Memo

(23/11/2018)

To: [redacted]

cc: [redacted]

From: [redacted]

Reviewed: [redacted]

Subject: Design Flows for the Wolverton Culverts Project

1. Background

[redacted]

As a key stakeholder, Healthy Waters has been working with AT, providing technical input and supporting information, as required.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

As part of the due diligence for the project, AT wants an independent peer review of the design flows.

This memo therefore aims to provide the basis and key parameters used when deriving the originally supplied peak flows of 89m3/s and 75m3/s for the Wolverton Culverts Project. Other design considerations such as debris and blockages have been discussed with AT but is not included as part of this memo, as these do not impact the design flow arriving at the culverts.

2. Healthy Waters Design Flow Requirements

Healthy Waters' requirements for culvert design and flow requirements are set out as per the Auckland Council Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater V2.0 2015 (SW CoP). Occasionally, additional consideration or deviation to the SW CoP may be required, and should be assessed on a case by case basis.

Below listed some of the key criteria required by Healthy Waters for culvert design.

- As per section 4.3.9.8 in Auckland Council SW CoP, *"The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without affecting upstream or downstream property."*
- As per section 4.3.5.2 in Auckland Council SW CoP, *"Secondary systems shall be designed to accommodate the 1% AEP design storm event assuming the conditions listed in Section 4.3.5.6."*
- As per section 4.3.5.1 in Auckland Council SW CoP, *"For larger catchments, or where significant storage elements (such as ponds) are incorporated, surface water runoff shall be determined using an appropriate hydrological and/or hydraulic model to the approval of Auckland Council."*

3. The Design Flow Basis and Key Parameters

The 100yr design peak flow numbers extracted from the Healthy Waters Whau catchment models, and as advised to AT on Monday 12 November, are 89m3/s for Wolverton No.1 culvert and 75m3/s for Wolverton No.2 culvert.

The flows were based on a number of key parameters, as listed below:

1) The peak flow rates have been derived from assessing both the detailed Whau East Catchment Model and the rapid flood hazard analysis (RFHA) model for the Whau Catchment.

    a) In the detailed catchment model, major stream and network constraints were removed upstream of the culverts, before the flows were extracted at the culvert sites. This provides more conservative peak flows as some upstream attenuation and storage areas were removed.

    b) The more conservative RFHA model was also used to compare and adjust the peak flow numbers extracted from the detailed model.

    c) The supplied peak flow numbers of 89m3/s and 75m3/s, were based on the results of both models.

2) Imperviousness

    a) The imperviousness assumption in the detailed catchment model is based on spatial location of each unitary plan zone & its individual impervious % allowances. The combined % for our detailed model is approximately 60%, as there are large open areas such as golf course and parks, etc.

    b) In the RFHA model, a catchment wide imperviousness of 70% and an initial condition of 'all storage areas filled' was assumed. 70% imperviousness is generally considered to be

on the upper end for a typical catchment, and given the large open space areas within the catchments it is unlikely 70% will be exceeded.

3) TP108 Hydrology

   a) TP108 rainfall contours were used. This equals a 24-hour rainfall depth of 196mm for the 100-year ARI.

   b) 24-hour rainfall depth with nested temporal pattern was used, which resulted in filled storage area, therefore no significant peak flow attenuation.

   c) CN of 98 was used for impervious areas and CN of 74 was used for pervious areas

4) Future climate change was allowed, as per Auckland Council Stormwater Code of Practice Section 4.2.10 Climate Changes, which is in line with the 2008 MfE Climate Change Guidance Manual. The 24-hour rainfall depth used was 229mm, which includes climate change allowances.

5) Tidal boundary condition used was 10%tile mean high water springs of 1.57mRL + 1m sea level rise.

4. More Cross-Checks

For reference and comparison purposes, TP108 graphical method calculations were also carried out. It should be noted that TP108 graphical method doesn't allow flow attenuation due to network and topography and therefore provides conservative flow numbers, especially for catchments of this size. Adding to that, a conservative channelisation factor of 0.7 was also used.

The TP108 peak flow calculation results are listed in table below:

Table 1 – TP108 Peak Flows under the 100-year MPD scenario with Climate Change

	Flow in m3/s @ Wolverton Culvert No.1 (Whau River)	Flow in m3/s @ Wolverton Culvert No.2 (Avondale Stream)
Unitary Plan Zoning Imperviousness (Approx. 60%)	100	89
Assuming catchment being 100% impervious	111	100

Below is a summary of the various flows related to the Wolverton Culverts Project.

Table 2 – Various Peak Flows (m3/s) for the Wolverton Culverts Project

	Healthy Waters Catchment Model	TP108 Graphics Method	[redacted]
Wolverton Culvert No.1	89	100	[redacted]
Wolverton Culvert No.2	75	89	[redacted]

Based on the above cross check results, and given the conservativeness of the TP108 graphical method calculations, Healthy Waters believes that the supplied peak flows of 89m3/s and 75m3/s

provide a good estimate for the 100-year MPD scenario. The supplied flows meet Healthy Waters requirements for culvert design purposes.

Kind Regards,

[redacted] **Catchment Planning Team**
Healthy Waters | Infrastructure & Environmental Services

[redacted]

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