CONFRONTING THE RESIDUAL EFFECTS OF DEVELOPMENT ON STORMWATER

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ABSTRACT

Urban stormwater management is undergoing a paradigm shift. In a generation, New Zealand cities have moved from seeing stormwater as a waste to dispose of quickly and unobtrusively, towards being a vital part of a healthy urban environment. The tools we have to hand to manage stormwater today are potent and evolving. We can remove the majority of contaminant loads from waters before they hit our streams, lakes, rivers and oceans. We can reduce flash flows which cause erosion, instability and flooding. We understand more than ever the vital role that greenspaces play in our environmental, cultural and social systems.

However, there are limitations to our current stormwater toolbox. Stormwater from new developments, even when treated using well managed and maintained devices, contains residual contaminant load. Runoff volumes from developing land also increase, even when peak flows are attenuated. Increased stormwater volumes lead to increased scour and erosion. This leads to loss of land, vegetation cover, and sediment being discharged into streams.

These residual effects are sometimes written off as less than minor on an individual basis. Cumulatively these effects can be enormous. Hamilton City Council has begun to address some cumulative residual impacts of development through our Integrated Catchment Management Planning (ICMP) programme, and associated works. Managing residual effects is shaping up to be the next front in stormwater management, and one to be decisively acknowledged and addressed.

Two case studies are presented where residual effects have been addressed in Hamilton City.

The first case study is the developing Rotokauri Catchment, whose receiving environment is Lake Rotokauri. The lake is sensitive to nutrient load, particularly phosphorus. The recently completed Rotokauri ICMP has an objective of ensuring no further degradation of the lake. A key indicator for this is keeping chlorophyll a concentrations, which are dependent on phosphorus load, to predevelopment levels, even while allowing for development of approximately 550 Ha from pastoral to urban land use (Cooke, 2015). Under a standard TP10 approach, development on this scale would result in a substantial increase in contaminant discharge to the lake, including phosphorus, resulting in the lake becoming increasingly degraded. The ICMP has identified an innovative three stage treatment train approach to remove phosphorus and prevent chlorophyll a concentrations in the lake from increasing at all. This represents complete mitigation of residual effects of development on stormwater for a single critical contaminant.

The second case study is a city wide programme of erosion management. Developers in Hamilton are required to provide extended detention storage to reduce downstream scouring. Even with this measure, up to a fourfold increase in runoff volume may occur as a result of development. This can cause substantial erosion. Hamilton City Council now

requires developers to mitigate this, ideally at source, and where not practical to do so, through contributions to a programme of erosion remediation and prevention works.

Managing residual effects of stormwater discharge requires creative use of our stormwater management toolbox. Future tools in this space may include comprehensive treatment trains, water quality offsets, and substantial works programmes to proactively enhance receiving environments. The two examples presented in this paper provide excellent case studies in what the future of stormwater management may bring.

Rotokauri

Hamilton is rapidly growing. To aid in meeting that growth, a Structure Plan and ICMP have been prepared for Rotokauri, a large greenfields area on the western side of Hamilton City. These plans allow for substantial development within the catchment.

While most of Hamilton's waterways flow directly to the Waikato River, part of the Rotokauri Structure Plan area discharges to Lake Rotokauri. This creates a unique set of environmental constraints for development in this catchment.

Lake Rotokauri is one of the larger shallow peat lakes in the Waikato region. It has a surface area of 77 Ha including marginal wetland areas, and a maximum depth of 4m. The lake's water quality is currently poor. Several agencies are proactively engaged in restoring the lake and surrounding sub-catchment areas. The lake is managed to support wide ranging values including ecological, historical, cultural, public access and recreation. It also possesses significant biodiversity values (Hart, 2017).

The Lake and wider catchment are shown in Figure 1.

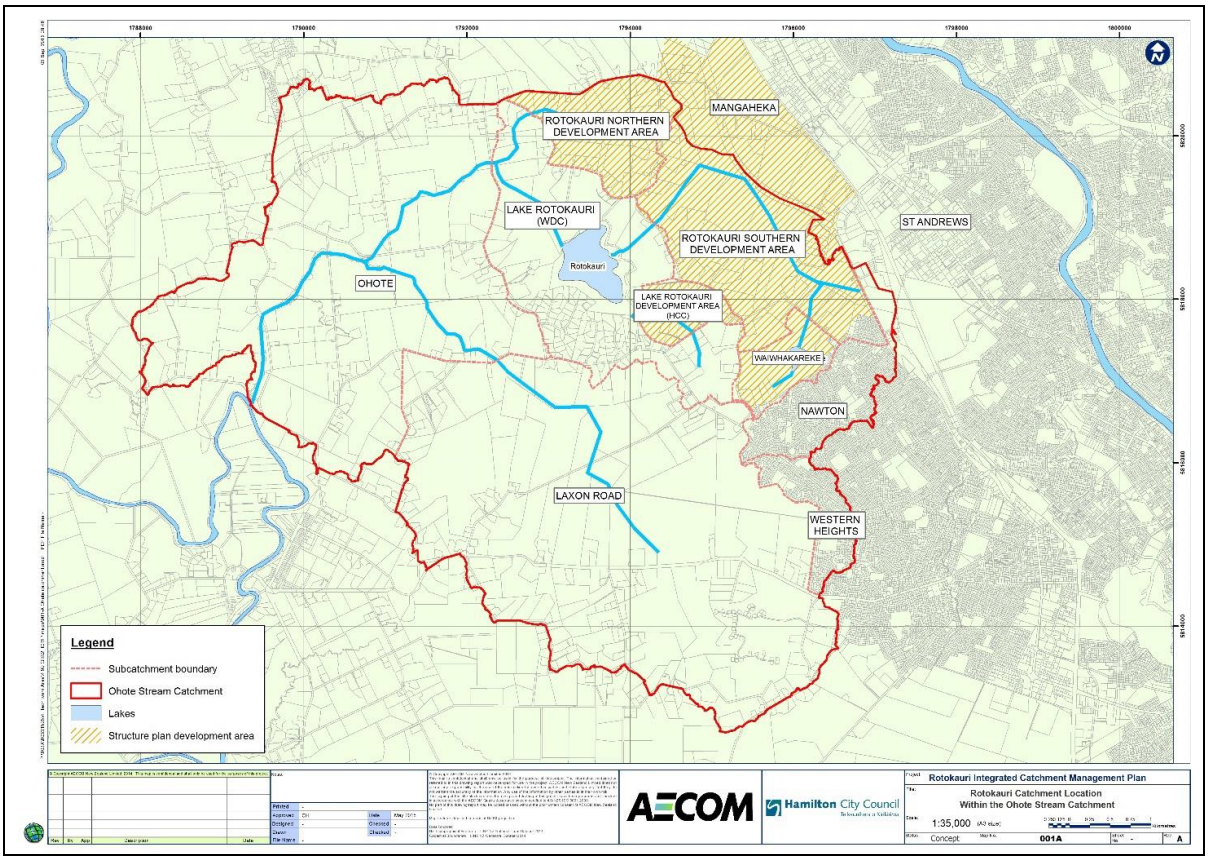

Figure 1: Rotokauri Catchment

Development upstream of a water body like Lake Rotokauri often results in further degradation. However, an ICMP allows for the effects of development to be assessed and strategically managed. Receiving environments can be protected and/or enhanced through this approach.

An ICMP was completed for the Rotokauri Catchment in 2017. A key ICMP objective was that "The quality of any degraded water bodies is enhanced through improved management". The ICMP identified that providing treatment to keep chlorophyll a concentrations in the lake at or below existing levels (requiring 70% removal of phosphorus to achieve) was shown to be sufficient to meet all other water quality targets for other contaminants.

Having identified objectives, the ICMP developed means of compliance for meeting those objectives. Means of compliance are one means by which ICMP objectives can be achieved. For water quality, the means of compliance proscribes three levels of treatment:

1. At source treatment. This may be raingardens, rain tanks, proprietary devices, swales etc. depending on what is most suitable for each site.

2. Sub-catchment wetlands or other devices located downstream of developments.

3. Sub-catchment wetlands located further downstream in a green corridor, serving multiple developments (See Figure 2).

In addition, all wetlands are required to be designed to maximise phosphorus removal through minimising depth and careful selection of vegetation.

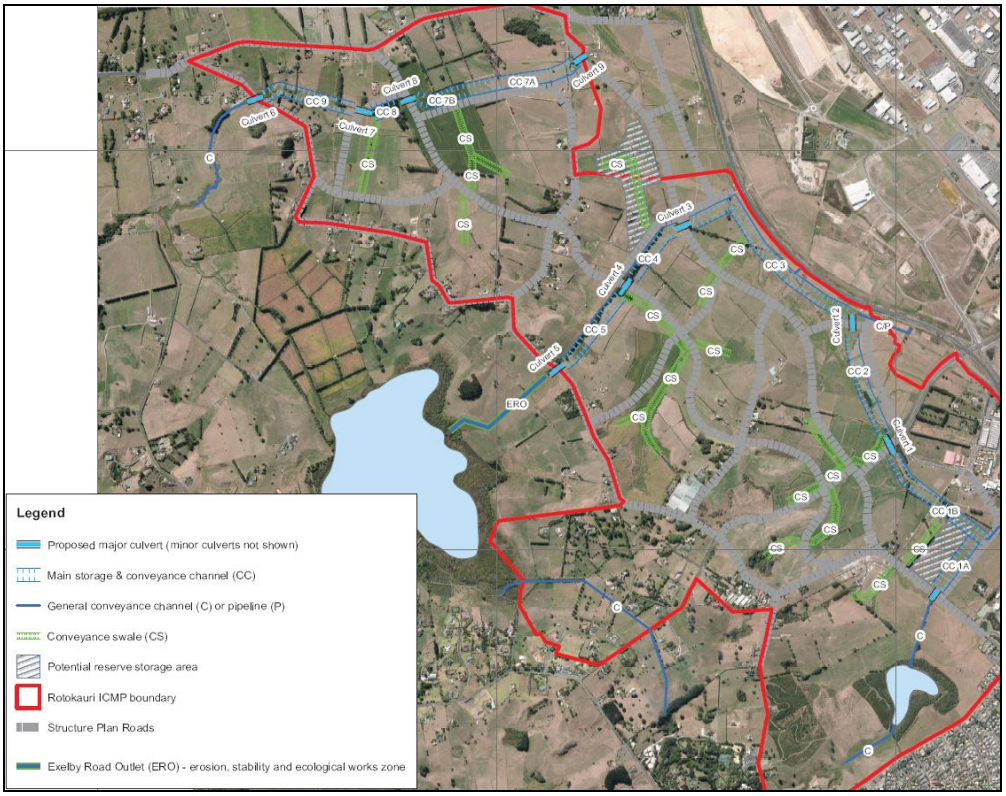

Figure 2: Rotokauri Stormwater Conveyance Infrastructure. Wetlands are located within main storage and conveyance channel in blue (CC), which is located in a green corridor.

A standard TP10 approach to water quality in this catchment, would likely entirely exclude the third level of treatment, and result in further degradation of the lake. The cost of the greenway wetlands (excluding costs for conveyance and storage in the greenway which are required anyway to meet a lake consent condition) is estimated at approximately $36,000,000 to serve the structure plan area draining to the lake. This is a significant, but on the scale of the 550 hectare area treated achievable, expenditure. Developers have responded well to the means of compliance, and are generally focussed on obtaining clarity on technical details and phasing.

It's noted that if a suitable alternative is identified which meets all objectives, it can be accepted in preference to the means of compliance laid out in the ICMP through the Resource Consent process. This allows for the adoption of new technologies, considerations and innovative solutions that did not exist at the time the ICMP was written. The ICMP will be updated if significant changes are required.

Erosion Programme

Even a well-managed development creates additional stormwater runoff volume. Where soakage or substantial re-use are not options, the best tools in the stormwater tool box will reduce peak flows, but have little impact on the overall volume of discharge. The effect of increased volume can be increased downstream erosion. This is often considered no more than minor on an individual consent scale. Cumulatively the volume increase can lead to expensive reactive erosion works.

Hamilton City Council has now embarked on an erosion prevention programme. The programme identifies projects which enhance stream resilience against existing and potential erosion issues, where these can be related to development. New developments upstream of streams are required to contribute to this programme.

A concept erosion prevention programme of works has been developed for streams downstream of the major growth catchments, shown in orange on Figure 3. These are the Rotokauri, Te Awa O Katapaki (serving Rototuna), Kirirkiriroa and Mangaonua (serving Ruakura) and Mangakotukutuku (serving Peacocke) streams.

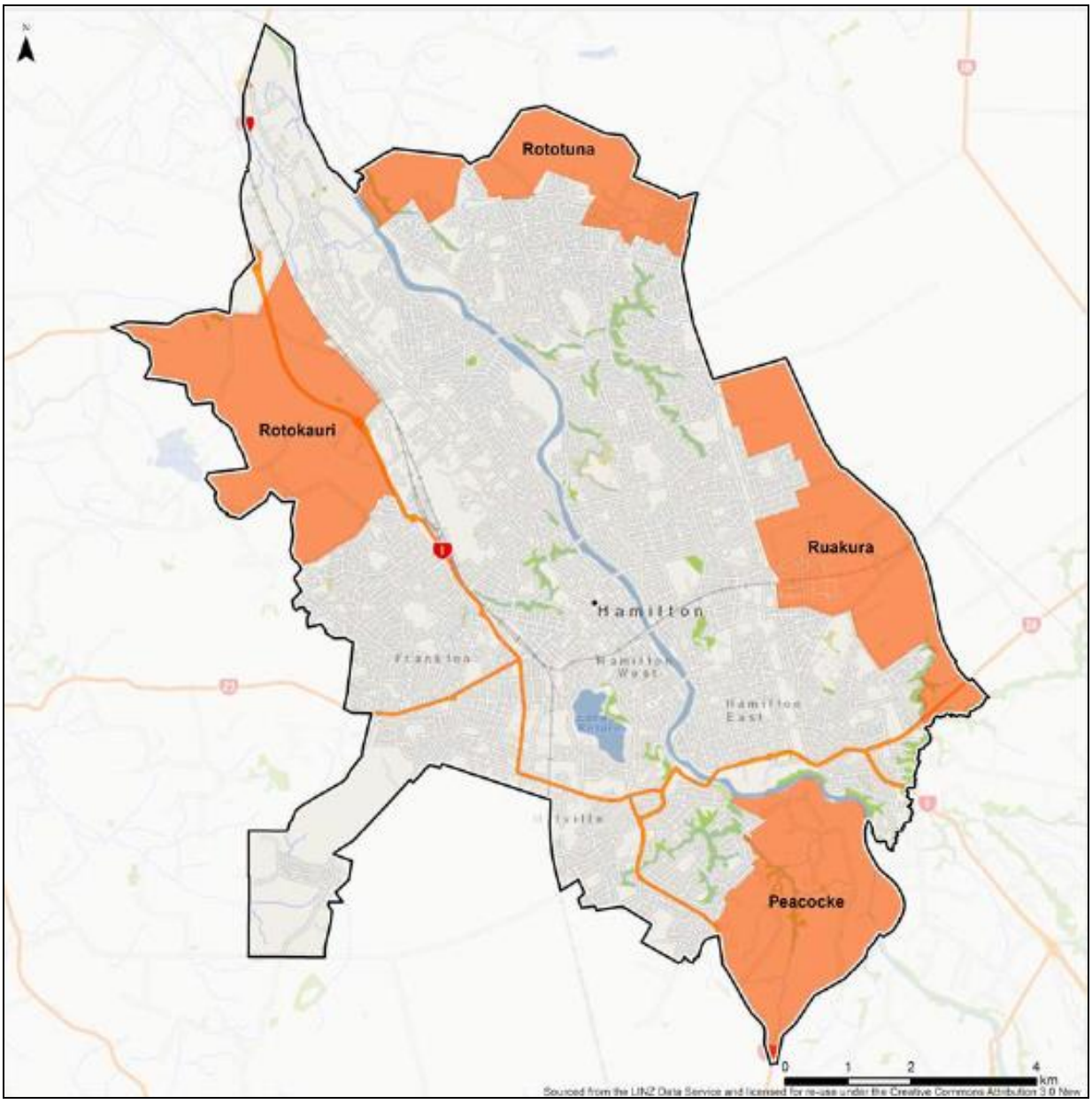

Figure 3:Key growth cells in Hamilton.

Cost estimates for the programme were developed using the length of stream requiring works and the cost for the type of planting/stabilisation required. The contributing catchment area at each project location was identified using the geometric network from the Hamilton City Council Stormwater Master Plan 2016. Costs are apportioned to developers based on a formula using the proportion of the catchment they are developing. A per hectare rate for developers has been developed on this basis. It has been applied through the city and regional council consenting process for recent developments in these catchments.

The staff Hamilton City Council 2018-28 10 Year Plan funding request has included the erosion prevention programme which, if successful, could result in the greenfields financial contribution forming part of the Development Contribution payment. The remainder of the programme costs (particularly where erosion cannot be attributed to development) are intended to be funded through the existing Project Watershed, requiring funding from Waikato Regional Council, Hamilton City Council, and land owners.

Project identification was restricted to existing and potential erosion issues only. Projects do not currently include additional water quality, ecological enhancement or amenity considerations. The current concept programme of works will be developed to a more detailed level that will consider these wider objectives, alongside availability of access, land ownership and growth impact on erosion. Timing of implementation will be dependent on Waikato Region's and Hamilton City's Long Term Plan.

Summary

Residual effects of development on receiving environments are often written off as less than minor. This may not be the case where cumulative effects are present. While much of our current stormwater toolbox accepts residual effects, these effects can be avoided when addressed at a catchment level.

Ambitious, holistic and creative approaches are able to address residual effects. As councils become more experienced in stormwater management, there is increasing capacity and appetite to manage residual effects of development on stormwater. This has been demonstrated through two case studies of works undertaken by Hamilton City Council in relation to erosion throughout Hamilton, and water quality in Lake Rotokauri.

KEYWORDS

Integrated Catchment Management Plan Residual Effects Mitigation

REFERENCES

Hart, R (2017), "Rotokauri Integrated Catchment Management Plan", Hartland Environmental Limited

Cooke, J, et al. (2015) "Rotokauri ICMP – Broad scale Water Quality Assessment", Streamlined Environmental