Appendix 18: Urban Stormwater

1. Introduction

This paper examines the impacts of urban stormwater on receiving waters and assesses potential actions for the Waikato River catchment to remedy those impacts. In urban areas, stormwater flowing off surfaces such as roads, pavements and roofs can contain elevated levels of a range of pollutants including vehicle fuel and oil, heavy metals, rubbish, fertilisers, pesticides and fine sediment. This stormwater can cause adverse effects when it enters the streams and rivers flowing through an urban area, as has been described for Hamilton streams (Williamson, 2001; Collier et al., 2009) and comprehensively studied in Auckland streams (as reviewed in Mills and Williamson, 2009).

As well as the effects of the quality of stormwater, urban streams may also be affected by higher flows during rainfall, and sometimes lower flows during dry weather. Channels may be extensively altered physically by channelisation and culverting, causing disruption to fish passage and loss of riparian vegetation. Thus these aquatic ecosystems may be affected by a large number of stressors including increased light levels, deposition of fine sediments and elevated turbidity, physical changes, high (and low) flows, and presence of toxic contaminants. The effect that this has on stream ecology is decreased biodiversity with fewer species of fish and invertebrates and dominance by a few tolerant species, and sometimes higher concentrations of algae and more macrophytes. This has been found to be the situation for Hamilton's urban streams (Williamson, 2001; Collier et al., 2009). Stormwater can also affect larger aquatic systems such as lakes and large rivers but the impacts are mainly associated with contaminants and fine sediment (Williamson, 1999; NIWA, 2001).

The severity of the effect that stormwater run-off has is usually proportional to the area of urban land use directly connected to the receiving water. This can be measured as the percentage of the catchment with impervious cover (%IC) and this has been shown to be a useful predictor of potential impacts of urbanisation on stream health (ARC, 2004). It has been found, both overseas and in New Zealand, that catchments with less than 10 %IC can support aquatic communities that are largely unmodified (Stark, 2006). This can vary from site to site depending on local differences in instream habitat and riparian quality. When %IC increases beyond 10 – 15 percent it is common for stream health to be affected. Beyond 25 percent, streams can become highly modified. This is consistent with the findings of a recent study of Hamilton City streams (Collier et al., 2009). Within the Waikato River catchment, the extent of aquatic habitat degradation caused by urban stormwater will be confined to a relatively small area because the proportion of the streams and

rivers that have more than 10 %IC in their catchment area is relatively small. As a consequence, the effect on larger water bodies is relatively minor. For example, the effect that Hamilton has on the Waikato River will be highly localised to where urban streams discharge into the main stem (NIWA, 2001) because contaminant concentrations and flow effects are likely to be rapidly diluted and attenuated (Williamson, 1999).

Urban stormwater discharges from other towns along the Waikato River (i.e., Cambridge, Huntly, Ngaaruawaahia, and Tuakau) are also unlikely to have any significant widespread impact. Te Awamutu may have minor effects on the Mangawhero but Otorohanga is unlikely to have any significant widespread impact on the Waipa River. However, all these towns will have impacts on any small streams in these urban areas or on streams flowing through the town where urban landuse forms more that 10 – 25 percent of the catchment area.

2. Actions

It has been suggested that urban stream restoration needs to focus on actions within the catchment itself rather than instream or on riparian habitat (Roy et al., 2006). Drainage systems need to be designed to reduce the amount of impervious surface area causing stormwater to flow directly into urban streams through stormwater pipes by maximising run-off detention, infiltration and off-channel retention of water (Taylor et al., 2004; Walsh 2004; Walsh et al., 2005), but at the same time still serving their primary function of flood control. This has multiple benefits: reducing stormwater run-off volumes, increasing infiltration (and hence low flow), reducing the mobilisation and transport of contaminants to receiving waters and reducing instream erosion and the need for channel works to safely convey high flows. Appropriate technology can be implemented with relative ease in many new developments, but there are obvious difficulties and costs associated with retrospectively disconnecting stormwater systems. There is a growing trend in New Zealand to implement these designs in new developments. The major issue is the slowness with which these measures and new technologies are adopted by territorial authorities.

Older urban areas pose the biggest challenges for effective management of stormwater as it is technically difficult and costly to retrofit environmentally sensitive design and treatment. Local authorities are deterred from using these new technologies and methods because of the extremely high cost and the uncertainty of the significant benefits which might accrue. Based on cost estimates of about $11 billion (in 2004) to meet stormwater goals for the greater Auckland area (Infrastructure Auckland 2004), comprehensively addressing stormwater impacts in Hamilton and regional towns would be estimated to cost around $1 billion.

In older urban areas, where catchment management options are more limited and expensive, some impacts can be addressed in the receiving waters. Gully restoration in Hamilton has been achieved at relatively low cost and produced clear environmental benefits for local streams.[1] Restoring natural vegetation and fostering native terrestrial biodiversity in the gullies of Hamilton City has also linked terrestrial restoration with the protection and enhancement of aquatic values (Clarkson and McQueen, 2004).

A recent study has examined restoration options for the aquatic habitat and fauna of Hamilton City streams (Collier et al., 2009). The four tributary stream/gully systems in the city have been recognised as major geomorphological features and part of Hamilton's character (Wall and Clarkson, 2001; Clarkson and McQueen, 2004). They have a combined length of about 120 kilometres and form eight percent (750 hectares) of the city's area. The headwaters of these streams lie outside the city boundaries in farmland and water quality is therefore affected by both rural and urban run-off, as well as groundwater inputs containing high iron concentrations (Williamson, 2001). Collier et al., (2009) found that the occurrence of macroinvertebrates (e.g., insects, snails, and kooura (freshwater crayfish)) indicated that stream habitat in the city ranged from poor to good and occasionally very good. They also supported a reasonably diverse fish population. Shortfinned and longfinned tuna were reasonably common, while giant and banded kookopu (galaxiids), iinanga (whitebait), and smelt were found at two to six sites in the city.

Factors impacting restoration actions considered included:

- Cities are where people interact with biodiversity most often so restoration of urban streams was considered a priority.

- Restoration appeared to be constrained by hydrology and possibly by contaminants. Minimising the connection between urban streams and impervious area was seen as high priority for protecting high-value streams and seepages.

- The presence/absence of animals indicated that riparian planting to provide shade, organic matter and woody debris would be beneficial. However, because of potential flooding issues, the addition of wood debris would need to be handled carefully. (The ongoing gully restoration will hopefully fully utilise riparian planting as a management technique).

- There were 46 barriers to fish migration created by poorly positioned road culverts. However, there is the danger that removing the barriers would allow ingress by troublesome pest fish, so fish ladders may be the preferred option.

[1] http://www.gullyguide.co.nz/files/Gully%20Book%20Mar%2007.pdf

- Restoration of fish communities was seen as challenging – apart from restoring passage and riparian vegetation as described above. Rather, the addition and enhancement of iconic native species (e.g., giant kookopu) was seen as an attainable goal, by introducing farm-raised species.

Hamilton City Council and Environment Waikato have made considerable progress in the management of Hamilton's urban stormwater. As a result, additional attention to urban stormwater does not need to be a high priority. There is already sufficient guidance and technology available for local authorities to continue to address stormwater issues in new subdivisions. If these were carried out, then there should be a good fit with other restoration activities in the Waikato River catchment. The Study team concluded that given that there are sufficient means available to address new urbanisation in the Waikato River catchment, urban stormwater impacts in new areas should be a relatively low priority for the Waikato River Authority, compared with other issues considered.

However, the issue of comprehensively addressing the impact of existing urban areas is very challenging and expensive. Comprehensively retrofitting urban-sensitive designs or stormwater treatment devices in older areas, so that run-off volumes, flow rates and contaminant levels are reduced to levels that do not seriously impact streams is possible but will be very costly.

In older urban areas, the Study team recommends the following actions:

- Restore stream and riparian habitat to the extent possible and investigate means to increase aquatic life (e.g., restocking iconic native species).

- Restore fish passage, by using devices that allow the passage of climbing glaxiides but not pest fish. Where these are installed eliminate pest fish upstream and restock with iconic native species.

- Reduce run-off volumes and flows by encouraging controls at the source (e.g., financial incentives for land owners to slow and treat run-off). These could also include incentives that reduce run-off rates by encouraging the reduction in impervious areas, the implementation of ground soakage (where possible) and installation of simple on-site treatment (such as rain gardens). Because there are risks associated with these measures, it is essential that there is clear guidance available (e.g., 'how to' and 'where to' handbooks).

- Continue, and enhance, education programmes for the community about connectivity of urban areas to waterways and the danger created by disposal of wastes on impervious areas and stormwater systems.

- Continue, and enhance, inspections of businesses (and their stormwater systems) that store and use substances that could contaminate stormwater,

especially those businesses that fall within those categories recognised as potentially hazardous (on the Hazardous Activities and Industries List[2]).

These actions would restore aquatic resources in areas where people interact with biodiversity most often. While they will not result in full restoration, the measures are comparable with those proposed for the wider, and much larger, rural environment (e.g., see Appendix 11: Riparian aesthetics). There would be restoration of first and second order streams comparable with riparian planting in pasture land, enhancement of aesthetics and access, restoration of banded kookopu, tuna habitat, and other taonga (treasured) species, as well as addressing education and engagement. The Study team concluded that while these measures are largely the responsibility of town and city councils, the Waikato River Authority could work with councils to expand restoration activities to include taonga species. In addition, the links between restoration in 'town and country' should be part of the Waikato River Authority's education and engagement programmes (refer Appendix 27: Engagement).

3. References

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[2] http://www.ew.govt.nz/Environmental-information/Hazardous-substances-and-contaminated-sites/Contaminated-sites/Managing-contaminated-sites/

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