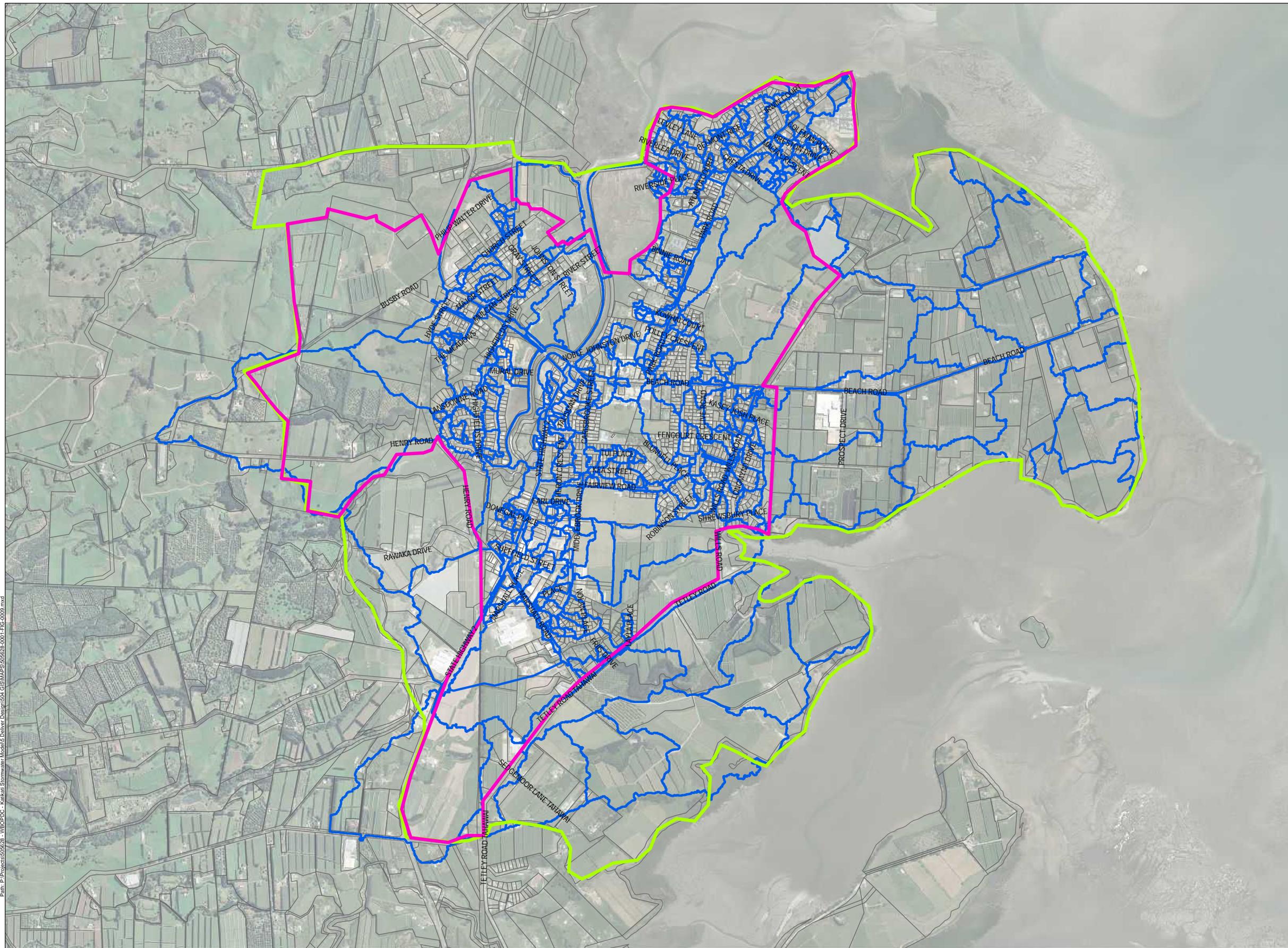
# Appendix D

## Subcatchment Boundaries



**LEGEND**

-  KATIKATI URBAN GROWTH
-  STUDY EXTENT BOUNDARY
-  SUBCATCHMENT MOUNDARY
-  PROPERTY BOUNDARIES



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A1 scale: 1:10,000



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 COORDINATE SYSTEM: NZTM

WESTERN BAY OF PLENTY DISTRICT COUNCIL - **KATIKATI STORMWATER MODELLING**

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