Catchment Planning

What Level of Detail is Appropriate when Modelling Future Development Scenarios

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aurecon

Acknowledgements

Tauranga City Council (Client)

DHI (Peer Review)

Target Audience

Anyone who uses model information:

- ✓Planners
- ✓Engineers
- ✓Modellers

Aim of Presentation

- To get modellers to appreciate what development in a catchment typically involves and how this impacts their models and the choices they make.
- To get planning engineers to understand what information is required by modellers and the dangers of some of the assumptions the modellers may otherwise make.

And eventually came out with a thick report to give to the planning engineer.

Which the planning engineer didn’t understand and put on a shelf to collect dust.

But then came GIS and 2d Modelling

But there are still issues

- While 2d results can look very precise this may not always be the case;
- This presentation focuses on some of the pitfalls when modelling;
- The focus will be on future development scenarios.

Catchments

We will look at 4 different catchments in Tauranga and the different problems faced.

- Mount Maunganui;
- Papamoa West;
- Papamoa East;
- Kopurererua Stream.

Modelling Scenarios

- Existing development;
- Maximum probable development.

Existing Scenarios

- Modelling detail depends on budget and data availability;
- And what results are to be used for;
- Generally more detail is better;
- Rain on grid – in flat catchments;
- Steeper catchments rain on grid may run past catch-pits so may not always be appropriate.

Maximum Probable Development

- Usually based on planning zones;
- Include an allowance for climate change and sea level rise;
- Catchment shape and size may differ from the existing extent.

Catchment 1 – Mount Maunganui

Mount Maunganui

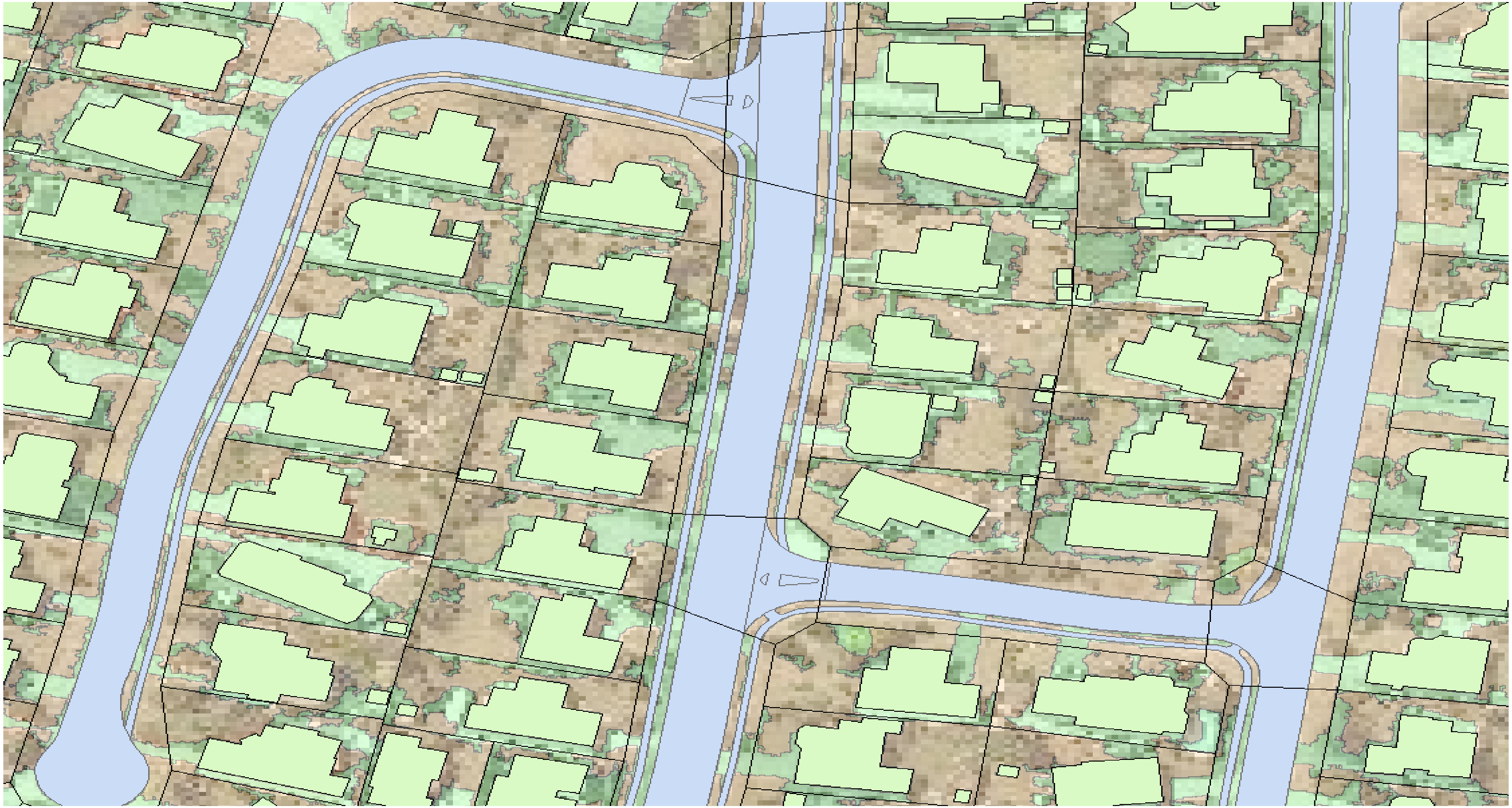
- Mount Maunganui – an example of a mature catchment which is already completely developed;
- But future intensification with infill development is still occurring.

2011

2017

Te Ngalo Road
Marine Parade
Grove Avenue
Muricata Avenue
Pitau Road

- Currently Modelled with Rain on Grid;
- Infiltration layer with initial and constant loss rates;
- Infiltration rates (and hence excess rainfall runoff rates) depend on surface type;
- TCC had this information digitised.



Maximum Probable Development

2017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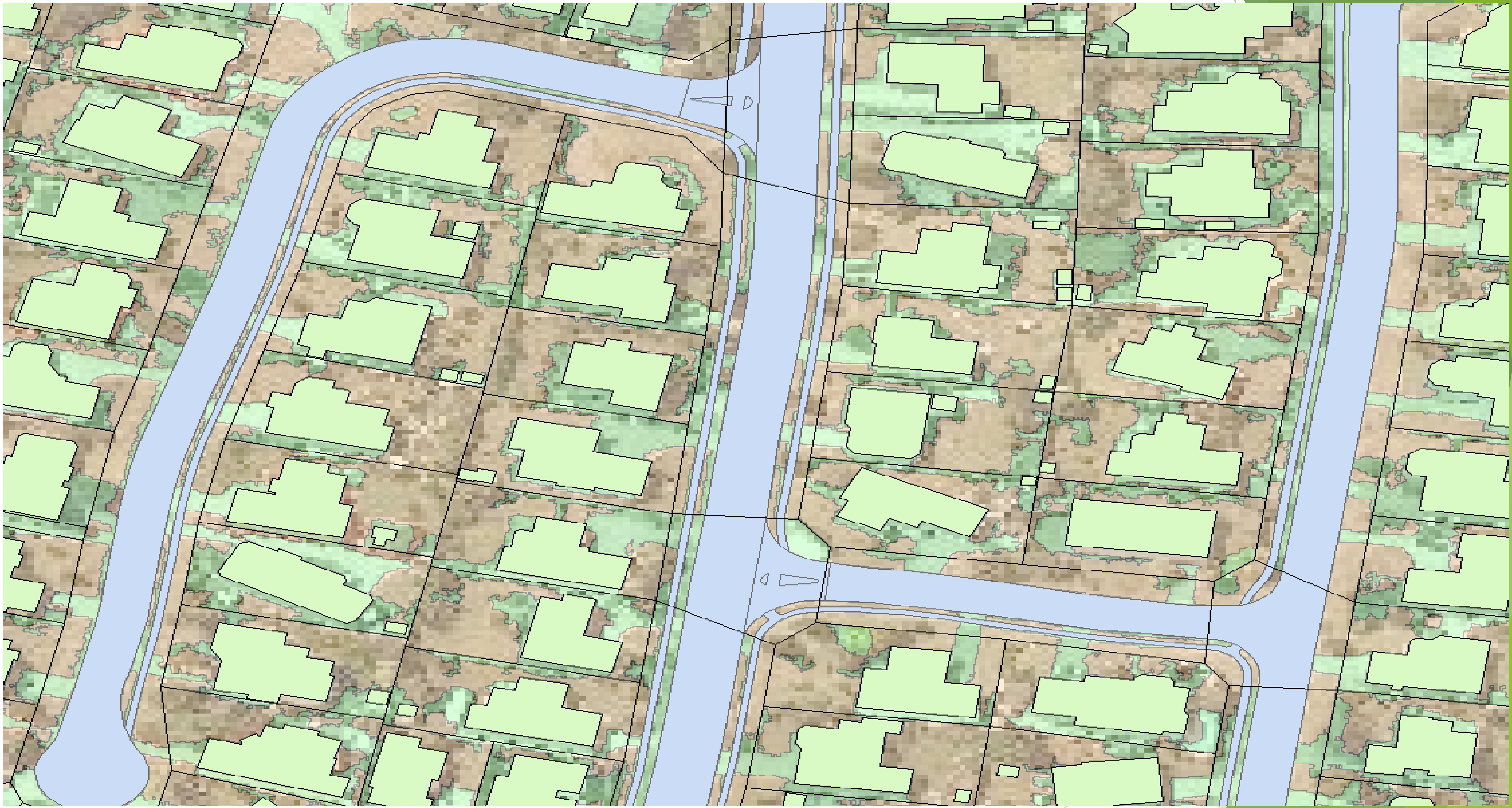
Marine Parade
Grove Avenue
Muricata Avenue
Pitau Road



- Using GIS techniques the existing imperviousness was calculated for each lot;
- This is compared to the future maximum imperviousness for that zone and the infiltration rate of that lot weighted accordingly.

Example

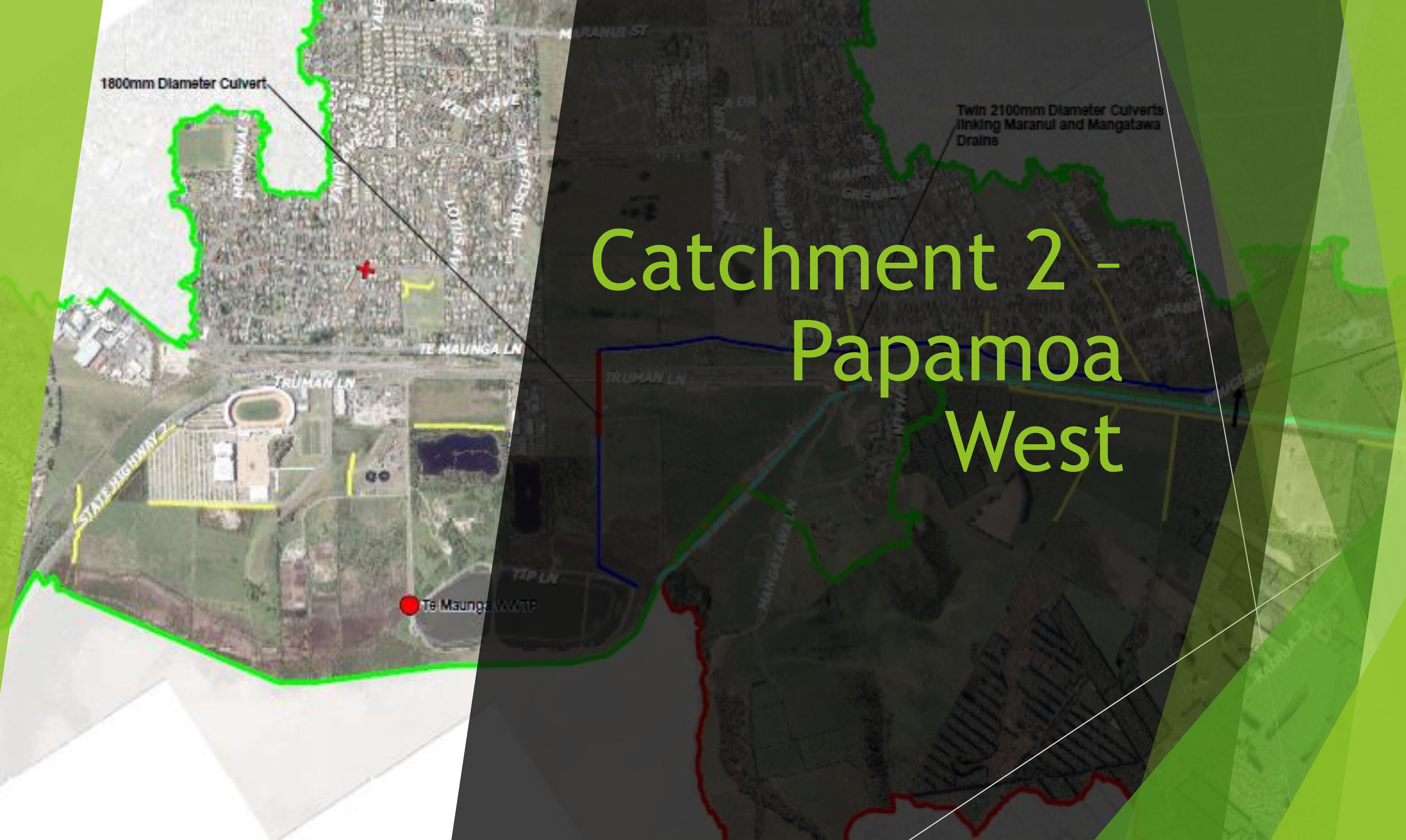
- Lot size 1000m^2;
- Roof and driveway 400m^2;
- I.e. existing imperviousness 40%;
- Future maximum imperviousness predicted at 70%;
- So expect impervious area to increase to 700m^2;
- Pervious area to reduce from 600 to 300m^2.

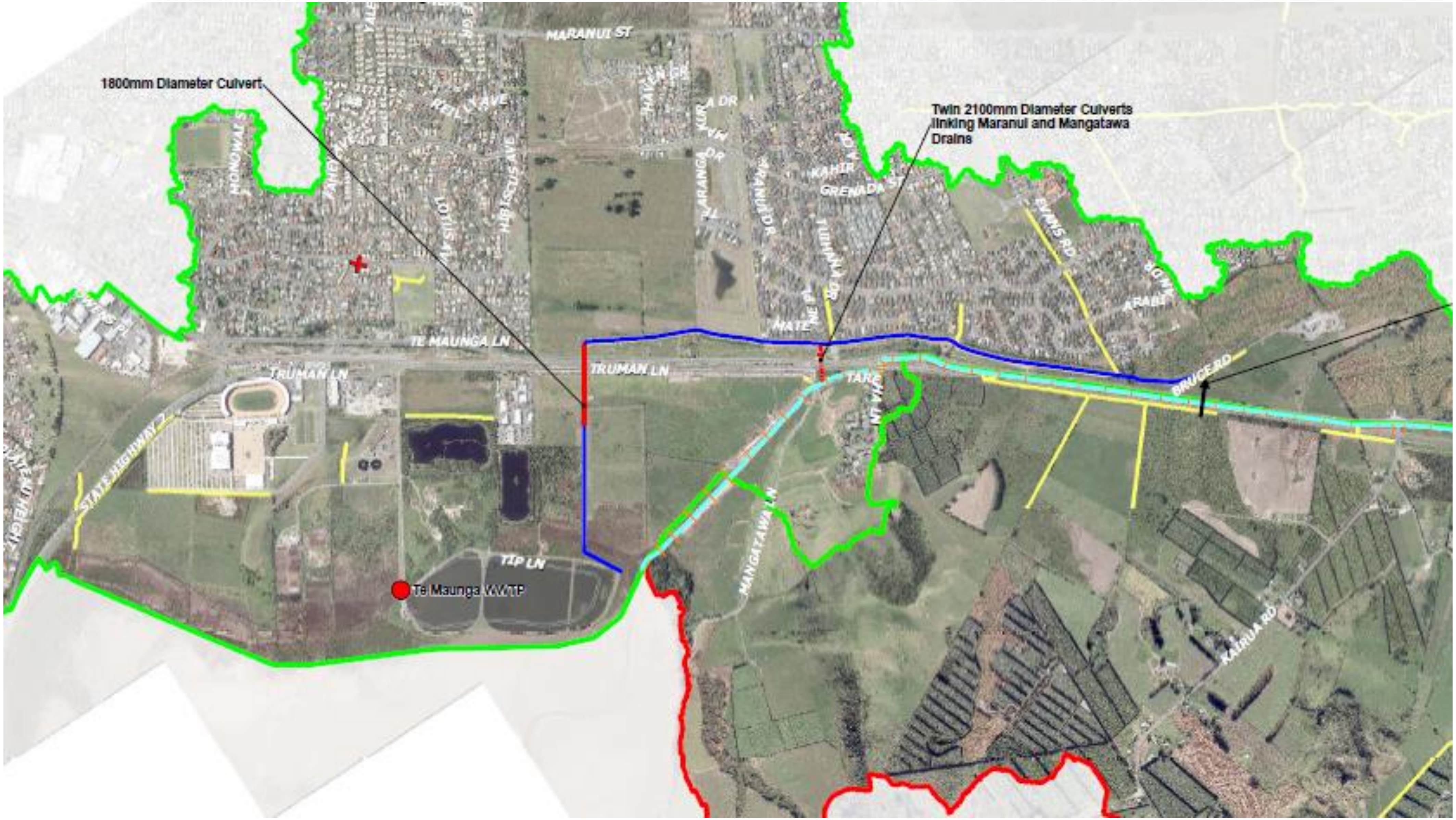
Example continued

- Say pervious infiltration rate 20mm/h;
- Impervious infiltration rate 0mm/h;
- Pervious area is predicted to halve;
- So for this particular lot halve infiltration rate for pervious area from 20mm/h to 10mm/h.

- This method is obviously an approximation but on a lot by lot basis is quite a good representation of the infill process;
- GIS techniques mean that this modification of the infiltration layer can be done relatively simply without doing hand calculations for each lot.

Catchment 2 – Papamoa West




1800mm Diameter Culvert
Twin 2100mm Diameter Culverts linking Maranui and Mangatawa Drains
Te Maunga WWTP
MARANUI ST
TE MAUNGA LN
TRUMAN LN
TIP LN
STATE HIGHWAY 2
BRUCE RD
KAIRUA RD
MANGATAWA LN
GRENADA ST
HIBISCUS AVE
BYRNIS RD

- Papamoa West is very similar in terrain and soil type to Mount Maunganui;
- So for the urban area the same modelling approach was recommended;
- But Papamoa West still includes areas of greenfield.

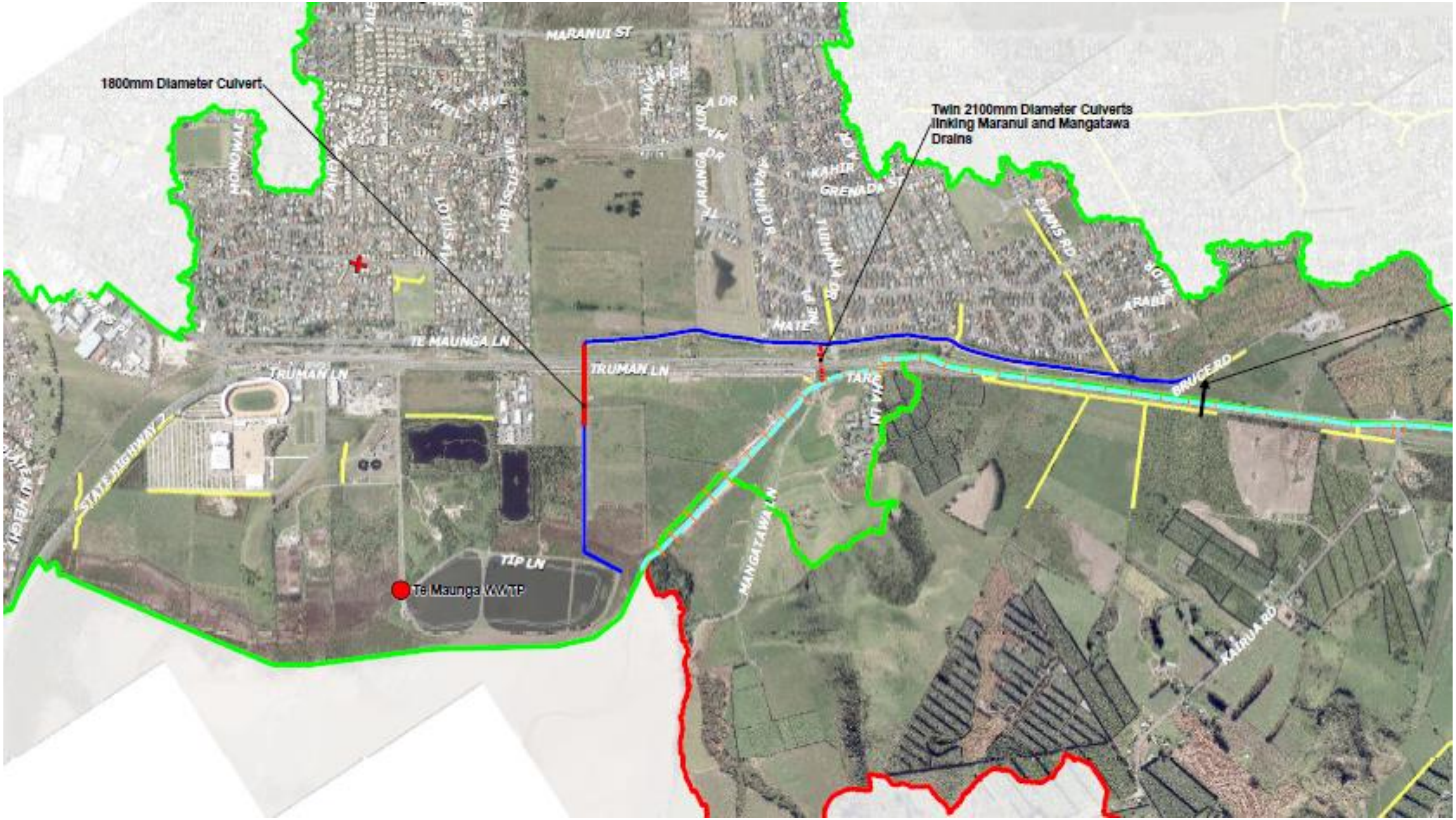
Maranui Street
Sunbrae Grove
Seaspray Drive
Grenada Street
Tania Place
Fahey Avenue
Reilly Avenue
Sunrise Avenue
Gloucester Road
Denny Hulme Drive
Lotus Avenue
Jasmine Place
Hibiscus Avenue
Te Maunga Lane
Truman Lane
State Highway 2
Franks Way
Haven Grove
Hugo Way
Otira Close
Coast Boulevard
Aranui Drive
Range Road
Te Ara Place
Logan Road
Pacific View Road
Ocean Crest
Keepa Close
Matene Place
Evans Road
Ella Place
Tareha Lane

- Existing greenfield land in Papamoa includes lines of dune ridges and valleys parallel to the shore;
- Rain on grid drains to the inter-dunal valleys.

Flood map of Existing Development

MPD Scenario

- The technique from Mount Maunganui Catchment was applied in Papamoa West;
- But decreasing infiltration in green field areas doesn’t increase the runoff from these areas as the water is still trapped in the interdunal valleys;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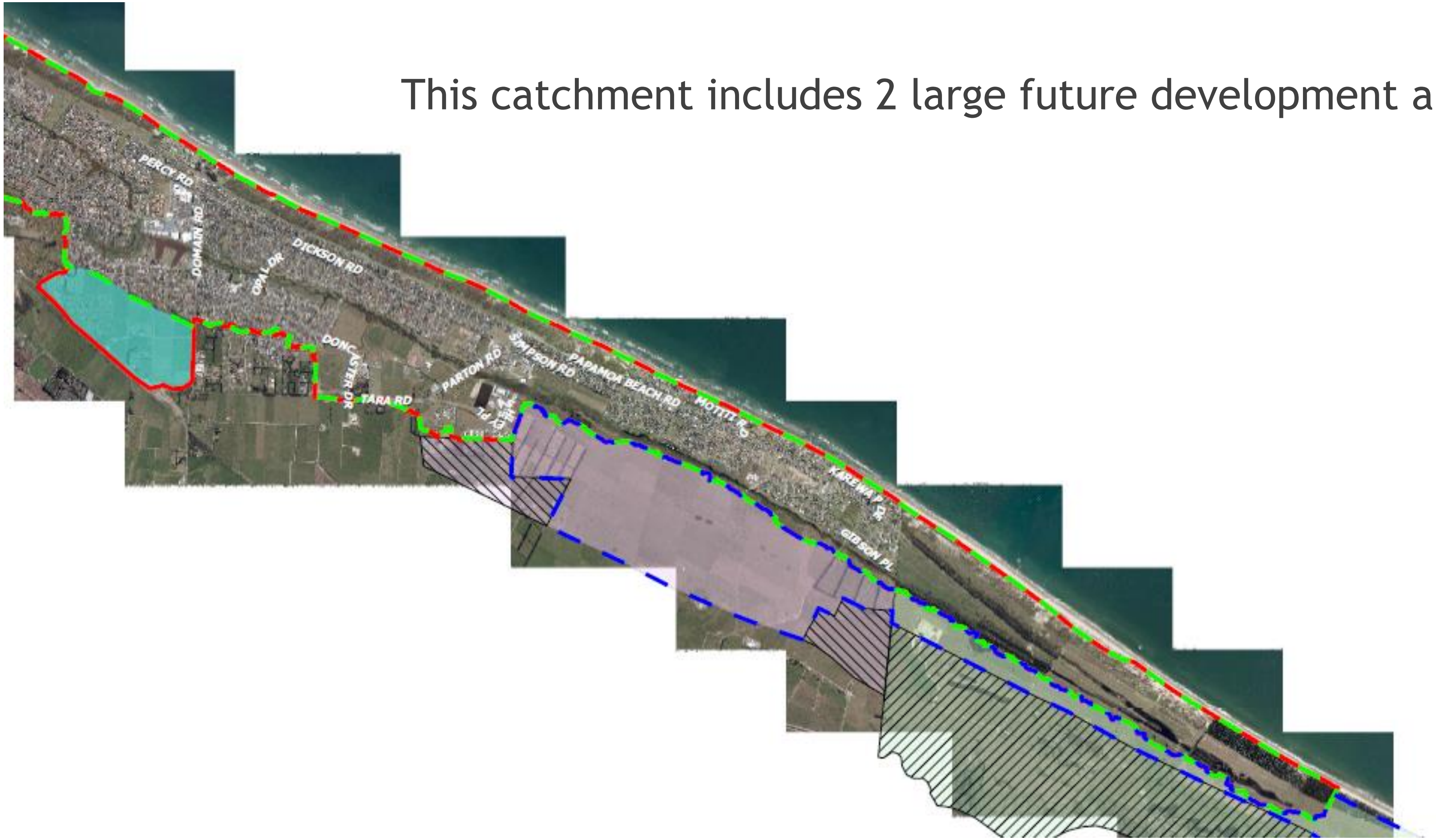
KAIRUA RD
HIBISCUS AVE
HONOWAI
ARABI

- Using the “Mount” technique significantly underestimated the future runoff from this block of land;
- Levels in the receiving Maranui Swale were also significantly underestimated;
- Fortunately this did not affect flood mapping in residential areas;

- For this catchment the ‘complicated’ Mount method was not appropriate for greenfield blocks;
- A simpler runoff method would have given better results.

Catchment 3 – Papamoa East

This catchment includes 2 large future development areas



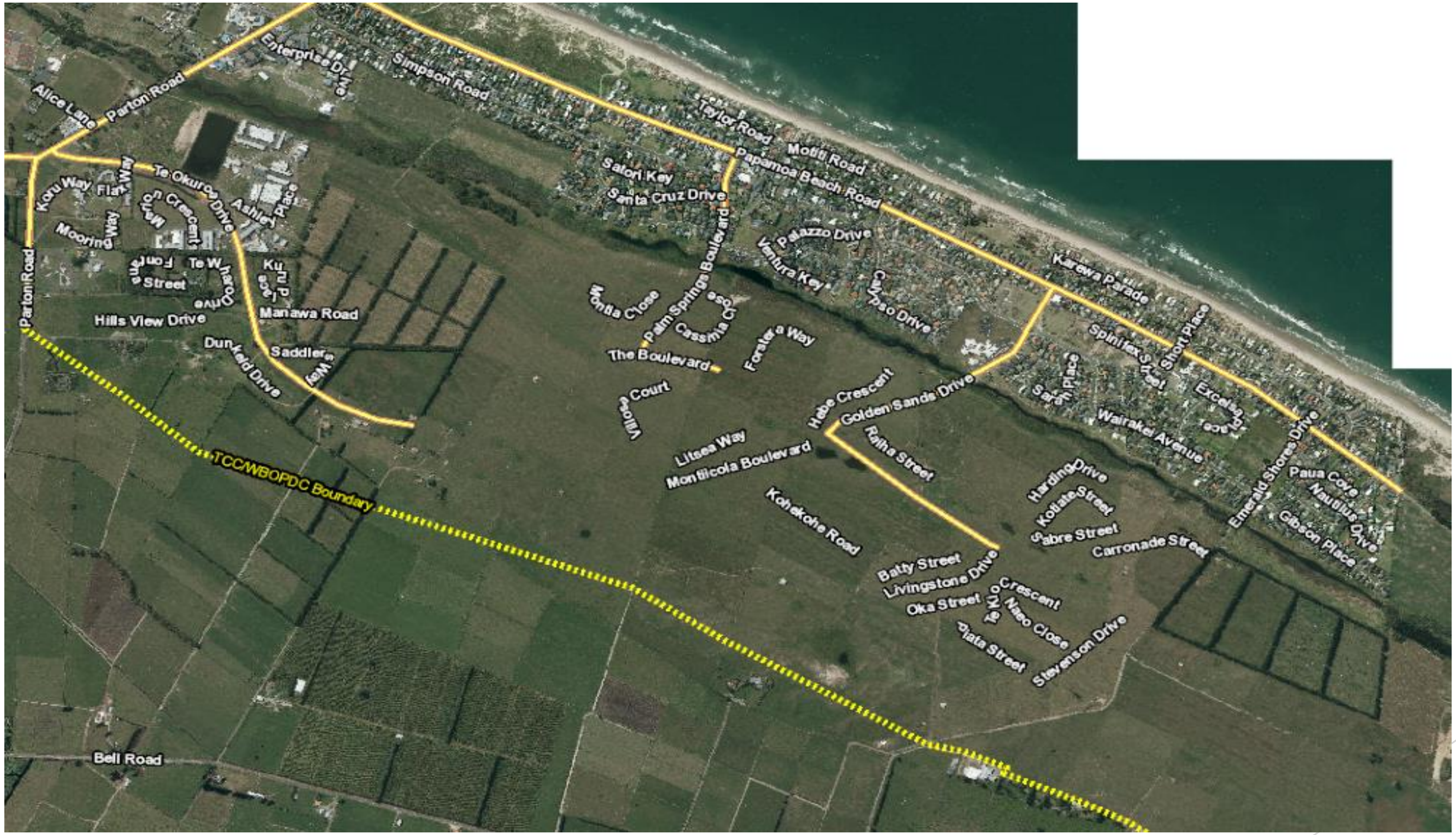
- Using rain on grid in these large greenfield areas would have had similar issues to Papamoa West;
- Runoff would have again become trapped in inter-dunal valleys rather than discharging to the stream;
- Instead the consent conditions for this area were studied closely and the model developed to reflect these conditions.


outlet Part1 OTS
outlet_m21_59165
soakhole_29063
soakhole_59773
soakhole_59263
soakhole_77632_2
outlet_m21_59927
outlet_m21_59624
sump_75638
sump_71853

Updating the Model

- This catchment has developed rapidly and Council engineers were interested in impacts on flooding.

2011


Enterprise Drive
Simpson Road
Alice Lane
Parton Road
Taylor Road
Motiti Road
Papamoa Beach Road
Satori Key
Santa Cruz Drive
Palm Springs Boulevard
Palazzo Drive
Ventura Key
Calypso Drive
Karewa Parade
Spinifex Street
Short Place
Koru Way
Te Okuru Drive
Ashley Place
Mooring Way
Manawa Road
Hills View Drive
Saddler Way
Dunkeld Drive
Montia Close
Cassinia Close
The Boulevard
Foratera Way
Court
Hebe Crescent
Golden Sands Drive
Raiha Street
Litsea Way
Monticola Boulevard
Kohekohe Road
Wairakei Avenue
Harding Drive
Kotiate Street
Sabre Street
Carronade Street
Emerald Shores Drive
Paua Cove
Nautilus Drive
Gibson Place
Batty Street
Livingstone Drive
Oka Street
Te Kio Crescent
Naeo Close
Piata Street
Stevenson Drive
TCC/WBOPDC Boundary
Bell Road

2015

Enterprise Drive
Simpson Road
Alice Lane
Parton Road
Road
Taylor Road
Motiti Road
Papamoa Beach Road
Safari Key
Santa Cruz Drive
Te Okuroa Drive
Ashley Place
Koru Way
Mooring
Palazzo Drive
Ventura Key
Karewa Parade
Parton Road
Manawa Road
Hills View Drive
Saddlers Way
Palm Springs Boulevard
Forsteria Way
The Boulevard
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2017

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Motiti Road
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Safari Key
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Te Okuroa Drive
Koru Way
Manawa Road
Hills View Drive
Palazzo Drive
Ventura Key
Calypso Drive
Karewa Parade
Foreshore Way
The Boulevard
Golden Sands Drive
Spinifex Street
Wairakei Avenue
Emerald Shores Drive
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Livingstone Drive
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Bell Road

Updating the Model

- In particular Council engineers were keen to test out developers landforms before they have been earth-worked.

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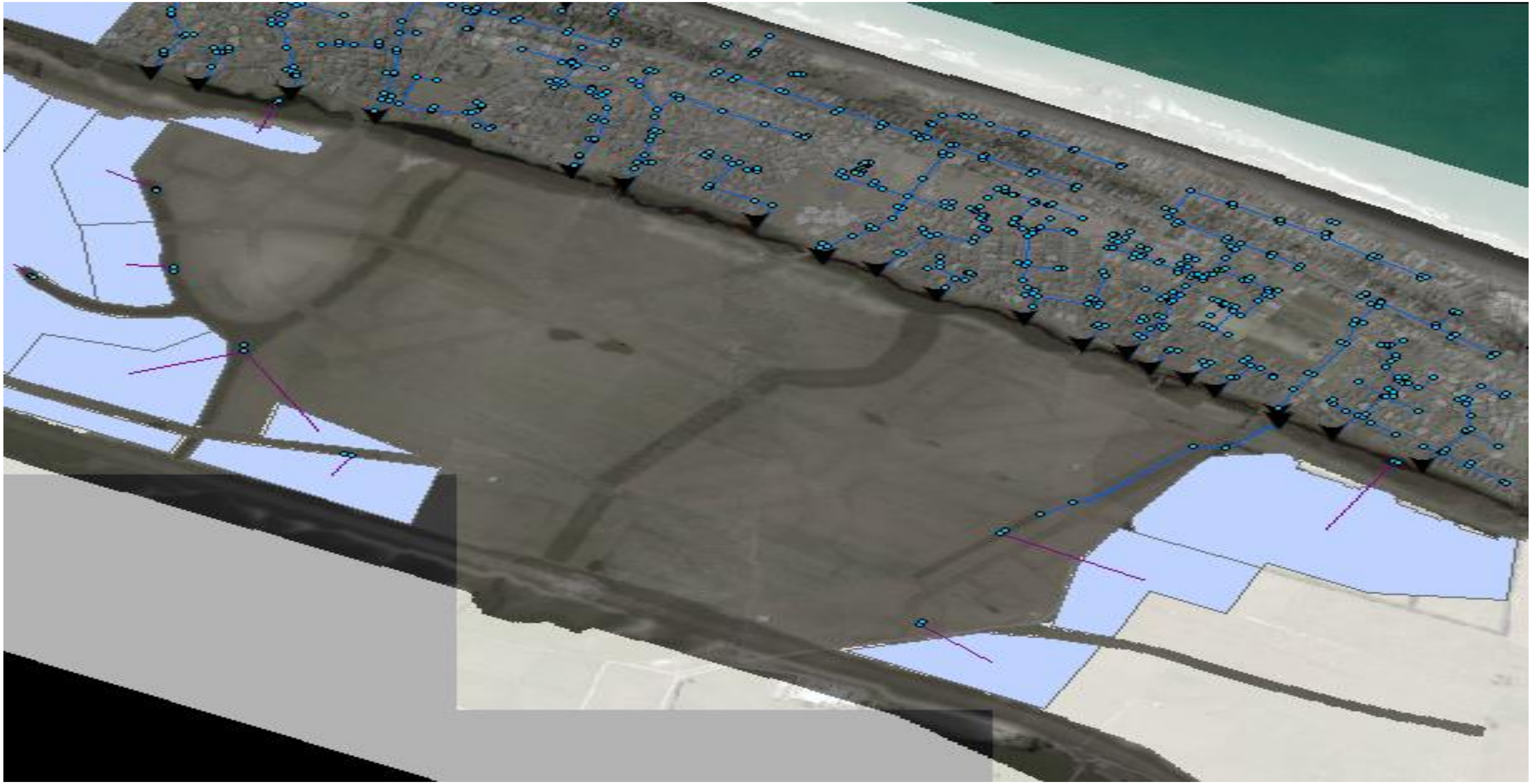
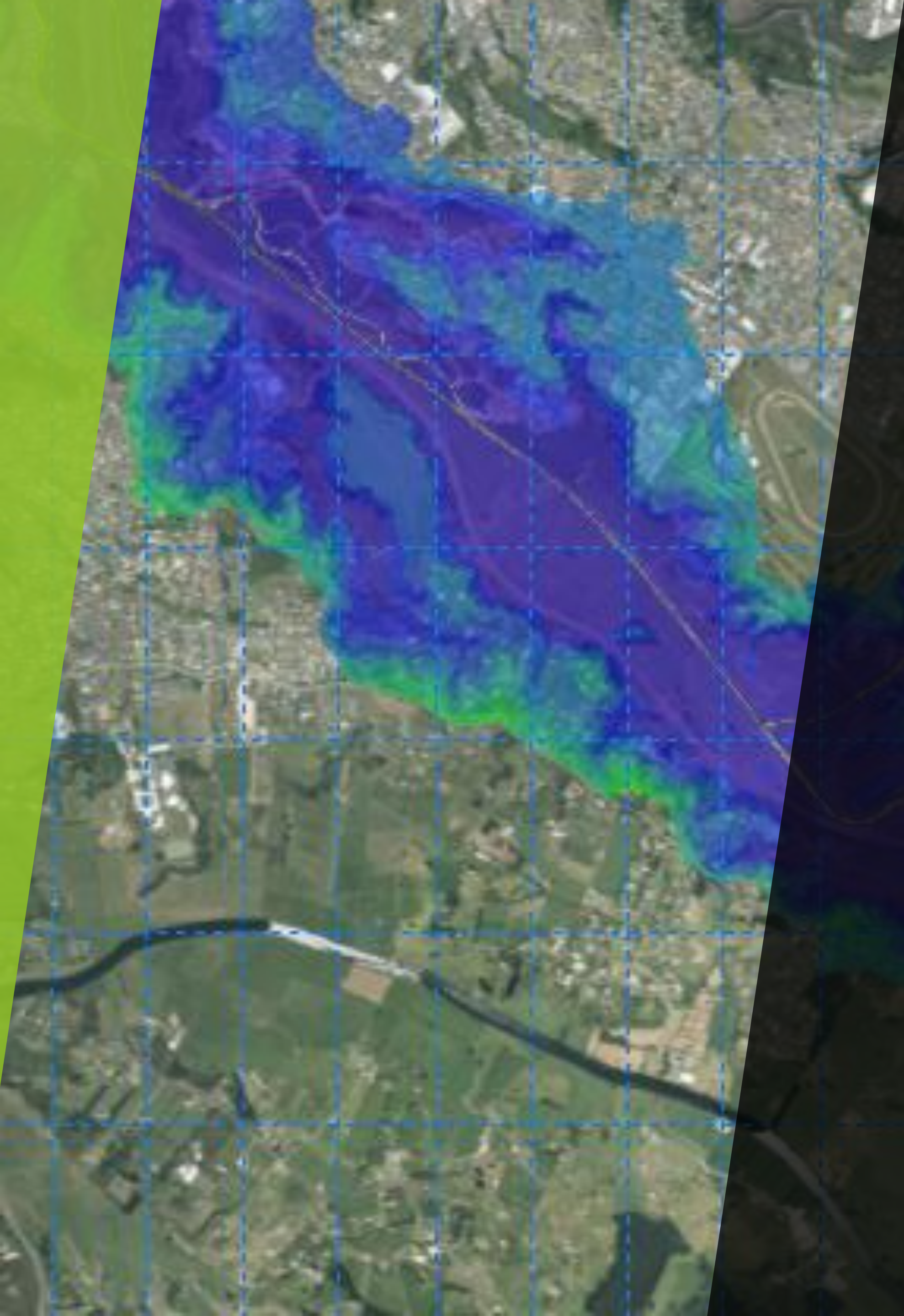
soakhole_59773
soakhole_59263
outlet_m21_59165
outlet Part1 OTS
outlet_m21_58340

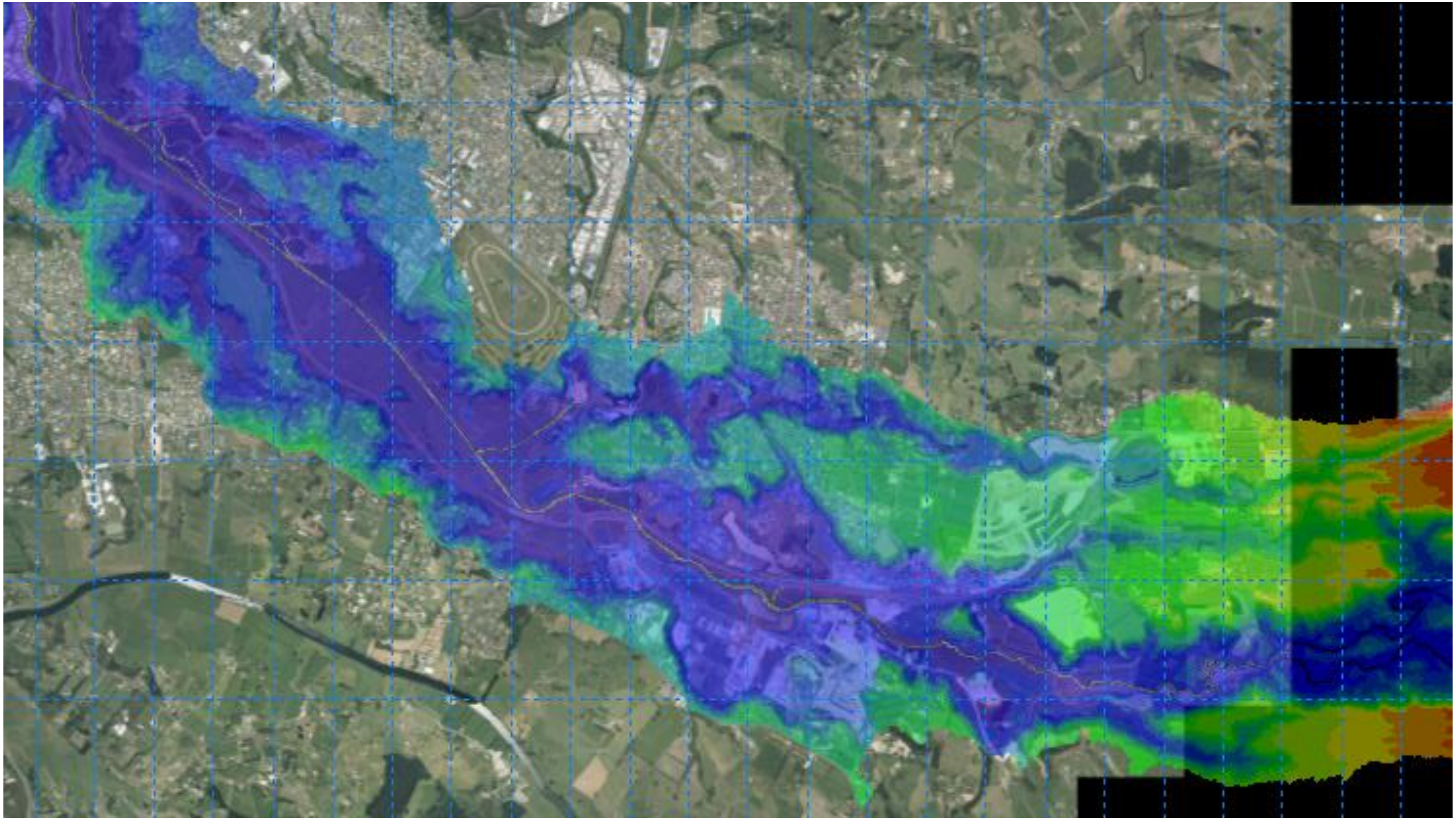


- This has helped guide
  - Swale and culvert sizes;
  - Building platform levels especially in areas distant from the receiving Wairakei Stream.

Above 5.8
5.6 - 5.8
5.4 - 5.6
5.2 - 5.4
5.0 - 5.2
4.8 - 5.0
4.6 - 4.8
4.4 - 4.6
4.2 - 4.4
4.0 - 4.2
Below 4.0



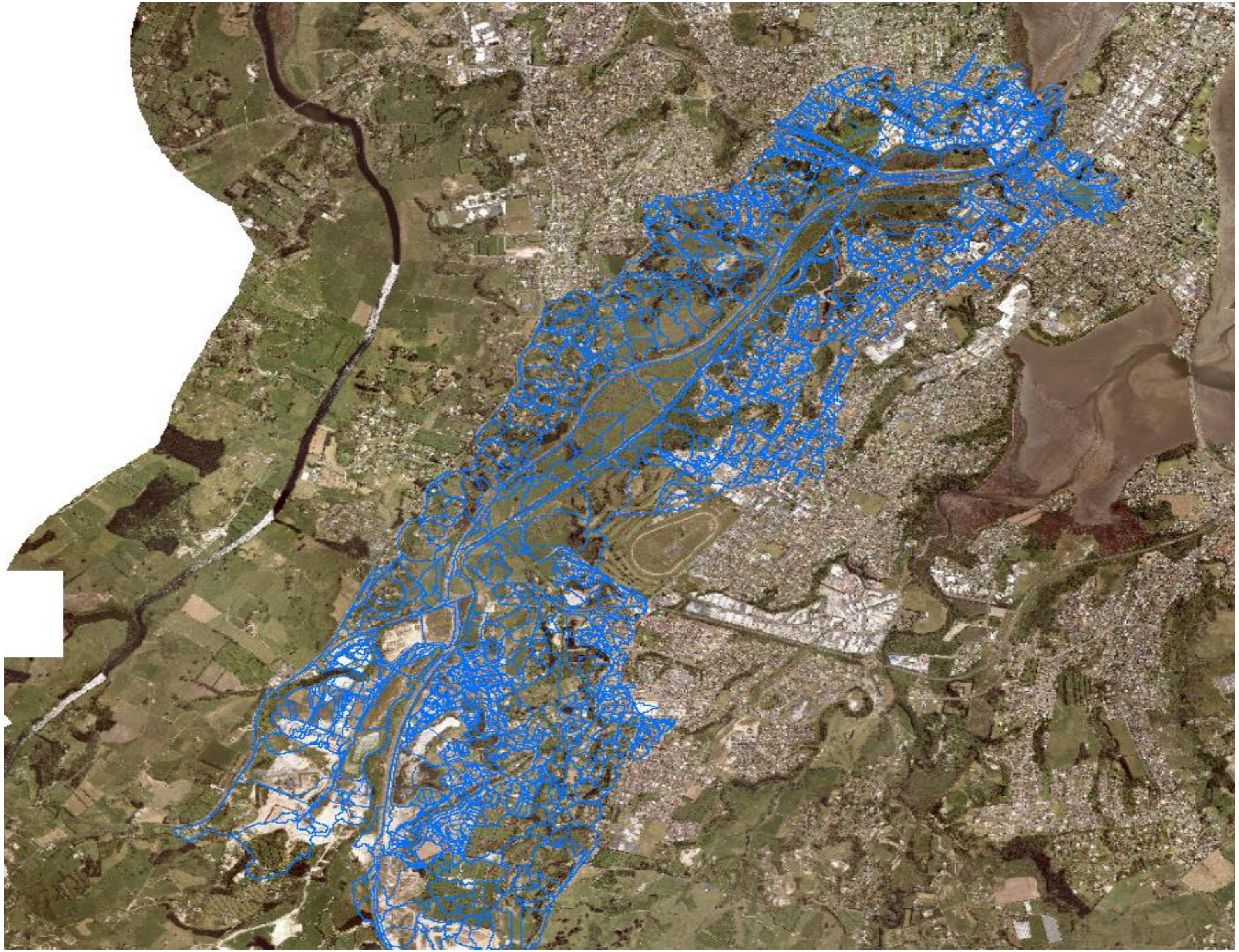
Catchment 4 – Kopurererua Stream



- Large catchment stretching from the Kaimais to the harbour;
- Major development is occurring in the catchment (On the left driving out from Tauranga up the Kaimais towards Hamilton);

- Quite different from the first 3 catchments:
  - Hilly rather than flat;
  - Ash soils rather than sand;
  - Large rural upper catchment.
- But Similar to Papamoa in that it is growing rapidly:
  - Tauriko industrial area;
  - ‘The Lakes’ residential area.

- Due to steep terrain hydrology was not modelled via rain on grid;
- Instead flows were calculated for a large number of sub-catchments which were then loaded onto the 2d surface terrain;
- Surface changes due to earthworks are therefore not as problematic as per rain on grid model described earlier.



- However the modeller for this catchment was not aware of consent conditions applying to this catchment;
- Key features of the future development scenario were therefore missed from the model;

- Consented future floodplain filling was not incorporated into the model;
- Consented mitigation measures were also missed from the model including:
  - A dam;
  - A large overflow area from the stream;
  - Attenuation ponds.

- This is an example of a catchment in which not enough detail was put into modelling the MPD scenario

Conclusions

Conclusions

- The amount of detail to include in modelling the MPD scenario varies from catchment to catchment;
- Sometimes a simpler approach is better (e.g. Papamoa West);
- But sometimes missing consented future works in the catchment can be crucial (e.g. Kopurererua Stream catchment);

- Future development models usually account quite well for:
  - Sea level rise;
  - Climate change;
  - Increased imperviousness as per planning zones.
- However future development models can struggle to account for:
  - Landform changes due to earthworks (especially problematic with rain on grid models);
  - Future consented changes to the catchment.

- Models can and should be updated and used as much as possible – e.g. testing developers design landforms;
- Modellers, Planners and Engineers need to keep talking.

Thank you for listening

Any questions?

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