greater WELLINGTON
THE REGIONAL COUNCIL

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Committee **Environment**
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Progress report on the investigation of chemical contaminants in urban stormwater

1. Purpose

To provide an update on an investigation into chemical contaminants in the stormwater derived from urban areas in the Wellington Region.

2. Background

The Greater Wellington Regional Council (GWRC) is measuring chemical contaminants and other variables in stormwater derived from selected urban catchments to:

- Determine what chemical contaminants are present.
- Estimate the relative concentrations of the chemical contaminants in the solid and liquid phases.
- Estimate the pH, total suspended solids, and concentrations of various nutrients.

The sampling sites have been chosen to represent stormwater derived from various urban land uses (residential/commercial/industrial). The analytes include 31 metals, one metalloid (arsenic), nitrogen, phosphorus, organic carbon, organochlorines (14 varieties), chlorophenols (18 varieties), polycyclic aromatic hydrocarbons (16 varieties), and polychlorinated biphenyls (40 varieties). The majority of the organic analytes are US EPA "Priority Pollutants".

The investigation links to the GWRC study of chemical contaminants in marine food chains, in which the same suite of chemical contaminants has been analysed in shellfish. A progress report on the shellfish study was presented to the Environment Committee in May 2003.

3. Strategic Context

Clean and healthy rivers, streams and coasts are an objective of Greater Wellington's strategic plan. One target for that objective is that by 2013 there will *be no significant deterioration of water quality in our key streams and rivers*. Stormwater discharges may represent a major impediment to the achievement of this objective

4. Results

To date eight sites have been sampled, as listed in Table 1, and laboratory analyses of pH, total suspended solids, nutrients, and chemical contaminants have been completed for the first five of these sites. In addition, Connell Wagner Limited has prepared event mean concentration (EMC)-based pollution run-off models for four of the catchments in the study. These models will enable initial estimates to be made of the annual contaminant loads to the receiving environments of these catchments.

Table 1: Location of stormwater samples from the Wellington Region used for the analysis of chemical contaminants, 2002/2003.

Locality	Date collected	Grid reference		Nature of system at sample point	Catchment area (ha)	% of catchment urbanised
		Easting	Northing			
Owhiro Stream (Wellington)	9/06/2002	2657149	5983285	open stream channel	953	11
Browns Stream (Porirua)	17/06/2002	2666645	6009635	open stream channel	123	86
Island Bay (Wellington)	24/08/2002	2669325	6010746	stormwater pipe	467	83
McLeod Park (Upper Hutt)	2/05/2003	2669600	5993020	stormwater pipe	35	100
Duck Creek (Porirua)	2/05/2003	2669646	5991109	open stream channel	869	19
Te Roto Drive (Kapiti)	9/06/2003	2667482	5986637	stormwater pipe	ND	> 50
Semple Street (Porirua)	3/10/2003	2664932	5982542	stormwater pipe	ND	> 50
Gracefield (Lower Hutt)	4/09/2003	2661470	5983320	stormwater pipe	ND	> 50

The next section of the report examines the results from Owhiro Stream and Duck Creek, two open channel sites situated where "reasonable mixing" would have occurred. At these sites, nutrient and chemical contaminant concentrations in the dissolved phase can be legitimately compared with the ANZECC (2000) "trigger values" for aquatic ecosystem protection in "slightly to moderately disturbed systems". Similarly, the concentrations of chemical contaminants on the particulate phase can be compared with the "trigger values" of the ANZECC (2000) interim sediment quality guidelines. For the chemical contaminants, these two sets of "trigger values" are the concentrations which, if exceeded, result in a definable risk of adverse effects on the biota based on direct toxicity assessment data.

Nutrients

At both the Owhiro Stream and Duck Creek sites, the concentrations of nutrients as measured by soluble oxides of nitrogen (NO_x), total nitrogen (TN), dissolved reactive phosphorus (DRP), and total phosphorus (TP), were 1.5–3.8 times their respective "trigger values" for lowland streams. Concentrations of total organic carbon (TOC) were approximately double the average values which have been recorded in (western) rural streams as part of the ambient freshwater monitoring programme.

Heavy metals

At both the Owhiro Stream and Duck Creek sites, copper and zinc were measured in the dissolved phase at concentrations 2–3 times higher than their respective "trigger values". At the Owhiro Stream site, arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc were measured in the particulate phase at concentrations above ISQG-High, and chromium at a concentration above ISQG-Low. At the Duck Creek site, cadmium, copper, lead, silver, and zinc were measured in the particulate phase at concentrations above ISQG-High, and nickel and arsenic at concentrations above ISQG-Low.

Organochlorines

Heptachlor was detected at very low concentrations in both the dissolved and particulate phases at the Owhiro Stream site. DDE, TDE, and DDT were detected at the Owhiro Stream site, and DDE and DDT at the Duck Creek site, and these were generally associated with the particulate phase. The concentration of DDE in the particulate phase at the Duck Creek site was above ISQG-Low.

Chlorophenols

4-monochlorophenol (4-MCP) was detected in the particulate phase at both the Owhiro Stream and Duck Creek sites, and pentachlorophenol (PCP) in the dissolved phase, also at both sites. 2,6-dichlorophenol was detected in the dissolved phase at the Duck Creek site, and 2/4,2/5-dichlorophenol and 2,4,6-trichlorophenol in the particulate phase. There is no "trigger value" for 4-MCP in the particulate phase, and the concentrations of PCP were well below its

"trigger value" in the dissolved phase. No "trigger values" are available for the remaining chemicals in the phases in which they were detected.

Polycyclic aromatic hydrocarbons (PAHs)

A number of high molecular weight PAHs were detected at both the Owhiro Stream and Duck Creek sites, and these were associated exclusively with the particulate phase. Those PAHs for which "trigger values" are available were all at concentrations well below ISQG-Low. There are also 'trigger values" for total high molecular weight PAHs and total PAHs. At both sites the total concentration of high molecular weight PAHs and the total concentration of PAHs were also well below ISQG-Low.

Polychlorinated biphenyls (PCBs)

Eleven PCB congeners were detected at the Owhiro Stream site, and one PCB congener at the Duck Creek site, and these were associated exclusively with the particulate phase. Individual PCBs do not have "trigger values", but a value is available for total PCBs. At both sites total concentrations of PCBs were well below ISQG-Low.

5. Discussion

That the Owhiro Stream and Duck Creek sites are located in open stream channels rather than in piped systems is not the only point of difference with the majority of the other sites sampled. Their catchments are also the least urbanised. Not surprisingly, therefore, the concentrations of many of the contaminants in the piped systems examined were often found to be markedly higher than those reported at the Owhiro Stream and Duck Creek sites. In addition, a greater variety of organic contaminants were detected in the piped systems, and differences (in the range of chemicals) between the sites were noted that might be related to specific types of urban activities.

The results of the current investigation are consistent with those from several earlier studies. A site in the lower reaches of the Porirua Stream was found to have dissolved lead and zinc at concentrations above their respective "trigger levels" during rainfall events. The stream bed sediments at the site had concentrations of lead, zinc, DDD, TDE, and DDT above ISQG-High. Stream bed sediments from near the mouth of the Kaiwharawhara Stream had lead and zinc concentrations which exceeded ISQG-High, and arsenic, chromium, copper, and nickel concentrations above ISQG-Low. Organic chemicals were not tested at the site.

It is worth remembering that the four groups of organic chemicals tested in this investigation are only a fraction of the organic chemicals that are likely to be present in stormwater derived from urban areas. Those not examined include aromatic hydrocarbons, phenols, phthalates, organophosphorus pesticides, carbamate pesticides, pyrethroids, herbicides and fungicides. As is the case with some of the tested chemicals, many of these do not have aquatic ecosystem protection "trigger values" assigned because of insufficient direct toxicity assessment data. Also, a number of toxic organic chemicals, such as

DDT and PAHs, bind strongly to sediment and therefore tend to accumulate in the environment.

Heavy metals and organic chemicals that bind to sediment will ultimately end up being deposited in the marine environment. Sediments in low energy areas of the marine environment, such as harbours, are therefore likely to accumulate these contaminants. The results of a number of previous studies indicate that this phenomenon is occurring in parts of both the Wellington and Porirua Harbours. The recent GWRC study of shellfish has shown that chemical contaminants from the Region's urban stormwater are entering marine food chains.

6. Conclusion

There are a number of chemical contaminants in the Region's urban stormwater, particularly some heavy metals, which are probably having, or through long-term accumulation, will eventually have, significant adverse effects on the aquatic ecosystems of some streams and of the depositional zones in the Wellington and Porirua Harbours. In addition, the Region's urban stormwater is adding significant amounts of nutrients to some streams and the harbours, which encourages the excessive growth of aquatic algae and plants. This in turn can cause other physical and chemical stressors to influence the composition and abundance of the fauna.

7. Next steps

Sampling and analytical work for the present investigation will be completed and a technical report prepared for publication this financial year. Investigation options being considered for the 04/05 and 05/06 financial years include:

- Long-term marine sediment monitoring programmes for the depositional zones of Wellington and Porirua Harbours.
- Additional pollution run-off models for urban catchments.
- Further analyses of urban stream waters for heavy metals, and of stream-bed sediments for heavy metals and PAHs.

8. Communications

Data from the Owhiro Stream and the Island Bay stormwater system, collected during this investigation, was supplied to MWH New Zealand for inclusion in a Baseline Assessment of Environmental Effects of contaminated urban stormwater discharges prepared for the WCC. Data from the Browns Stream and Duck Creek sites has been supplied to PCC for use in their infrastructure and land use planning. Data from the Gracefield site was used in a successful GW bid for SMF support of remediation planning for the Waiwhetu Stream, and also it has provided the impetus for a catchment risk assessment project in the Gracefield area by the GW Pollution Control team.

9. Recommendations

It is recommended that the Committee:

1. ***receive** the report; and*

2. ***note the contents**.*

Report prepared by:	Report approved by:	Report approved by:
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