

RESOURCE MANAGEMENT

Urban stormwater quality problems recognised

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Research into the effects of stormwater discharges on aquatic ecosystems is still at a relatively early stage and managing stormwater discharges poses difficult resource management questions.

STORMWATER is rainwater that runs off impervious surfaces, such as roofs and roads, in urban areas. In general, stormwater is directed through a system of pipes to a discharge point. The primary purpose of these stormwater systems is to remove water efficiently in order to minimise the nuisances and flood hazards that would otherwise occur. Unfortunately, runoff from urban areas picks up a range of toxic chemicals which can result in long-term environmental degradation.

Where does stormwater go?

Stormwater is often discharged into a natural watercourse, which then flows into a river, lake or coastal sea water. In New Zealand, many cities are near the coast, so the receiving environments are often coastal waters.

Where stormwater discharges into open coastal waters, waves and currents ensure that any toxins present are greatly diluted. There is generally no immediate toxicity to the animals that live in this type of high-energy environment.

However, under some circumstances there may be long-term and insidious effects from stormwater discharges. Receiving environments such as sheltered lakes, harbours or estuaries are likely to trap and accumulate particulate matter carried in the stormwater. Such low-energy water bodies are termed "accumulation zones". The hydrodynamic processes in estuaries and harbours tend to "pump" fine particles towards the head of the estuary, so most of the fine particles discharged become part of the bottom sediments.

Accumulation zones are characterised by fine, muddy sediments, such as those found in estuaries and upper harbour areas.

Effects on benthic animals

It is accepted that stormwater runoff can cause a build-up of toxic substances in marine sediments (see panel below). How does this affect marine benthic organisms? Because the changes occur gradually, the impacts are not dramatic. However, increasing contaminant concentrations can cause detrimental long-term changes without directly killing organisms. These are "sublethal" effects.

Laboratory and field manipulation experiments at NIWA and Auckland University have identified a range of responses to sublethal toxicity in estuarine biota. They include:

- Physical impairment:
 - reduced reproduction in oysters
 - retarded growth rates of juvenile shellfish and amphipods
 - physical deformities in flounder and oysters;
- Behavioural changes:
 - avoidance of contaminated sediment
 - migration of juvenile shellfish but not adults
 - reduced burrowing rates of shellfish.

What's in stormwater?

VARIOUS CHEMICALS and materials are found in urban stormwater. A few distinct groups are characteristic: suspended solids, nutrients, toxic substances and micro-organisms. Of these, suspended solids (especially catchment soils eroded during land development) and toxic substances impact directly on the bottom sediments in accumulation zones.

Most of the toxic substances found in stormwater are incorporated on or in suspended particulate matter. Therefore suspension and transport of particles is the

principle mechanism of transport of toxic substances through the stormwater system to the receiving environment.

Toxic substances in stormwater are heavy metals, petroleum and other synthetic hydrocarbons, and pesticides. Most of these toxins are persistent (they do not break down but persist in the environment). Therefore their concentration will increase if they continue to be added to an accumulation zone.

Road transport activities are a major source of heavy metals, e.g., copper, zinc and lead

(although the latter source is largely from historic use of leaded petrol). Traffic also produces poly-aromatic hydrocarbons (PAH) which are toxic and break down very slowly in the environment.

NIWA scientists, in conjunction with the Auckland Regional Council (ARC), have been developing a model which predicts the build-up of contaminants in the sediments of estuaries which receive stormwater discharges. The work is funded jointly by the ARC and the Foundation for Research Science and Technology.

This model assumes that 75% of the suspended sediments discharged in urban stormwater are retained in the estuary and settle in 4% of the catchment area. These assumptions are based on design criteria for stormwater treatment ponds in the Auckland metropolitan area.

The model has successfully predicted the build-up over successive storm events of copper, zinc and lead in two urbanised estuaries. It has yet to be tested for estuaries receiving treated stormwater runoff.

