# CIVIL INFRASTRUCTURE REPORT
# FOR A PROPOSED SUBDIVISION
# FOR HOPPER DEVELOPMENTS LTD
# AT SIMPSONS BEACH, WHAREKAHO

**Job No:** 85260/01
Rev. 01

**Issue Date: 15 December 2025**

**Airey Consultants Ltd | Takapuna Office**
PO Box 33-103, Takapuna, 0740 | Level 8, 19-21 Como Street, Takapuna
T: +64 9 486 4542 E: takapuna@aireys.co.nz

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# Document Control Record

**Document Prepared By:**
Airey Consultants Limited
Level 8 BDO Building
19-21 Como Street, Takapuna
Auckland
PO Box 33 103, Takapuna, Northshore 0740

T: +64 9486 4542
E: jamesg@aireys.co.nz
W: **aireys.co.nz**

**Client:**
HOPPER DEVELOPMENTS LTD
14 Tamariki Avenue, Orewa
Auckland



| Revision | Description | Issue Date | Prepared by | Reviewed by |
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# EXECUTIVE SUMMARY

This report has been prepared to inform on civil engineering services related to a residential development by Hopper Developments Ltd, for the development of 248 residential lots at Wharekaho/Simpsons Beach, Whitianga. The development does not fall under any Structure Plan and a plan change would be required. This report informs the civil engineering aspects of the development namely access, stormwater and wastewater drainage, water and utility supplies.

# 1 INTRODUCTION

This report highlights the civil engineering aspects for the development of a residential subdivision at Simpsons Beach, Wharekaho.

This civil infrastructure report identifies the issues related to services, access, stormwater and wastewater, water and utilities, earthworks associated with the development of the site.

# 2 APPLICATION DETAIL

| | |
|---|---|
| **Applicant**: | Hopper Developments Ltd |
| **Site Address**: | 25 and 39 Kuaotunu Wharekaho Road SH25, Wharekaho |
| **Legal Description**: | 6E1 ML Kuaotunu and 6D2 ML Kuaotunu |
| **Area of Legal Title**: | 66.16 Ha |
| **Area of Development Site**: | 66.16 Ha |
| **Type of Consent Sought**: | Plan Change and Subdivision Consent to create residential lots |
| **Contact Details**: | Airey Consultants Ltd<br>19 Como St, Takapuna<br>PO Box 33-103, Takapuna<br>Ph 09 486 4542<br>Email: jamesg@aireys.co.nz |

# 3 SITE DESCRIPTION

The Proposed development is located over two rural lots at 25 and 39 Kuaotunu Wharekaho Road (SH25) at Simpsons Beach. The development is bounded by SH25 and residential lots on the east and bounded by rural lots to the north and west. A recent residential development is located on the southern boundary of the development. The Tohetea Stream runs through both lots, falling from west to east and discharges below the site under a road- bridge on SH25 towards Simpsons/Wharekaho Beach.

# 4 EARTHWORKS

The site is generally flat adjacent to the Tohetea Stream with relatively steep topography beyond the flat areas, generally in the northern and western edges of the development.

Earthworks procedures will include the establishment of sediment controls, followed by earthworks and forming of the finished ground levels. Residential development will be elevated to provide platforms with freeboard above potential flood elevations in the site. Excavation will be undertaken

in areas of higher elevation to provide material for filling in lower areas, and to achieve compliant road gradients to development areas.

Earthworks will include the placement of engineered fill excavated from within the site and imported material sourced externally.

Earthworks design will be refined with detailed deign to optimise cut and fill volumes. Earthworks volumes are expected as follows, as upper limits:

- Area of earthworks 33.6 Ha
- Anticipated volume of cut 267,850m³
- Anticipated volume of fill 430,040m³ (assuming 20% compaction)
- Earthworks Balance 162,190m³ of fill required

The proposed construction will be required to comply with NZS6803 Acoustics – Construction Noise.

Consents for earthworks will be obtained from Thames Coromandel District Council and Waikato Regional Council.

## 5 ROADING AND ACCESS

One access into the development off Kuaotunu Wharekaho Road (SH25) is proposed.

For the preliminary traffic assessment, refer to the report prepared by Traffic Planning Consultants. Internal roading will be designed to meet Council standards with maximum longitudinal grades no steeper than 12.5% (1V:8H) and no flatter than 0.5% as per Austroads Guide to Road Design Part 3: Geometric Design (section 8.5.3 and 8.5.6).

Private access roads and right of ways will also be designed to meet Council standards with maximum longitudinal grades no steeper than 20% (1V:5H).

Due to the nature of the site and the shape of the lots it is anticipated that retaining structures in the order of 3 – 4m height will be required at specific locations to form roading at maximum grades in either cut of fill scenarios and in some cases both sides of proposed roading.

## 6 STORMWATER

The Tohetea Stream traverses the proposed development and flows from west to east towards Simpsons/Wharekaho Beach.

A Primary stormwater network will be provided to convey stormwater discharge into the Tohetea Stream after proper treatment and detention. Treatment is expected to be required by both District

Council standards and Regional Council standards. Detailed design will be provided at further design stage.

The site is within an existing floodplain. Inline ponds are proposed to provide up to 100-year ARI event attenuation. Smaller wetlands, raingardens or swales will be provided for water quality treatment and extended detention to protect the existing stream, in accordance with development standards.

The Primary stormwater network and overland flow paths for Secondary flow will be provided in accordance with Thames Coromandel District Council and Regional Infrastructure Technical Specification (RITS). Adequate freeboards will be provided for the proposed dwellings to the 100-year flood plain.

In summary, the proposed development, with proposed water quality treatment and extended detention and inline ponds, will provide adequate stormwater quality and quantity management for the proposed development, to ensure potential flooding and flow-rate effects of development are mitigated or reduced. *Appendix A - Wharekaho Flood Management Report* provides further details.

## 7 WASTEWATER

An existing gravity sewer network is located to the southwest of the development within the recent Wharekaho residential development. A pump station has also been installed within the recent Wharekaho residential development near the common boundary to this proposed development. A 100mmØ rising main pumps from the new pump station southwest towards an existing gravity manhole in Harbour Lights Terrace. Flows then gravitate to the Brophy's pump station in Tom Truly Park.

The existing pump station in the recent Wharekaho development is identified as the most feasible connection point for this proposed development, with pump, storage and rising main capacities able to be increased to cater for greater catchment areas and flows.. Other reticulation options, such as use of Low-Pressure Sewer systems are also considered feasible and may be designed in conjunction with Thames Coromandel District Council to optimise reticulation of the currently un-sewered Simpsons Beach catchment.

All work will be carried out to TCDC subdivision standards under Engineering approval.

## 8 WATER SUPPLY

An existing water supply network is located within the new Wharekaho residential development, fed from reservoirs west of the proposed development. The reservoirs in Centennial Drive are located at approximate ground level of RL70m. The reservoirs further north in Rimu Street are located at approximate ground level of RL140m.

It appears unlikely that the existing reticulation has sufficient capacity to meet peak demands from the subdivision. An additional reservoir may be required in the proposed development to provide adequate supply, or other works undertaken within the existing network.

A supply network for the proposed development will be installed to feed all proposed lots as well as to provide firefighting supply.

All work will be carried out to TCDC subdivision standards under Engineering approval.

## 9 UTILITIES AND LIGHTING

Private power and telecommunications will be supplied to service all new residential lots in this development. These services will be designed by the relevant utility companies and specialist designers.

Power supply and fibre will be reticulated underground.

Street lighting will be designed and constructed to meet relevant District Council development standards.

## 10 SUMMARY

From preliminary investigation, the proposed Simpsons Beach subdivision can be adequately serviced in accordance with the requirements of the Thames - Coromandel District Council and Waikato Regional Council Standards. The development will be serviced from existing and proposed infrastructure, with connections to services readily available from the adjacent residential developments.

Capacity in the infrastructure including roading, wastewater and water networks are to be further assessed during the detailed design stage.

Building site ground levels will be created in consideration of recommendations for freeboard against conservative assessments of potential long-term sea-level rise and associated risks of storm surge, river floods and tsunamis.

Earthworks operations can be controlled for sediment loss and dust control through construction of standard sediment control devices and the use of water carts.

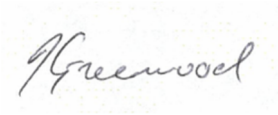
Regional Council Resource consents for earthworks will be obtained.

Stormwater disposal will be via gravity network into the existing Tohetea stream after treatment and detention. Stormwater management and discharge will be subject to Regional Council consents and conditions.

Wastewater disposal will be connected to the existing wastewater network, with necessary upgrades to meet capacity demands from the proposed development able to be completed.

Water supply will be connected to the existing water network. Works to increase reticulation capacity will be undertaken as necessary as development progresses.

It is considered that all infrastructure works, and operations of the development will comply with Council requirements and can be controlled through the issue of Resource Consent Subdivision Conditions and Engineering Works Approvals or building consents.



Report prepared by
**AIREY CONSULTANTS LTD**

On behalf of
**HOPPER DEVELOPMENT LTD**

# Appendix A

**- Flood Management Report**

# FLOOD MANAGEMENT REPORT
# TO SUPPORT THE CONCEPT DESIGN
# FOR THE PROPOSED DEVELOPMENT
# FOR HOPPER DEVELOPMENTS LTD
# AT 25 AND 39 WHAREKAHO ROAD, WHAREKAHO

**Job No:** 85260-004

**Issue Date:** 09 January 2023

**Airey Consultants Ltd | Takapuna Office**
PO Box 33-103, Takapuna, 0740 | Level 8, 19-21 Como Street, Takapuna
T: +64 9 486 4542 E: takapuna@aireys.co.nz

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**Appendix A Catchment Plan and Wetland Pond Location** a

**Appendix B Catchment Plan and Inline Pond Location** b



**Airey Consultants Ltd | Takapuna Office**
PO Box 33-103, Takapuna, 0740 | Level 8, 19-21 Como Street, Takapuna
T: +64 9 486 4542 E: takapuna@aireys.co.nz

# 1 Introduction and Existing Stormwater System

This flood management summary report is prepared to inform on engineering aspects of a residential subdivision at 25 and 39 Kuaotunu Wharekaho Road. The subject site is rectangular in shape and located at the north-western side of Kuaotunu Wharekaho Road. The existing Tohetea Stream traverses the site and SH25 culvert and then discharges to Wharekaho Beach. The entire catchment for Tohetea Stream is about 413 Ha. The site is located at the lower catchment of the Tohetea Stream. There is no existing stormwater infrastructure on site apart from culverts under SH25.

There is an existing development south of the site. Stormwater runoff from the adjacent properties is collected and treated by an existing wetland and then discharged to Tohetea Stream near the SH25 culvert. Treatment, flood control and flow attenuation are provided by the treatment pond built by the developer and the existing wetland.

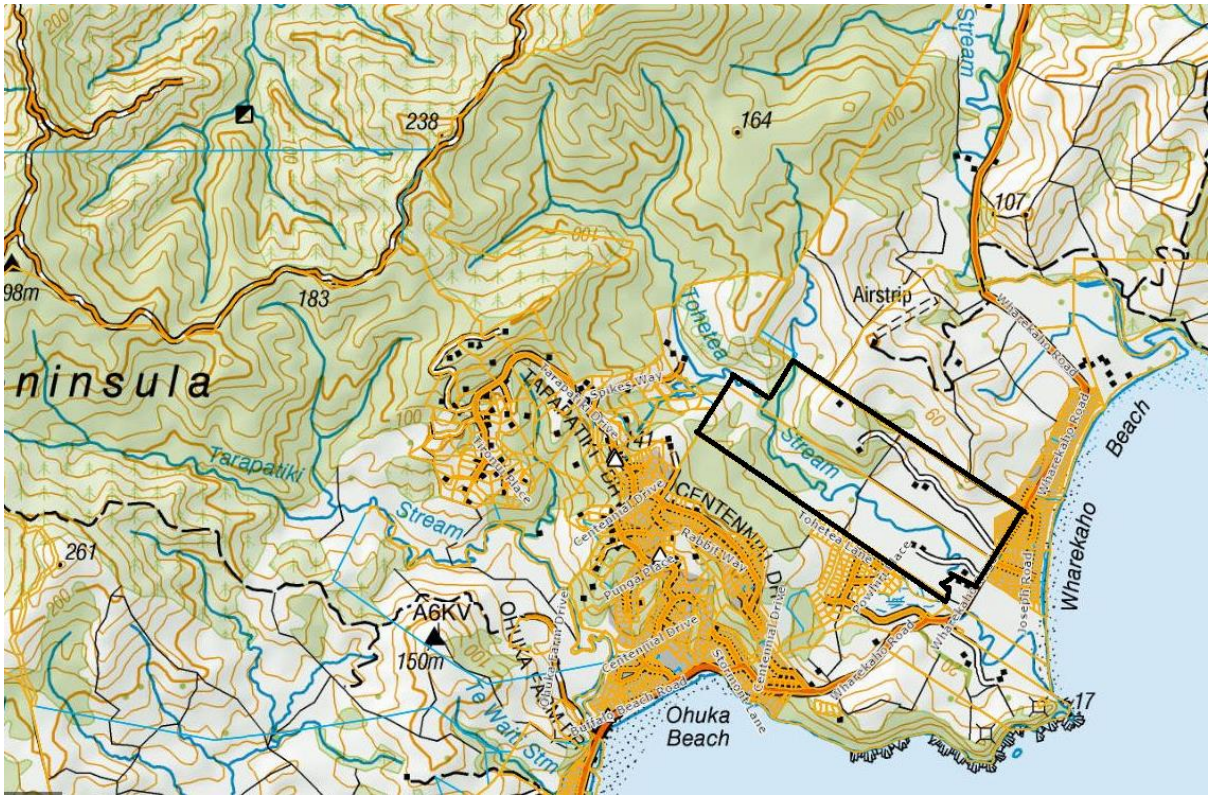



***Figure 1 Site Location and Existing Condition***

Cato Bolam has been engaged by Hopper Developments in 2022 to carry out an existing flood assessment for this site to evaluate the potential of residential development. Existing flood extent has

been identified as per Figure 2. A portion of the site is within the 100-year flood plain, especially the south-eastern portion. The existing culvert under SH25 is under capacity during a 100-year storm event, and the lower lying portion of SH25 is flooded during extreme storm events.

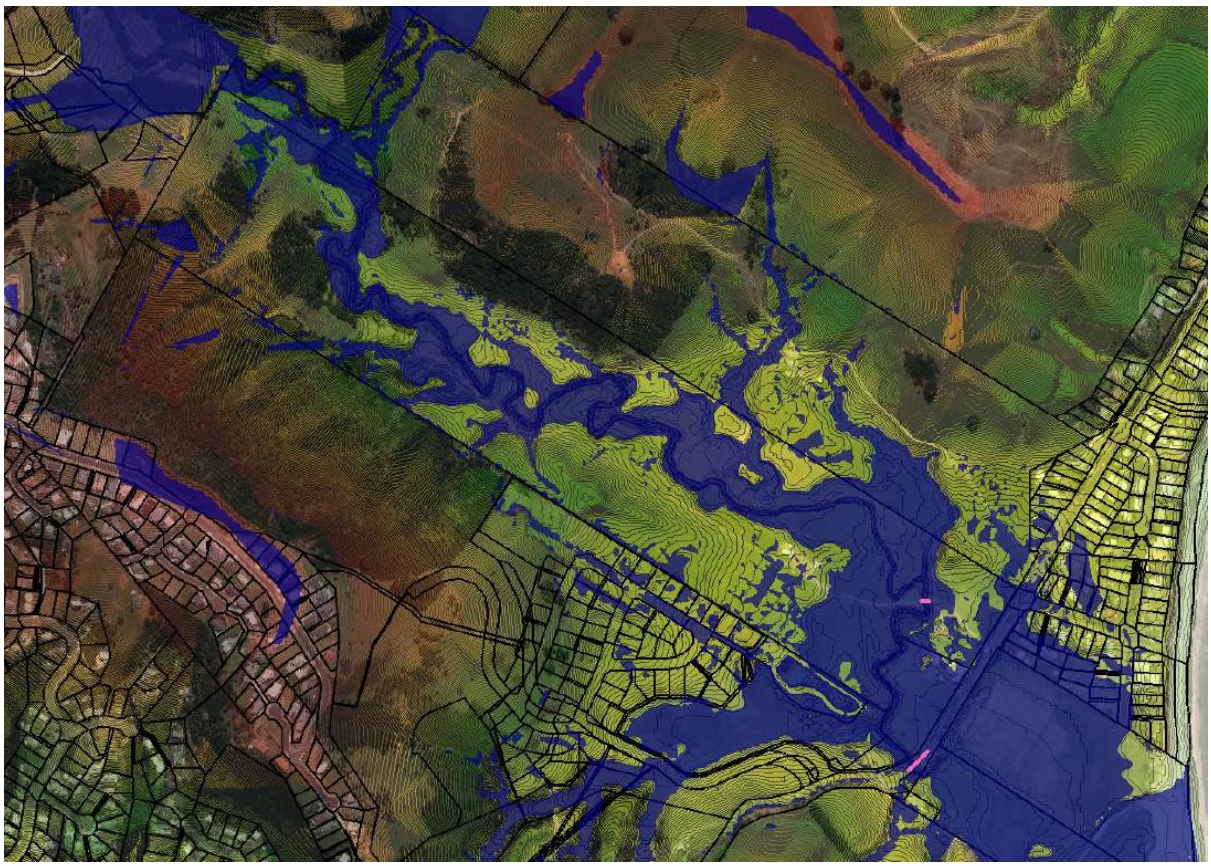


***Figure 2: Existing Flood Extent based on Cato Bolam State Highway 25, Simpsons Beach, Whitianga Flood Assessment Report***

## 2 Relevant Guidelines, Specifications and Code

The Waikato Regional Infrastructure Technical Specification (RITS) replaces the Hamilton Infrastructure Technical Specifications and after 1 November 2018, the RITS will be the default requirement for resource consents.

The Waikato Regional Infrastructure Technical Specification (RITS) Section 4 Stormwater provides a summary of the design parameters to address specific stormwater criteria and guidance on when these are required. See table 1 below replicated from RITS

Table 1 Design Parameters

| CRITERIA | DESIGN PARAMETER | WHEN REQUIRED | Note for this site |
|---|---|---|---|
| **Design calculations** | Rational method up to 8ha. For catchments greater than 8ha, appropriate hydrological methods shall be confirmed with Council, who will look to the appropriate standards and guidelines | Always. | Catchment larger than 8Ha. HEC-HMS model is used. |
| **Runoff coefficients** | Pre-development runoff coefficients shall be based on the existing land use. Post-development runoff coefficients shall be based on the zoning. Refer Table 4-8 in RITS: Runoff Coefficients. | Always. | Coefficients in Waikato stormwater runoff modelling guideline used. |
| **Design Rainfall** | Refer to Design Rainfall (RITS section 4.2.4.3 and 4.2.4.4). | **Current rainfall** shall be used for the following: determining pre-development stormwater runoff flows and volumes for use in combination with calculated post development flows to determine SW treatment (quantity and quality) requirements<br>**Climate change** adjusted rainfall shall be used for the following: Determining post-development stormwater runoff flows and volumes for SW infrastructure design. | Applicable to this site. Current rainfall is used for existing model and Climate change adjusted rainfall is used for post development model |

| | | | |
|---|---|---|---|
| **Time of concentration** | Calculated, with a minimum of 10 minutes. Refer to relevant (or HCC) SW Modelling Methodology. | Always. | Applicable to this site |
| **Flood Control (100 year ARI event)** | Detention required, limiting the post development 100 year ARI event flow rates to 80% of the pre-development 100 year ARI event flow rates. | Where identified downstream flooding (or risk of) exists. | **Assessed in Section 3** |
| **Flow attenuation (Attenuation of the 2 year and 10 year ARI events)** | Match pre-development flow rates for the 2 and 10 year ARI events through controlled attenuation and multi stage outlets or devices that reduce the runoff flow. | Catchment location dependent. Always required in the upper half of the catchment. If the development is located close to the catchment outlet and discharging to a watercourse with sufficient capacity, then flow mitigation may not be required. This may also apply if the site is in the lower half of the catchment, and attenuation might worsen flooding due to relative timing of peaks from the upper catchment. | **Assessed in Section 3** |
| **Volume** | Match pre-development volume runoff through reduced runoff practices and sub catchment management If this cannot be achieved, mitigation within the receiving environment will be required, such as channel stabilisation. | When discharge is into a natural stream or modified channel. (Refer RITS Table 4-5) | Channel stabilisation will be provided |
| **Water quality treatment** | Refer to the stormwater management disposal hierarchy (section 4.2.3.1) and treatment devices hierarchy (section | Always. | Water quality treatment will be provided |

| | | | |
|---|---|---|---|
| | 4.2.16) for disposal and treatment preferences. Water quality requirements | | |
| **Water quality storm** | 1/3 of 2 year 24-hour ARI rainfall depth with climate change used to calculate water quality volume (WQV) | Always. If extended detention is required to protect natural receiving environments (refer below), half of the calculated WQV can be included within the EDV. Hence the water quality volume provided as permanent water volume can be reduced by 50%. | Applicable. Water quality storm will be provided in the proposed wetland. |
| **Extended Detention Volume (EDV)** | Extended Detention Volume (EDV) is assessed using the Water quality storm as above. | When discharge is into a natural stream or modified channel (refer to Table 4-5 Receiving Environment Categories for further definition). | Applicable. EDV will be provided in the pond and outlet is sized to release the EDV over a 24-hour period. |
| **Primary and Secondary System Level of Service** | As per Level of Service for the zone – Table 4-7. For secondary flow path design requirements for infill residential development refer to Table 4-7 Secondary overflow as per Level of Service Clause 4.1.3. | Always. | Applicable. Primary network and Secondary flow path will be provided. |
| **Minimum Floor Levels** | Freeboard requirements: 100 year ARI event plus minimum freeboard heights as per NZS 4404 Clause 4.3.5.2, as follows: "The minimum freeboard height additional to the computed top water flood level of the 1% AEP design storm should be as follows or as specified in the district or regional plan: Freeboard • Habitable dwellings (including attached garages) = | Always. | Applicable. 0.5m minimum freeboard will be provided from 100-year flood level to habitable dwellings. |

| | | | |
|---|---|---|---|
| | 0.5m min height; • Commercial and industrial buildings = 0.3m min height; • Non-habitable residential buildings and detached garages = 0.2m min height. The minimum freeboard shall be measured from the top water level to the building platform level or the underside of the floor joints or underside of the floor slab, whichever is applicable.” | | |

# 3 Stormwater Management Design and Considerations-Offline Pond Option

As summarized in Section 2 Table 1, water quality volume and Extended Detention Volume will be provided in the proposed wetland pond.

As the proposed site is located within an existing flood plain and upstream of the SH25 culverts, where identified flooding exists, 100-year flood control is proposed for the development. As per the table above, the design target is to control the post development 100-year ARI event flow rate to be no more than 80% of the pre-development 100-year ARI event flow rate.

HEC-HMS models have been built to size the wetland pond for Concept design to assess the feasibility of the proposed development. Wetland pond details will be further adjusted based on detailed design at later design stage. Please Refer to Appendix 1 for indicative pond location and catchment plan.

In order to assess the effect of the proposed development and feasibility of flood control and flow attenuation, four HEC-HMS models were built initially:

**Model 1: Pre-Development subject site**: The total catchment area is 68 Ha. 10% impervious and 90% pervious. 100-year 24 hour rainfall depth without climate change is used (310mm). Compared to a simple rainfall-surface runoff process, the distance from final discharge point (SH25 culvert) to different part of the catchment varies. Runoff generated by rainfall will first discharge to Tohetea Stream and then travel along the stream to SH25 culvert. The travel time depends on the distance from the point runoff reaches Tohetea Stream up to the final discharge point at SH25 culvert. To better compare predevelopment and post development scenarios, predevelopment catchment has been divided into 5 subcatchments similar to the post development model. Time of concentration is 10 minutes for each of the sub catchment. Lag time is also added to subbasins based on distance to final discharging point to represent the real travel time in the stream. This is to better model real rainfall-surface runoff-Tohetea Stream flow-SH25 culvert flooding issue process. Subbasin 4 and subbasin 5 are very close to the SH25 culvert and no travel time added.

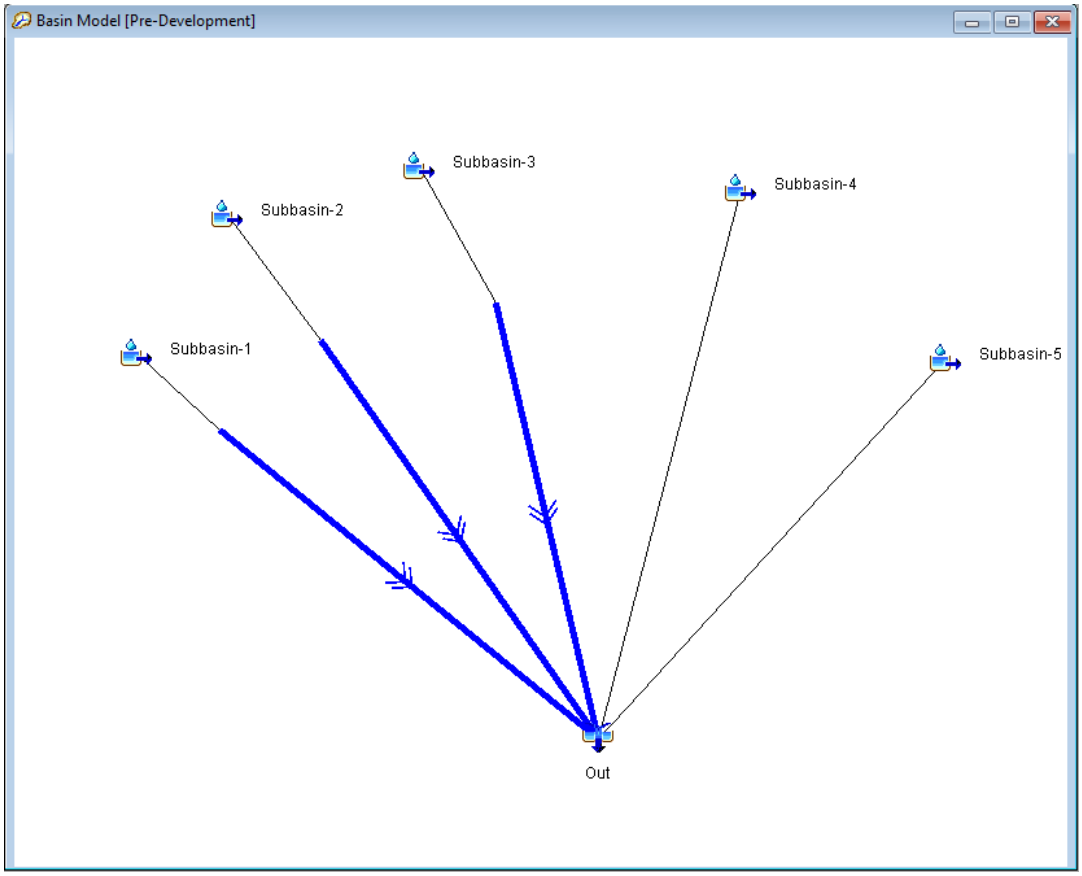



***Figure 2 Model 1 Catchment***

Global Summary Results for Run "100 year Pre Dev"

Project: 100 Year Flood Control Only  Simulation Run: 100 year Pre Dev

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Pre-Development
Meteorologic Model: 100-year event
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: MM 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Subbasin-1 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-5 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-4 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-2 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-3 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Reach-3 | 0.136 | 6.1511 | 01Jan2002, 12:20 | 240.110 |
| Reach-2 | 0.136 | 6.1511 | 01Jan2002, 12:29 | 239.369 |
| Reach-1 | 0.136 | 6.1511 | 01Jan2002, 12:37 | 238.710 |
| Out | 0.680 | 20.7777 | 01Jan2002, 12:15 | 239.946 |

***Figure 3 Model 1 Result***

**Model 2: Post-Development subject site:** The total catchment area is 68Ha. Time of concentration is 10 minutes. 70% impervious for proposed road reserve, 40% impervious for proposed residential lots. 100-year 24-hour rainfall depth with climate change RCP 6.0 Scenario is used (328mm). Same travel time in the stream as pre-development model have been added to each subcatchment at discharge point of proposed pond.

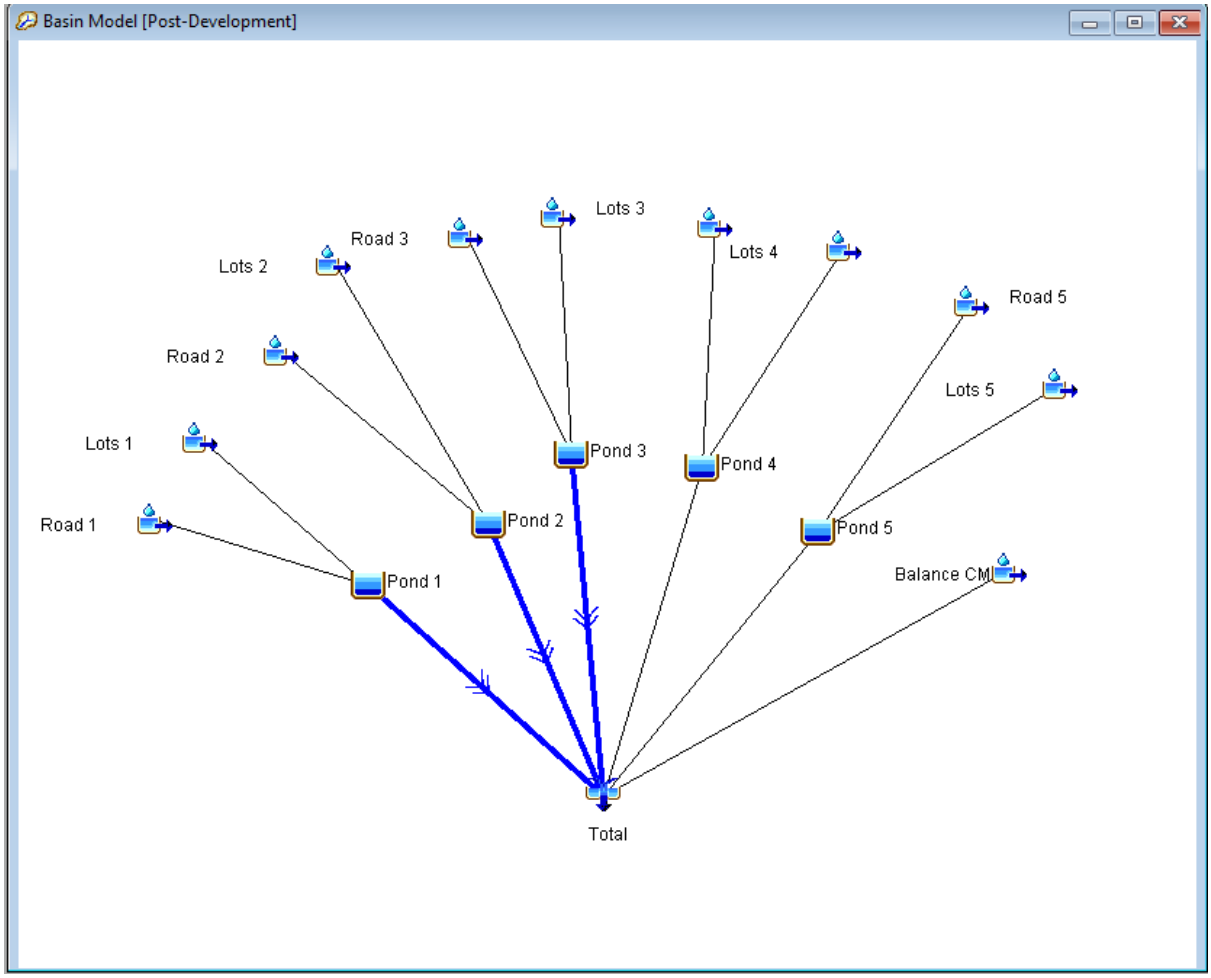
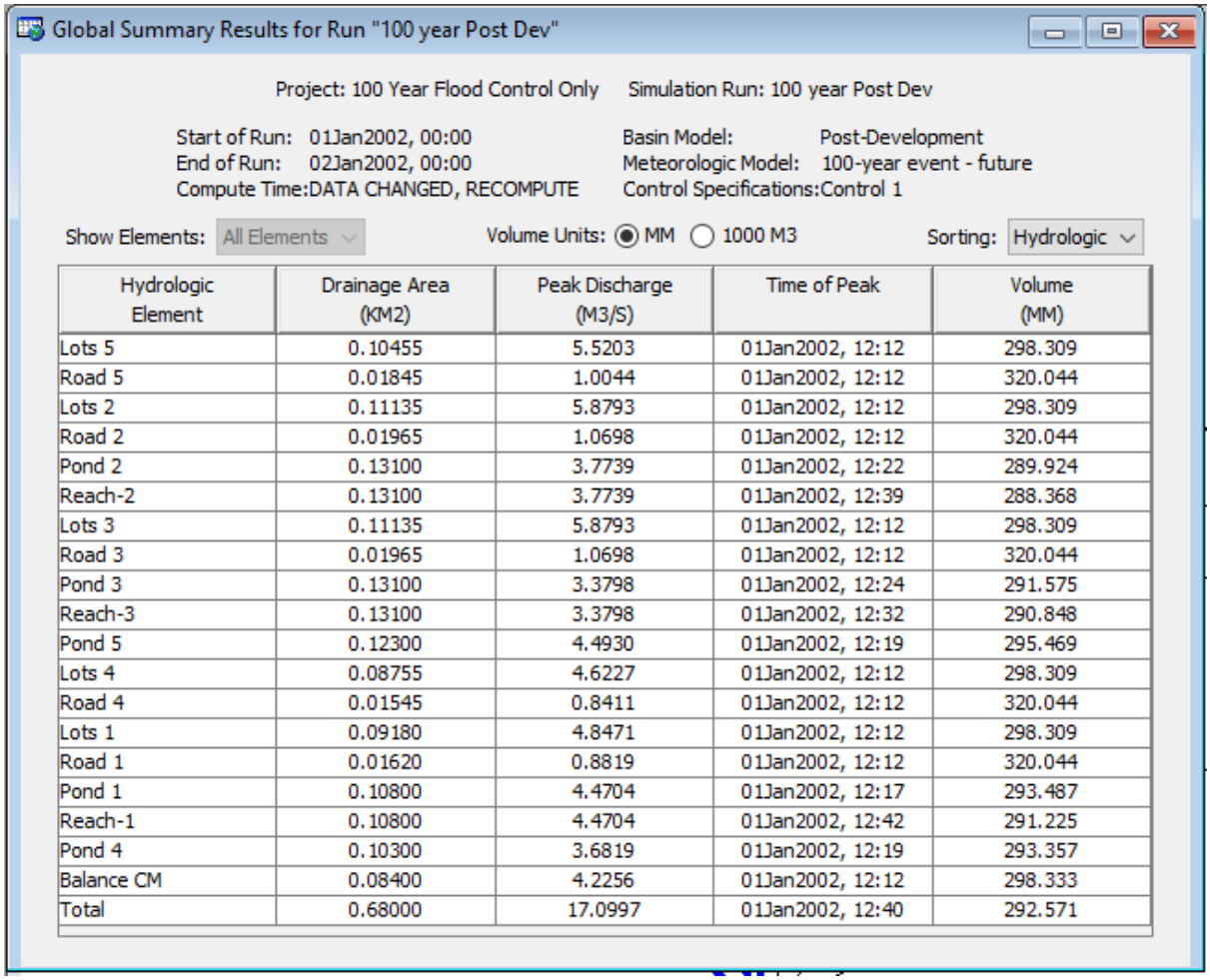



***Figure 4 Model 2 Catchment***



Global Summary Results for Run "100 year Post Dev"

Project: 100 Year Flood Control Only  Simulation Run: 100 year Post Dev

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Post-Development
Meteorologic Model: 100-year event - future
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: MM 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Lots 5 | 0.10455 | 5.5203 | 01Jan2002, 12:12 | 298.309 |
| Road 5 | 0.01845 | 1.0044 | 01Jan2002, 12:12 | 320.044 |
| Lots 2 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 2 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Pond 2 | 0.13100 | 3.7739 | 01Jan2002, 12:22 | 289.924 |
| Reach-2 | 0.13100 | 3.7739 | 01Jan2002, 12:39 | 288.368 |
| Lots 3 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 3 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Pond 3 | 0.13100 | 3.3798 | 01Jan2002, 12:24 | 291.575 |
| Reach-3 | 0.13100 | 3.3798 | 01Jan2002, 12:32 | 290.848 |
| Pond 5 | 0.12300 | 4.4930 | 01Jan2002, 12:19 | 295.469 |
| Lots 4 | 0.08755 | 4.6227 | 01Jan2002, 12:12 | 298.309 |
| Road 4 | 0.01545 | 0.8411 | 01Jan2002, 12:12 | 320.044 |
| Lots 1 | 0.09180 | 4.8471 | 01Jan2002, 12:12 | 298.309 |
| Road 1 | 0.01620 | 0.8819 | 01Jan2002, 12:12 | 320.044 |
| Pond 1 | 0.10800 | 4.4704 | 01Jan2002, 12:17 | 293.487 |
| Reach-1 | 0.10800 | 4.4704 | 01Jan2002, 12:42 | 291.225 |
| Pond 4 | 0.10300 | 3.6819 | 01Jan2002, 12:19 | 293.357 |
| Balance CM | 0.08400 | 4.2256 | 01Jan2002, 12:12 | 298.333 |
| Total | 0.68000 | 17.0997 | 01Jan2002, 12:40 | 292.571 |

***Figure 5 Model 2 Result***

**Model 3: Pre-Development entire catchment** (includes entire catchment for Tohetea Stream): The total catchment area is 413 Ha. 10% impervious area near the lower catchment and 90% pervious for the rest of the catchment. Time of concentration is 71 minutes for pervious area up in the forest and 10 minutes for the subcatchments located at lower catchment. 100-year 24 hour rainfall depth without climate change is used (310mm). Travel time similar to Model 1 has been added to each subcatchment.

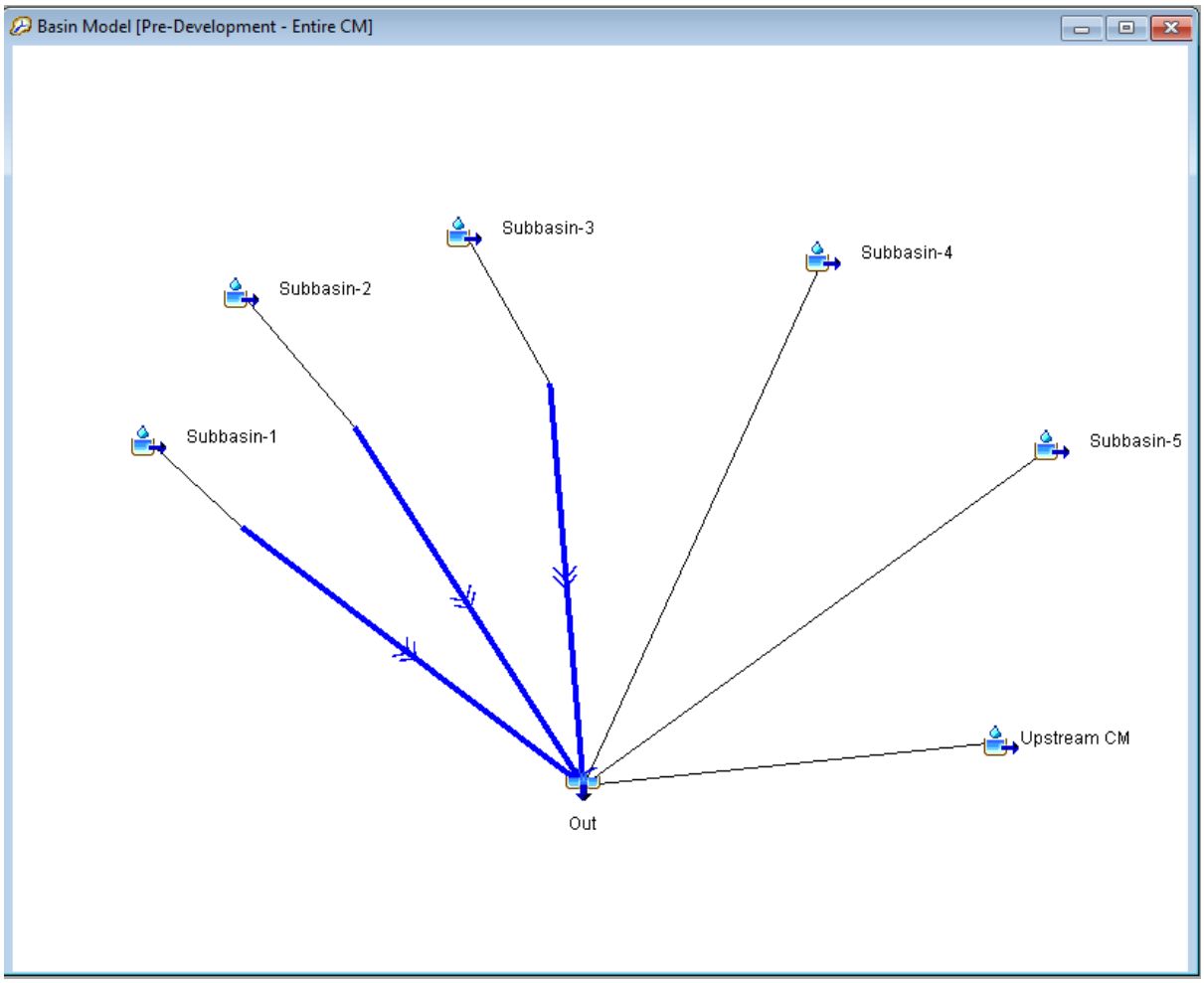



***Figure 6 Model 3 Catchment***

Global Summary Results for Run "100 YearPre Entire CM"

Project: 100 Year Flood Control Only  Simulation Run: 100 YearPre Entire CM

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Pre-Development - Entire CM
Meteorologic Model: 100-year event
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: MM 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Subbasin-1 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Upstream CM | 3.450 | 70.6007 | 01Jan2002, 12:54 | 244.705 |
| Subbasin-2 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-3 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-5 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Subbasin-4 | 0.136 | 6.1511 | 01Jan2002, 12:12 | 240.770 |
| Reach-3 | 0.136 | 6.1511 | 01Jan2002, 12:20 | 240.110 |
| Reach-2 | 0.136 | 6.1511 | 01Jan2002, 12:29 | 239.369 |
| Reach-1 | 0.136 | 6.1511 | 01Jan2002, 12:37 | 238.710 |
| Out | 4.130 | 79.1472 | 01Jan2002, 12:49 | 243.921 |

***Figure 7 Model 3 Result***

**Model 4: Post-Development entire catchment** (includes entire catchment for Tohetea Stream): The total catchment area is 413 Ha. 70% impervious for proposed road reserve, 40% impervious for proposed residential lots and upper catchment in the forest remains 100% pervious as existing models. Time of concentration for sub catchments within the proposed development is 10 minutes and remains 71 minutes for the upper catchment in the forest. 100-year 24 hour rainfall depth with climate change RCP 6.0 Scenario is used (328mm). Same travel time in the stream as pre-development models have been added to each subcatchment at discharge point of proposed pond.

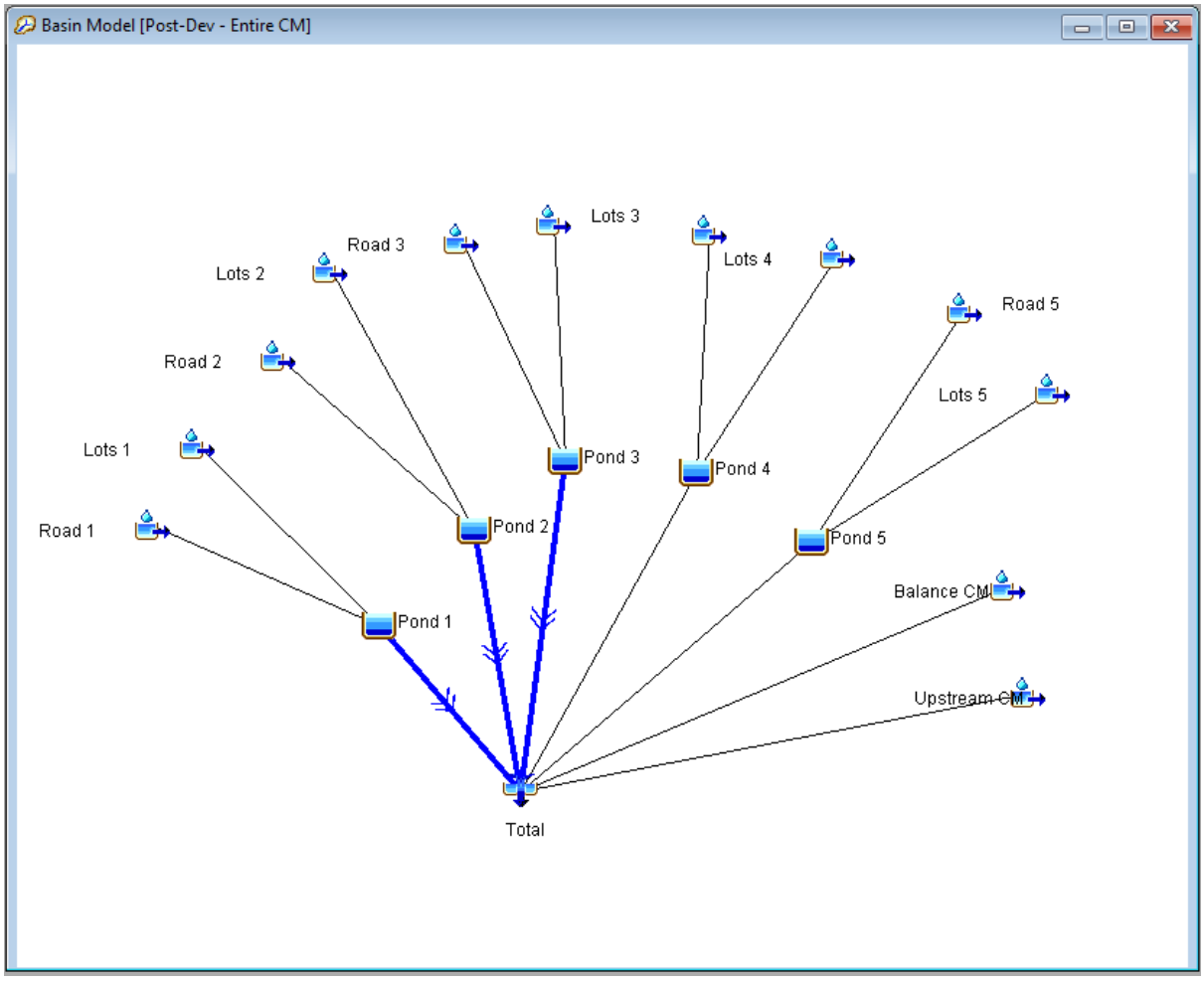



***Figure 8 Model 4 Catchment***

Global Summary Results for Run "100 Year Post Dev Entire CM"

Project: 100 Year Flood Control Only  Simulation Run: 100 Year Post Dev Entire CM

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Post-Dev - Entire CM
Meteorologic Model: 100-year event - future
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: (•) MM ( ) 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Upstream CM | 3.45000 | 75.2553 | 01Jan2002, 12:54 | 261.723 |
| Lots 5 | 0.10455 | 5.5203 | 01Jan2002, 12:12 | 298.309 |
| Road 5 | 0.01845 | 1.0044 | 01Jan2002, 12:12 | 320.044 |
| Lots 3 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 3 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Pond 3 | 0.13100 | 3.3798 | 01Jan2002, 12:24 | 291.575 |
| Reach-3 | 0.13100 | 3.3798 | 01Jan2002, 12:32 | 290.848 |
| Lots 2 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 2 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Pond 2 | 0.13100 | 3.7739 | 01Jan2002, 12:22 | 289.924 |
| Reach-2 | 0.13100 | 3.7739 | 01Jan2002, 12:39 | 288.368 |
| Pond 5 | 0.12300 | 4.4930 | 01Jan2002, 12:19 | 295.469 |
| Lots 4 | 0.08755 | 4.6227 | 01Jan2002, 12:12 | 298.309 |
| Road 4 | 0.01545 | 0.8411 | 01Jan2002, 12:12 | 320.044 |
| Lots 1 | 0.09180 | 4.8471 | 01Jan2002, 12:12 | 298.309 |
| Road 1 | 0.01620 | 0.8819 | 01Jan2002, 12:12 | 320.044 |
| Pond 1 | 0.10800 | 4.4704 | 01Jan2002, 12:17 | 293.487 |
| Reach-1 | 0.10800 | 4.4704 | 01Jan2002, 12:42 | 291.225 |
| Pond 4 | 0.10300 | 3.6819 | 01Jan2002, 12:19 | 293.357 |
| Balance CM | 0.08400 | 4.2256 | 01Jan2002, 12:12 | 298.333 |
| Total | 4.13000 | 89.0721 | 01Jan2002, 12:48 | 266.802 |

***Figure 9 Model 4 Result***

Model 1 and Model 2 results show the proposed development with wetland detention pond provides 100-year flood control as per The Waikato Regional Infrastructure Technical Specification (RITS) Section 4. The post development 100-year ARI event flow rates is no more than 80% of the pre-development 100 year ARI event flow rate (20.8 m3/s for predevelopment and 17.1m3/s for post development).

However, when assessing the effect on the entire Tohetea Stream catchment (about 413 Ha), Model 3 and Model 4 results show the proposed detention pond is increasing the total peak runoff (79.2 m3/s for pre-development and 89.1 m3/s for post development with detention pond). The detention pond is slowly releasing runoff from the subject site and deferring the peak discharge by holding runoff with controlled outlets. When assessing the subject site alone, the ponds can control flooding from the site and reduce peak runoff. When assessing the entire catchment, the ponds are located at lower

catchment and close to discharge point (SH25 culverts). The upper catchment has a longer time of concentration, when the ponds defer the peak discharge at lower catchment, the lower catchment peak runoff overlaps more with the upper catchment peak discharge. This results in a larger combined runoff at the time of peak.

Even though the proposed wetland ponds are providing flood control for the subject site, it is not positively improving the existing flood issue downstream. The Waikato Regional Infrastructure Technical Specification (RITS) Section 4 Stormwater also states: "If the development is located close to the catchment outlet and discharging to a watercourse with sufficient capacity, then flow mitigation may not be required. This may also apply if the site is in the lower half of the catchment, and attenuation might worsen flooding due to relative timing of peaks from the upper catchment".

Therefore, offline detention ponds are not recommended for the proposed development due to the fact that the subject site is located at lower part of the site.

To further assess the effect of the proposed development on the existing downstream flooding, Model 5 has been built.

**Model 5: Post-Development entire catchment** (includes entire catchment for Tohetea Stream) without pond: total catchment area is 413 Ha. No detention pond is proposed. 70% impervious for proposed road reserve, 40% impervious for proposed residential lots and upper catchment in the forest remains 100% pervious as existing model. Time of concentration for sub catchments within the proposed development is 10 minutes and remains 71 minutes for the upper catchment in the forest. 100-year 24-hour rainfall depth with climate change RCP 6.0 Scenario is used (328mm)

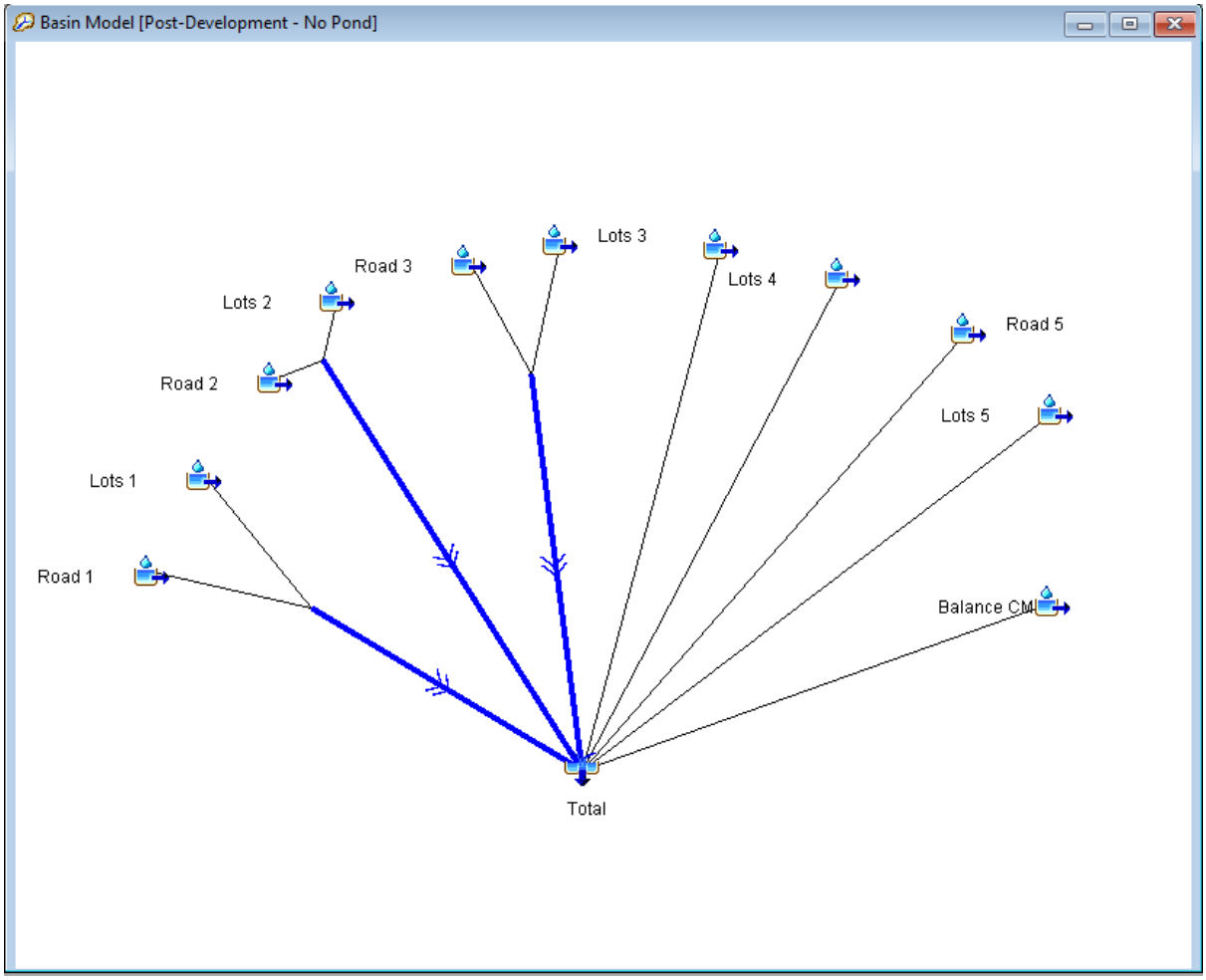
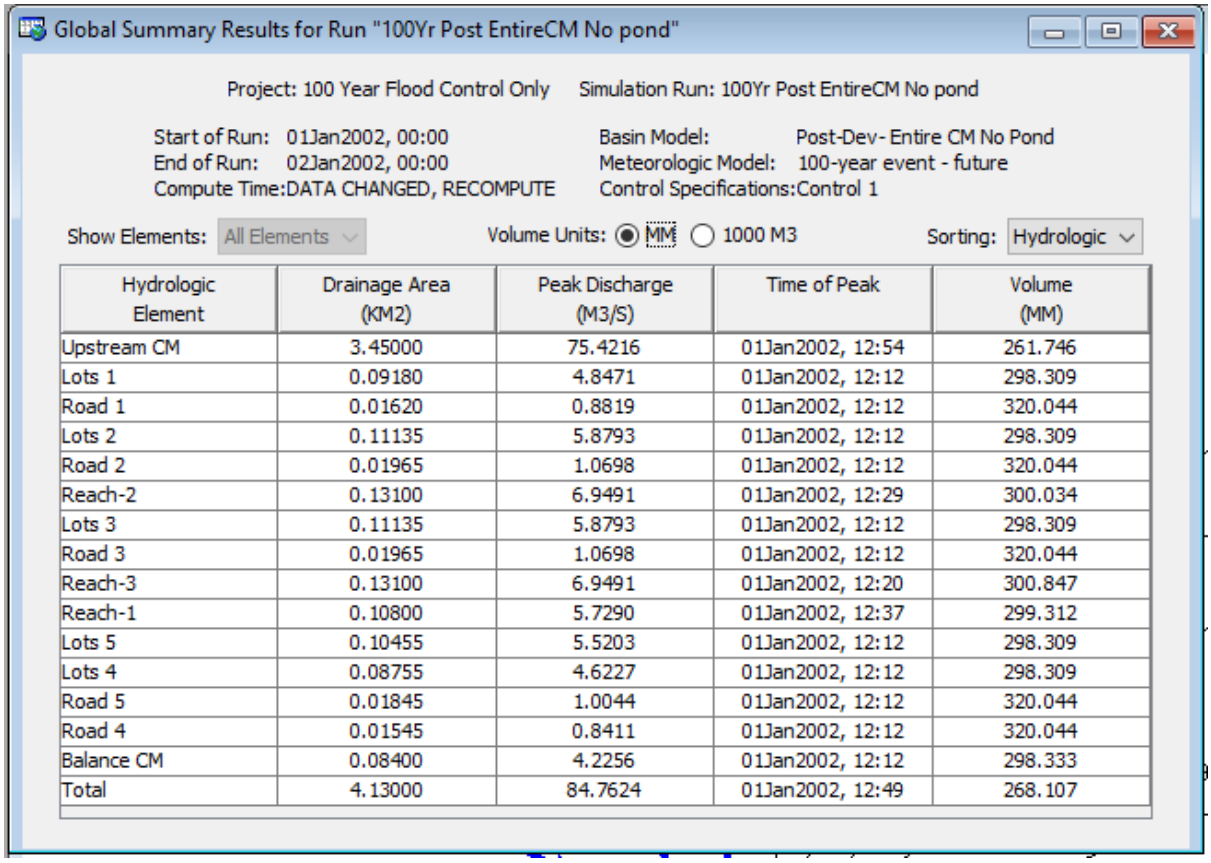



***Figure 10 Model 5 Catchment***



Global Summary Results for Run "100Yr Post EntireCM No pond"

Project: 100 Year Flood Control Only  Simulation Run: 100Yr Post EntireCM No pond

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Post-Dev- Entire CM No Pond
Meteorologic Model: 100-year event - future
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: MM 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Upstream CM | 3.45000 | 75.4216 | 01Jan2002, 12:54 | 261.746 |
| Lots 1 | 0.09180 | 4.8471 | 01Jan2002, 12:12 | 298.309 |
| Road 1 | 0.01620 | 0.8819 | 01Jan2002, 12:12 | 320.044 |
| Lots 2 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 2 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Reach-2 | 0.13100 | 6.9491 | 01Jan2002, 12:29 | 300.034 |
| Lots 3 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 3 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Reach-3 | 0.13100 | 6.9491 | 01Jan2002, 12:20 | 300.847 |
| Reach-1 | 0.10800 | 5.7290 | 01Jan2002, 12:37 | 299.312 |
| Lots 5 | 0.10455 | 5.5203 | 01Jan2002, 12:12 | 298.309 |
| Lots 4 | 0.08755 | 4.6227 | 01Jan2002, 12:12 | 298.309 |
| Road 5 | 0.01845 | 1.0044 | 01Jan2002, 12:12 | 320.044 |
| Road 4 | 0.01545 | 0.8411 | 01Jan2002, 12:12 | 320.044 |
| Balance CM | 0.08400 | 4.2256 | 01Jan2002, 12:12 | 298.333 |
| Total | 4.13000 | 84.7624 | 01Jan2002, 12:49 | 268.107 |

***Figure 11 Model 5 Result***

Figure 12 shows the post development without pond has a smaller peak runoff compared with the same catchment with proposed detention ponds (89.1 m3/s with detention ponds and 84.8 m3/s without detention ponds).

Note that the proposed development without detention pond is still having a larger 100-year ARI runoff compared with predevelopment. This could be caused by the increased rainfall depth for future scenario.

To further assess the effect alone, model 6 is built.

**Model 6: Post-Development entire catchment without climate change** (includes entire catchment for Tohetea Stream). Model 6 has same catchment as model 5 but is run with existing 310mm. With existing rainfall depth, model 6 shows very similar peak runoff compared with predevelopment in Model 3 (79.4 m3/s for post development and 79.2 m3/s for pre development scenario). This suggests,

without considering the effect of climate change, the proposed development without detention pond does not have significant effect on existing flood issue. In terms of managing the SH25 flooding issues downstream, the offline detention ponds should be excluded from the proposed development.

Global Summary Results for Run "100YrPostDevEntireNoPondNoCC"

Project: 100 Year Flood Control Only  Simulation Run: 100YrPostDevEntireNoPondNoCC

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time:DATA CHANGED, RECOMPUTE

Basin Model: Post-Dev- Entire CM No Pond
Meteorologic Model: 100-year event
Control Specifications:Control 1

Show Elements: All Elements  Volume Units: (•) MM ( ) 1000 M3  Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Upstream CM | 3.45000 | 70.6007 | 01Jan2002, 12:54 | 244.705 |
| Lots 1 | 0.09180 | 4.5656 | 01Jan2002, 12:12 | 280.556 |
| Road 1 | 0.01620 | 0.8330 | 01Jan2002, 12:12 | 302.118 |
| Lots 2 | 0.11135 | 5.5379 | 01Jan2002, 12:12 | 280.556 |
| Road 2 | 0.01965 | 1.0104 | 01Jan2002, 12:12 | 302.118 |
| Reach-2 | 0.13100 | 6.5483 | 01Jan2002, 12:29 | 282.341 |
| Lots 3 | 0.11135 | 5.5379 | 01Jan2002, 12:12 | 280.556 |
| Road 3 | 0.01965 | 1.0104 | 01Jan2002, 12:12 | 302.118 |
| Reach-3 | 0.13100 | 6.5483 | 01Jan2002, 12:20 | 283.108 |
| Reach-1 | 0.10800 | 5.3986 | 01Jan2002, 12:37 | 281.659 |
| Lots 5 | 0.10455 | 5.1997 | 01Jan2002, 12:12 | 280.556 |
| Lots 4 | 0.08755 | 4.3542 | 01Jan2002, 12:12 | 280.556 |
| Road 5 | 0.01845 | 0.9487 | 01Jan2002, 12:12 | 302.118 |
| Road 4 | 0.01545 | 0.7945 | 01Jan2002, 12:12 | 302.118 |
| Balance CM | 0.08400 | 3.9820 | 01Jan2002, 12:12 | 281.251 |
| Total | 4.13000 | 79.3931 | 01Jan2002, 12:49 | 250.965 |

***Figure 12 Model 6 Result no Climate Change***

In summary, offline detention ponds are not proposed for the development in order for existing downstream flood issues not to be worsened.

Table 1 Offline Model Result Summary

| Model | Catchment | Rainfall | Peak Runoff (m3/s) | Note: |
|---|---|---|---|---|
| **1** | Existing Project Site | Current | 20.8 | |
| **2** | Post Development Subject Site with Ponds | RCP 6.0 Climate change | 17.1 | 80% existing |
| **3** | Existing Entire Catchment | Current | 79.2 | |
| **4** | Post Development Entire Catchment With Ponds | RCP 6.0 Climate change | 89.1 | Larger than Model 3 and Model 5 |
| **5** | Post Development Entire Catchment Without Ponds | RCP 6.0 Climate change | 84.8 | Smaller peak runoff than Model 4 |
| **6** | Post Development Entire Catchment Without Ponds | Current | 79.4 | Similar peak runoff as Model 3 |

# 4 Stormwater Management Design and Considerations-Inline Pond Option.

As the proposed development is located at lower part of the Tohetea Stream catchment, inline ponds will be a much more feasible flood control solution when assessing entire catchment with existing SH25 flood issue.

To avoid earthworks within the stream as much as possible, existing riverbed and bank slopes on two sides of Tohetea Stream will be used as inline pond without much excavation. Gabion weir (Figure 14) or bridge crossing with culvert (Figure 15) will be provided as outlet flow control. A weir outlet and culvert will be placed at bottom of the existing stream and sized and designed to provide adequate flood control, fish passage, and maintain the stream's existing continuity of geomorphic processes. These will be provided at the detailed design stage.

***Figure 13 Gabion Weir Option***

***Figure 14 Culvert with Crossing Option***

To provide better flood management and limit the size of each inline pond, two ponds are proposed. Proposed pond 1 receives runoff from proposed road area 1 and lots area 1. Proposed pond 2 is located downstream of proposed pond 1. Pond 2 receives runoff from proposed road area 2, lots area 2 and attenuated runoff and overflow runoff from pond 1. Runoff from the rest of the site will discharge directly into the stream (after water quality treatment and extended detention). No flood control is proposed for the rest of the catchment. The theory is to let peak runoff from the rest of catchment pass before the attenuated peak runoff from upper catchment arrives, so that combined peak runoff arriving at SH25 culvert will be controlled and existing flood issues will be improved. HEC-RAS model is built to confirm this theory.

Inline pond HEC-HMS model (Model 7) is built. The model catchment plan is shown in Figure 16. Please Refer to Appendix 2 for indicative pond location and catchment plan.

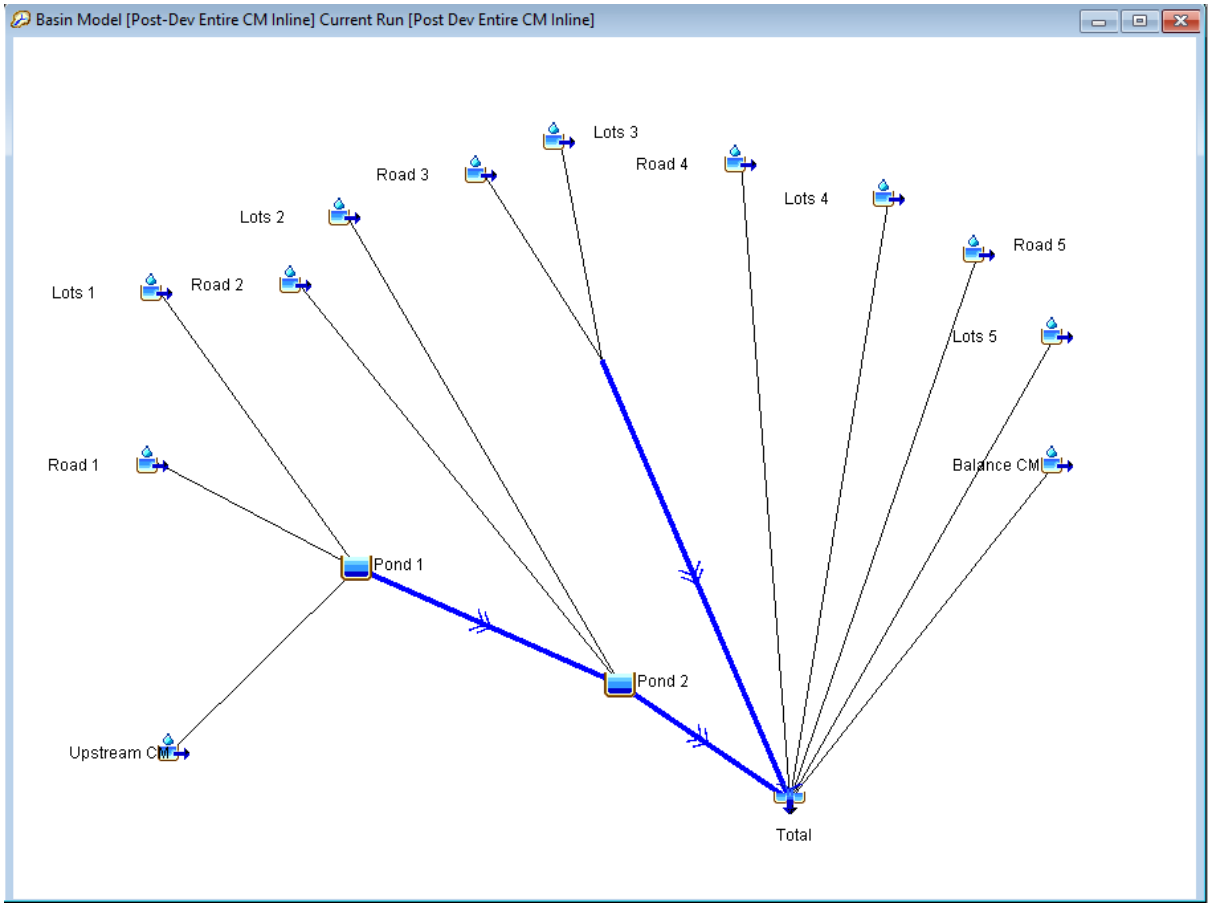
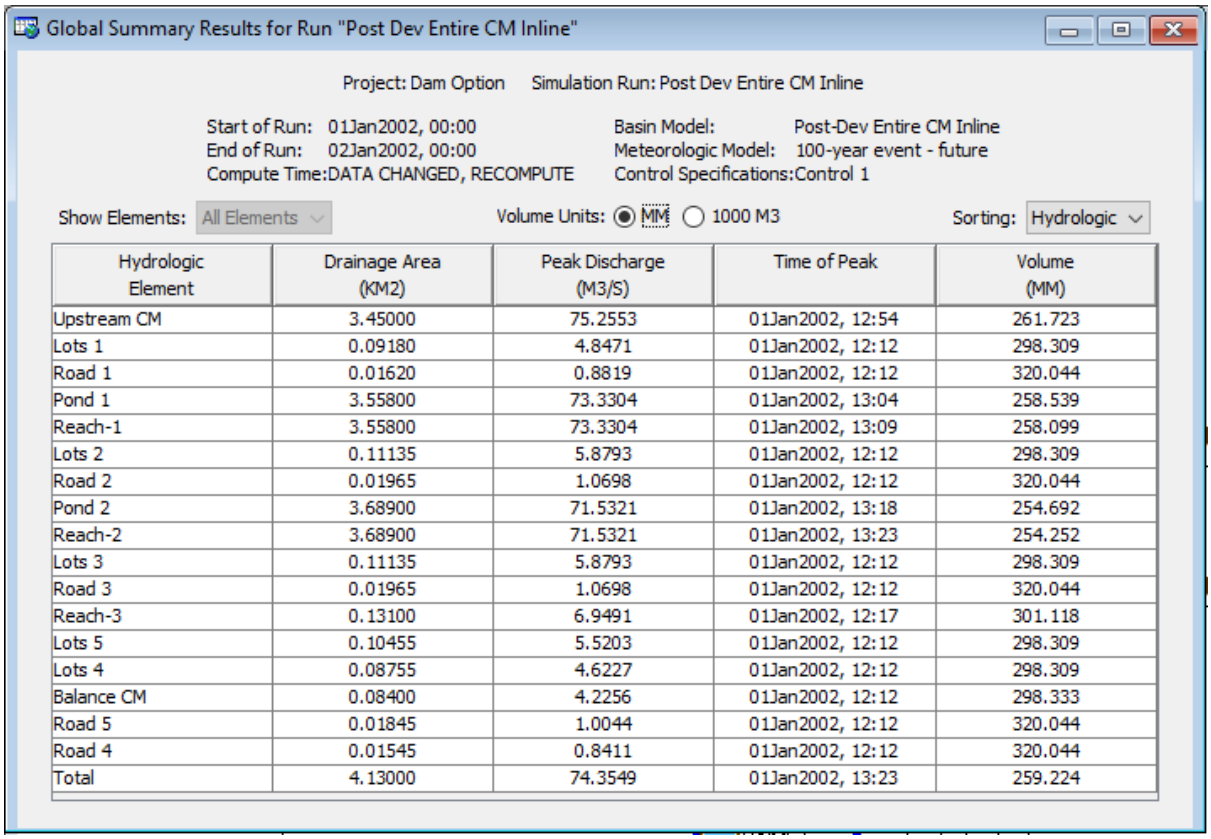



***Figure 15 Model 7 Catchment Plan***

**Model 7: Post-Development entire catchment with inline ponds** (includes entire catchment for Tohetea Stream): total catchment area is 413 Ha. 70% impervious for proposed road reserve, 40% impervious for proposed residential lots and upper catchment in the forest remains 100% pervious as existing model. Time of concentration for sub catchments within the proposed development is 10 minutes and remains 71 minutes for the upper catchment in the forest. 100-year 24-hour rainfall depth with climate change RCP 6.0 Scenario is used (328mm).



Global Summary Results for Run "Post Dev Entire CM Inline"

Project: Dam Option Simulation Run: Post Dev Entire CM Inline

Start of Run: 01Jan2002, 00:00
End of Run: 02Jan2002, 00:00
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Post-Dev Entire CM Inline
Meteorologic Model: 100-year event - future
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: MM / 1000 M3 | Sorting: Hydrologic

| Hydrologic Element | Drainage Area (KM2) | Peak Discharge (M3/S) | Time of Peak | Volume (MM) |
|---|---|---|---|---|
| Upstream CM | 3.45000 | 75.2553 | 01Jan2002, 12:54 | 261.723 |
| Lots 1 | 0.09180 | 4.8471 | 01Jan2002, 12:12 | 298.309 |
| Road 1 | 0.01620 | 0.8819 | 01Jan2002, 12:12 | 320.044 |
| Pond 1 | 3.55800 | 73.3304 | 01Jan2002, 13:04 | 258.539 |
| Reach-1 | 3.55800 | 73.3304 | 01Jan2002, 13:09 | 258.099 |
| Lots 2 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 2 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Pond 2 | 3.68900 | 71.5321 | 01Jan2002, 13:18 | 254.692 |
| Reach-2 | 3.68900 | 71.5321 | 01Jan2002, 13:23 | 254.252 |
| Lots 3 | 0.11135 | 5.8793 | 01Jan2002, 12:12 | 298.309 |
| Road 3 | 0.01965 | 1.0698 | 01Jan2002, 12:12 | 320.044 |
| Reach-3 | 0.13100 | 6.9491 | 01Jan2002, 12:17 | 301.118 |
| Lots 5 | 0.10455 | 5.5203 | 01Jan2002, 12:12 | 298.309 |
| Lots 4 | 0.08755 | 4.6227 | 01Jan2002, 12:12 | 298.309 |
| Balance CM | 0.08400 | 4.2256 | 01Jan2002, 12:12 | 298.333 |
| Road 5 | 0.01845 | 1.0044 | 01Jan2002, 12:12 | 320.044 |
| Road 4 | 0.01545 | 0.8411 | 01Jan2002, 12:12 | 320.044 |
| Total | 4.13000 | 74.3549 | 01Jan2002, 13:23 | 259.224 |

***Figure 16 Model 7 result***

Model 7 results in the smallest peak runoff compared with all offline pond options and existing conditions.

The existing subject site 100-year peak runoff is 20.1 m3/s (offline model 1). The existing entire catchment 100-year peak runoff is 79.2 m3/s (offline model 3). The peak runoff reduction from entire catchment point of view is 79.2 m3/s-74.4m3/s=4.8 m3/s. 4.8m3/s is larger than 20% of existing subject site 100-year peak runoff (20.1 m3/s).

In summary, the inline pond option provides a 100-year ARI event flow rate reduction no less than 20% of subject site pre-development 100 year ARI event flow rate. This meets The Waikato Regional Infrastructure Technical Specification (RITS) Section 4 requirements. From an entire catchment point of view, the inline pond option is also positively improving the downstream SH25 existing flood issue.

# 5 Proposed Stormwater Management System

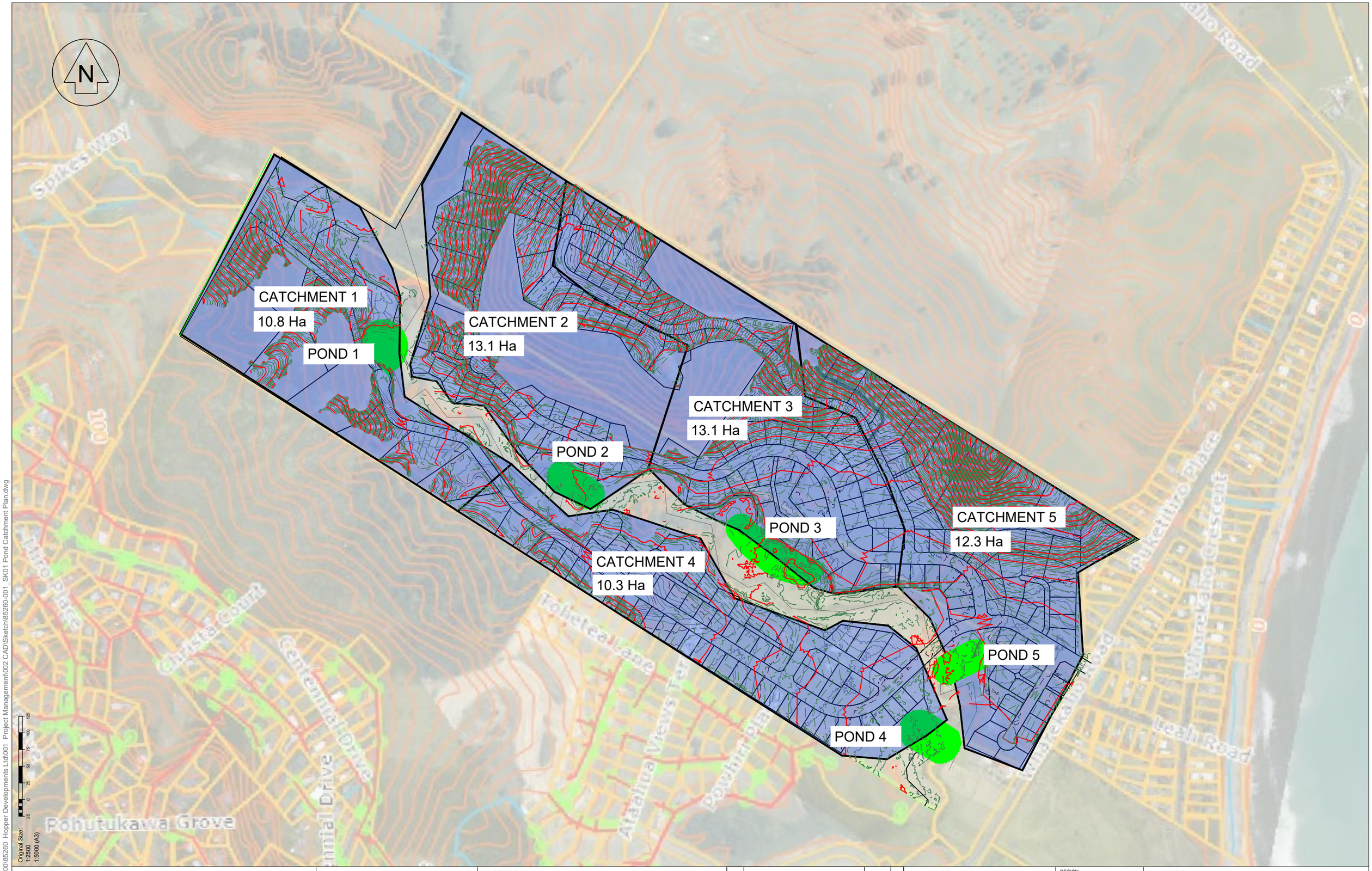
Inline ponds are proposed to provide up to 100-year ARI event attenuation. Smaller wetlands, raingardens or swales will be provided for water quality treatment and extended detention to protect the existing stream.

Primary stormwater network and overland flow paths will be provided as per RITS. Adequate freeboards will be provided for the proposed dwellings to the 100-year flood plain.

In summary, the proposed development with proposed water quality treatment and extended detention and inline ponds can provide adequate stormwater quality and quantity management for the proposed development. Detailed design will be provided at further design stages.

| Prepared by: | Approved by: |
|---|---|
| Jing Qi | James Greenwood |
| Civil Engineer | Director |

# Appendix A Catchment Plan and Wetland Pond Location





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HOPPER DEVELOPMENT LTD

PROJECT TITLE:

WHAREKAHO SUBDIVISION

25,39 WHAREKAHO ROAD SH25, WHAREKAHO

| REV | AMENDMENT | DATE | BY |
|---|---|---|---|
| A | FOR RC | 10/11/22 | JQ |

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ISSUE PURPOSE: RC

DESIGN:
DRAWN: JQ
CHECKED: JG
DATE: 7/11/2022
SCALE: 1:2500 (A1) 1:5000 (A3)
DO NOT SCALE FROM DRAWINGS

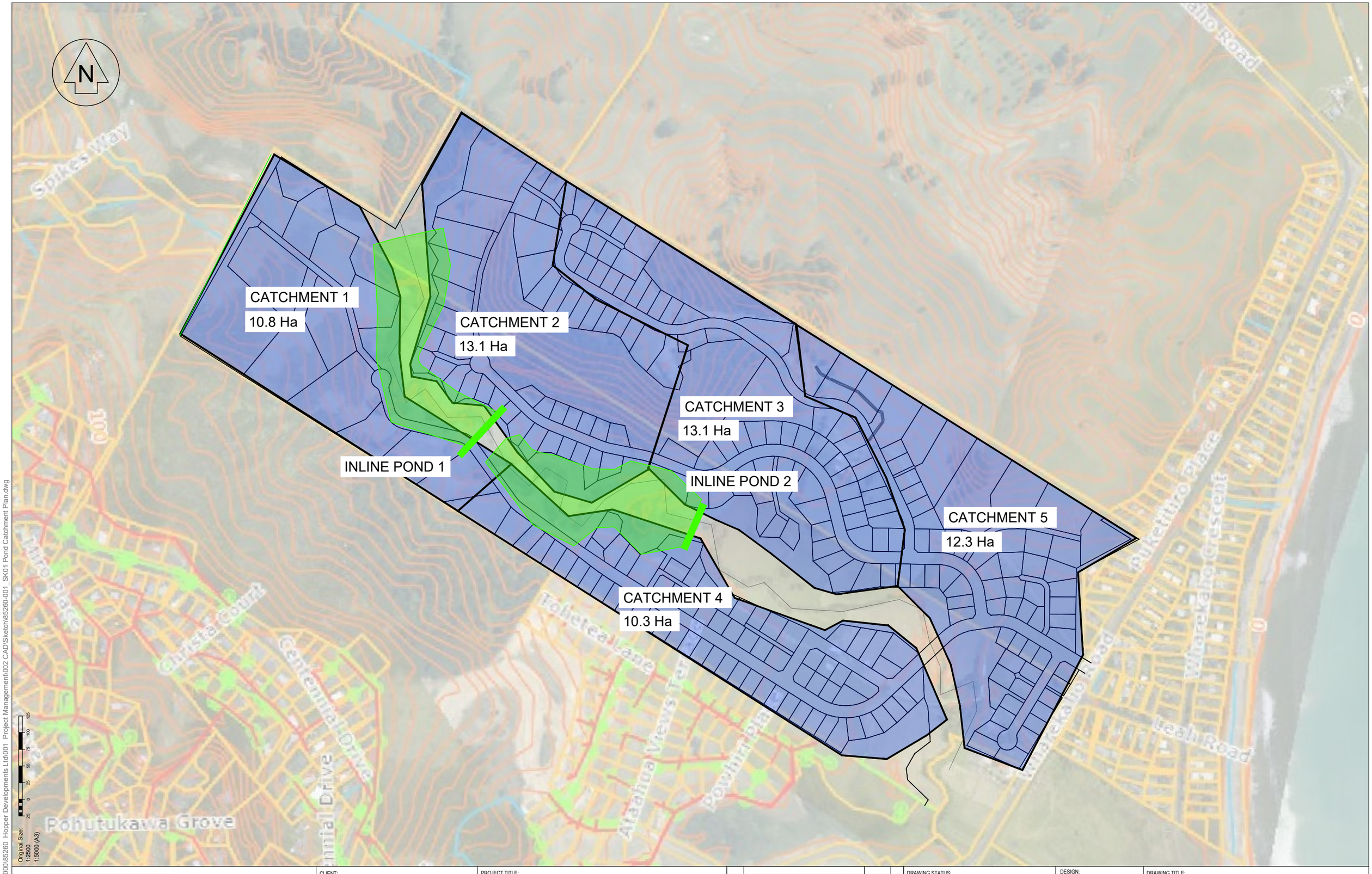


DRAWING TITLE:

SK01 CATCHMENT PLAN AND WETLAND POND LOCATION

JOB No: 85260/001 | SHEET No: SK01 | REV: A

# Appendix B Catchment Plan and Inline Pond Location



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25,39 WHAREKAHO ROAD SH25, WHAREKAHO

| REV | AMENDMENT | DATE | BY |
|---|---|---|---|
| A | FOR RC | 10/11/22 | JQ |

DRAWING STATUS: DRAFT

ISSUE PURPOSE: RC

DESIGN:
DRAWN: JQ
CHECKED: JG
DATE: 10/11/2022
SCALE: 1:2500 (A1) 1:5000 (A3)
DO NOT SCALE FROM DRAWINGS


DRAWING TITLE:
CATCHMENT PLAN AND INLINE POND LOCATION

JOB No: 85260/001
SHEET No: SK02
REV: A