Te Awarua-o-Porirua Whaitua Committee Workshop 29 March 2018

Introduction to modelling impacts of greenfield and infill development scenarios on stream flows and ecosystem health

Background

Many factors influence the ecosystem health of streams including water quality, stream flow rates and stream bank and bed habitat. In setting objectives for ecosystem health in the streams of Te Awarua-o-Porirua, we have been and will continue to look into a broad range of these. The workshop on March 29 2018 focuses specifically on stream flow attributes and how these are affected by urban development.

This memo briefly outlines what will be discussed at this workshop, including a refresh on the scenarios modelled, how these affect the stream flows that are important to ecosystem health and how this impacts potential costs of different approaches to urban development. This will help inform the Committee's recommendations around how greenfield and infill/brownfield urban development should be managed in terms of the changes in stream flows in urban or urbanising streams.

Case studies and scenarios

We have modelled scenarios of the potential impacts of changes in stream flows from urban development in two case study catchments (Figure 1):

- Camborne greenfield case study: a currently rural area that undergoes greenfield development, and
- Kenepuru infill case study: an existing urban area that experiences further infill development.

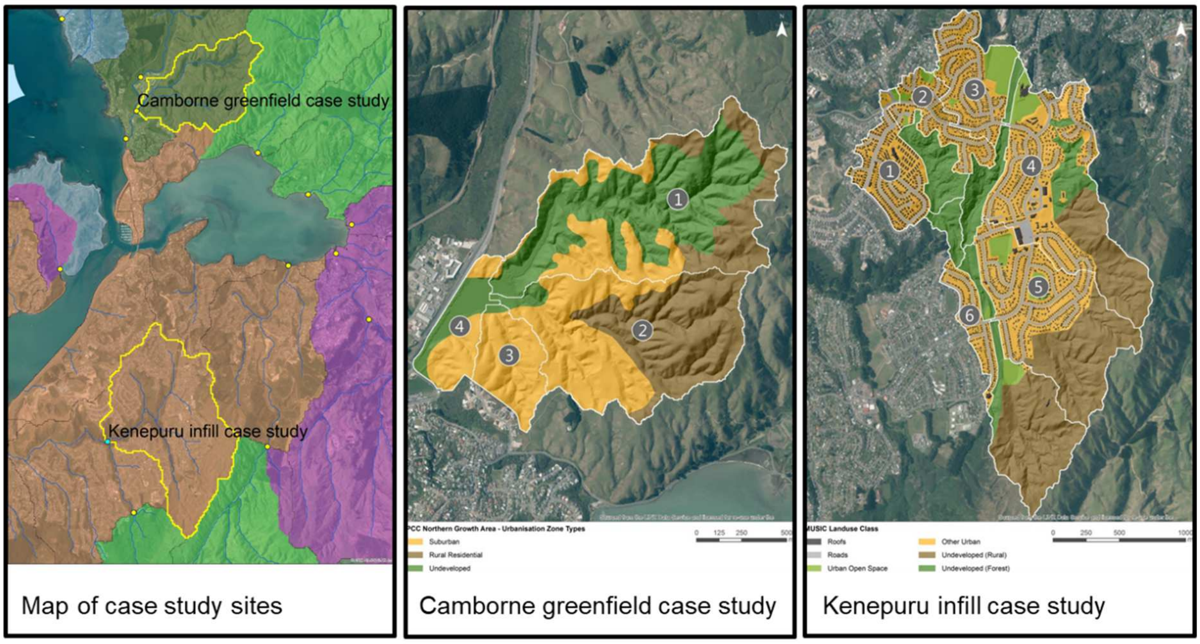

Figure 1. Case study catchments modelled

We modelled the impact of the three scenarios the Committee developed in 2017 in each case study area. These scenarios reflect three approaches to managing the impacts of stormwater practice in urban development:

- 'Business as usual' (BAU) – no mitigation of stormwater runoff
- 'Improved' – partial deployment of stormwater mitigation designed to intercept and slow water down, reflecting New Zealand good practice
- 'Water sensitive' – more widespread deployment of stormwater mitigation designed to intercept and store/release water through soil or in-house reuse and a smaller impervious footprint, reflecting international good practice

Attributes

We have modelled two attributes to show key changes that occur to flow in streams and how these affect stream health. These are:

- The average annual runoff volume
- The frequency of bed disturbing flows

Average annual runoff volume gives a big picture indication of the changes to flows in an urbanised area compared to its pre-urbanised state. The runoff volume typically increases in an urbanised catchment compared to its un-urbanised state and the extra volume is discharged in a more variable and unnatural pattern causing stress to stream life. Changes in these volumes and associated flow patterns can indicate a likely shift in the stream ecology towards less diverse macroinvertebrate communities with fewer sensitive species.

Assessing the frequency of bed disturbing flows gives an indication of the disturbance of stream communities (periphyton, macroinvertebrates and fish). Some level of disturbance is good for stream health, however, too much disturbance can mean only the tolerant species (typically the small and rapidly species colonising species) survive while sensitive species are lost. Urban catchments often have a higher frequency of these bed disturbing flows, as rainfall is quickly converted to runoff on the hard urban surfaces than in rural or forested catchments.

Results and key messages

The improved scenario stormwater mitigations intercept and slow water down, which reduced the frequency of bed-disturbing flows in both case study areas (Figure 2) but did not affect the average annual runoff volume (Figure 3). This means these types of stormwater mitigations are likely to help manage the disturbance effects from moderate flows on ecological communities, but may not help manage the stresses associated with small runoff amounts that would have been otherwise stored in an un-urbanised catchment.

The water sensitive scenario introduced greater levels of stormwater reuse throughout the year than the improved scenario. Combined with higher infiltration because of its reduced impervious footprint, this results in changes to both attributes in both case study areas (Figures 2 and 3). These results of the water sensitive scenario would likely contribute towards more diverse ecological communities more similar to those naturally occurring.

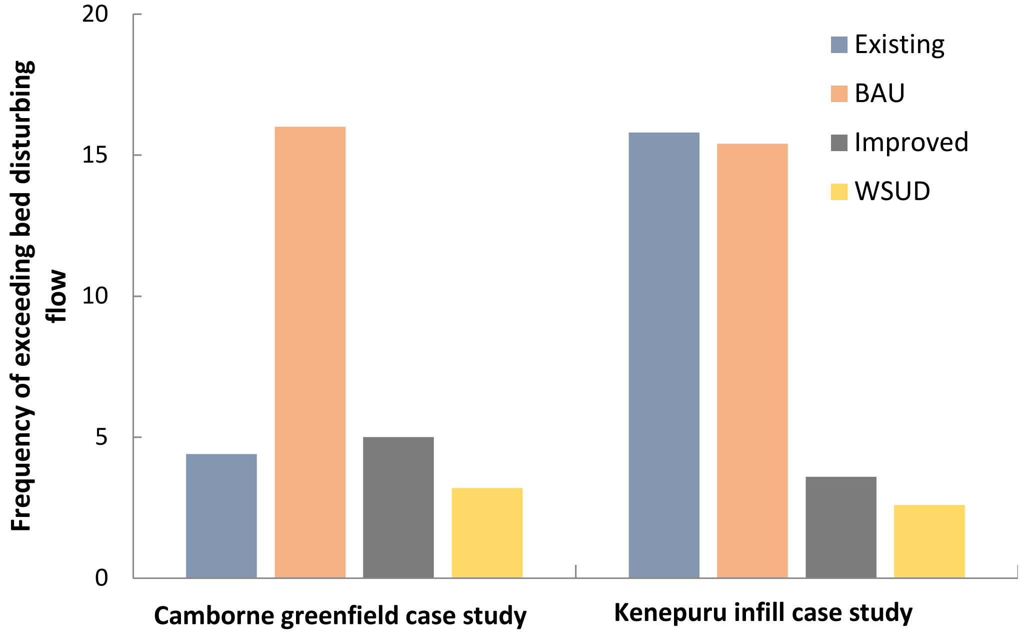

Figure 2. Changes in frequency of exceeding bed disturbing flows in each case study

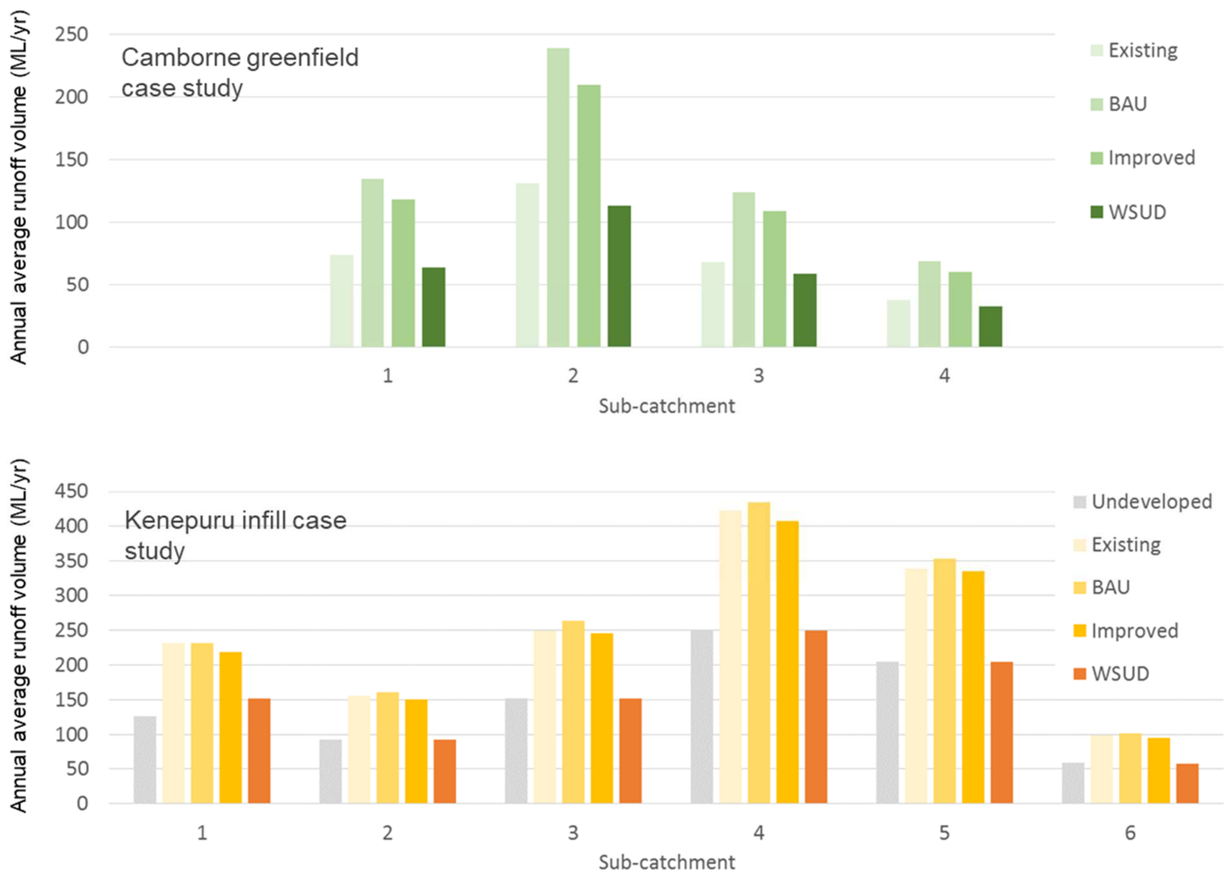

Figure 3. Changes in annual average runoff volume in each case study. Each group of bars are results for sub-catchments within each case study area. An 'undeveloped' volume has also been estimated for reference in the Kenepuru case study.

The stream flow variability described above is one of many influences on ecological condition in streams. These and other key influences (such as water quality, stream bank and bed condition, minimum flows and water takes) need to be managed together. The Committee has already explored the effects of minimum flows and water takes. We are currently assessing the effects of the scenarios on the remaining key influences and will bring all the results together for the Committee in April as part of an overall integrated assessment of the effects of scenarios on freshwater periphyton, macroinvertebrates and fish. This will help inform Committee decision-making on objectives for these three key attributes of ecosystem health.

Economic cost modelling will be presented at the 29 March 2018 workshop to illustrate the financial costs associated with the deployment of the different urban development practices tested in the case studies.