DESIGN RIGHT

Hydraulic neutrality

With urban densification putting a strain on infrastructure services, some councils now require stormwater to be dealt with in situ, easing the strain on public systems.

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FOR ANY BUILDING or development site, the area of ground able to absorb rainfall is reduced by the roofs of buildings and hard surface areas such as driveways and paving. The soil type also influences how much and how quickly water can be absorbed.

This means that water previously absorbed on an undeveloped site is typically discharged into a council stormwater system instead. The increasing density of urban and suburban development has significantly increased the stormwater load on public utilities.

Move to hydraulic neutrality

To address this and potentially reduce the need for costly stormwater system upgrades, several councils have adopted the principle of hydraulic neutrality, also known as stormwater neutrality or hydrological neutrality. With this approach, any rainfall on a site must be retained and disposed of on that site. No stormwater is to be discharged into the public stormwater system, either piped or by street drainage.

The aim is that no additional demand is placed on existing stormwater systems from new developments so that the risk of stormwater flooding in heavy rain events is reduced. A side benefit is the recharging of aquifers and the maintenance of groundwater levels.

Stormwater flood management varies

The Resource Management Act (RMA) is the primary legislation for the sustainable management of natural and physical resources. It assigns key roles and responsibilities for resource management to regional councils and territorial authorities, who in turn set out policies and rules for stormwater management.

Although the RMA covers flooding as a natural hazard, flooding as a result of extreme stormwater flows is not specifically covered in the Act. This has led to inconsistencies in how stormwater is dealt with nationally. For example, some councils reference New Zealand Building Code clause E1 *Surface water* for dealing with flooding, while others reference NZS 4404:2010 *Land development and subdivision infrastructure* for specific flood protection design requirements.

What causes stormwater flooding?

Stormwater flooding can occur after extreme rainfall events as a result of:

- rainwater that has not soaked into the soil accumulating on lower-lying areas
- drainage of stormwater being restricted by high tides or river and creek levels
- backflow up water courses during a high tide or river flood
- floodwater that has spilled over banks of streams and rivers as a result of too much stormwater draining into the waterways.

Managing stormwater run-off

The level of ground infiltration or absorption is affected by the amount of impermeable surface area. Urban development typically results in an increase in the amount of hard surfaces, so run-off must be managed on each site to ensure that the post-development peak water run-off is no greater than the pre-development peak water run-off.

Generally, this means dealing with water on site. Methods that can be implemented to achieve hydraulic neutrality include:

- improving soil infiltration or the ability of the ground to absorb water
- water flow attenuation or reducing the rate at which the water can flow away from an area so that the permeable ground is able to absorb the moisture, albeit at a slower rate
- on-site storage and disposal of all rainwater incidents on the site from roofs and paving, for example.

Gravelly and sandy soils readily absorb water so hydraulic neutrality can often be achieved by ensuring that stormwater is disposed of by infiltration on site.

Peat, clay or silty soils cannot absorb large quantities of water, so on-site storage in ponds or holding tanks – together with an on-site soakage or drainage system – may be required to achieve hydraulic neutrality.

Kāpiti Coast case study

Hydraulic neutrality is required for all new residential projects on the Kāpiti Coast. A driver for this has been that much of the residential areas are low lying and located inland of elevated dunes, which makes the area vulnerable to flooding from poor stormwater drainage.

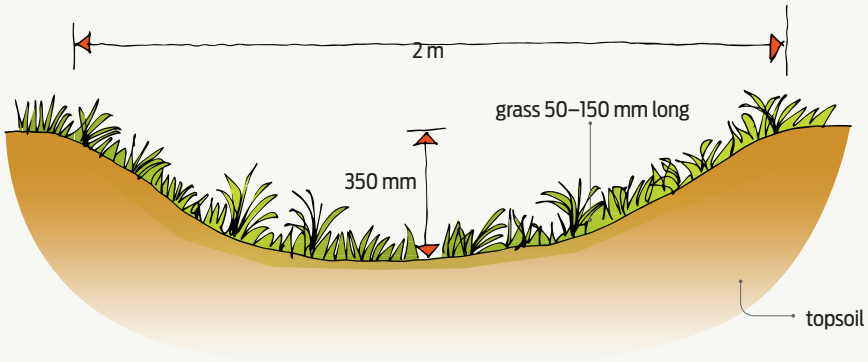

Figure 1 **Cross-section of a grass swale.**

No additional hazard from developments

The Kāpiti Coast District Council through the district plan applies sections 6 and 106 of the Resource Management Act. Policies place the responsibility on an applicant to show that there will be no additional hazard as a result of any proposed development.

In essence, the council requires all new residential buildings or developments to be provided with the means of managing stormwater by incorporating suitable stormwater retention capacity on site at peak periods to achieve hydraulic neutrality.

Ways to achieve hydraulic neutrality

The council suggests several methods to achieve hydraulic neutrality:

- Provide on-site water storage using either wet or dry ponds to contain and hold run-off and release it at a specified rate. Wet ponds are permanent pools of standing water, while dry ponds temporarily store stormwater run-off but are dry between storm events.
- Install water retention tanks in combination with on-site (overflow) soakage.
- Reduce or avoid non-permeable outdoor areas.
- Install outlet constraints on drainage outlets to reduce the rate of flow – for example, baffles or a sump in the base of a manhole.
- Install grassed swales or filter strips – these are broad, shallow grassed channels with gently sloping sides into which water can flow and slowly infiltrate into the soil (Figure 1). Swales may be lined to direct run-off or have a rocky base to slow down a fast flow of water.
- Install rain gardens – these are planted areas set in a shallow depression into which water can flow and slowly infiltrate into the soil (Figure 2).

Both swales and rain gardens are easy to establish and maintain and are more appropriate in larger-scale urban design. As well as providing stormwater run-off control, they help remove sediments and contaminants from the stormwater as it filters through the soil before discharging to a downstream stormwater system or waterway.

Auckland design approach

In Auckland, the water-sensitive design component of the Auckland Design Manual is essential to support the vision of the Auckland Plan. It promotes land use planning practices that balance land development with the ecosystem services necessary to support it.

Water-sensitive design is an inter-disciplinary design approach that considers stormwater management in parallel with the sensitivities of Auckland's harbours and watercourses, ecology of a site, best-practice urban design and community values.

Christchurch guidance

In Christchurch, guidance states that even small sites – less than 1,000 m^2 – can have a negative effect on stormwater. When this is combined with hundreds of other small sites, the effect can be significant. It is therefore important to mitigate these effects to help clean up streams and reduce flooding. This can be achieved, in order of preference, by:

1. reducing the amount of run-off generated within the site by minimising the impervious surfaces
2. increasing the amount of water soaking into soil, such as through soakage systems, permeable pavement or rain gardens
3. holding back as much of the run-off as possible using a stormwater storage system and releasing it slowly.

The council has criteria to determine whether or not a site requires mitigation:

- All hill sites – greater than 5º slope – are required to install rain tanks or other suitable mitigation devices when new development or intensification takes place.
- Flat urban areas require mitigation only if:
  - the additional impervious area added is greater than 150 m^2
  - the resultant impervious area covers more than 70% of the total site area.

Changes needed in designs

Hydraulic neutrality has implications for designers and landscapers, who need to assess the best design options for the site and ➤

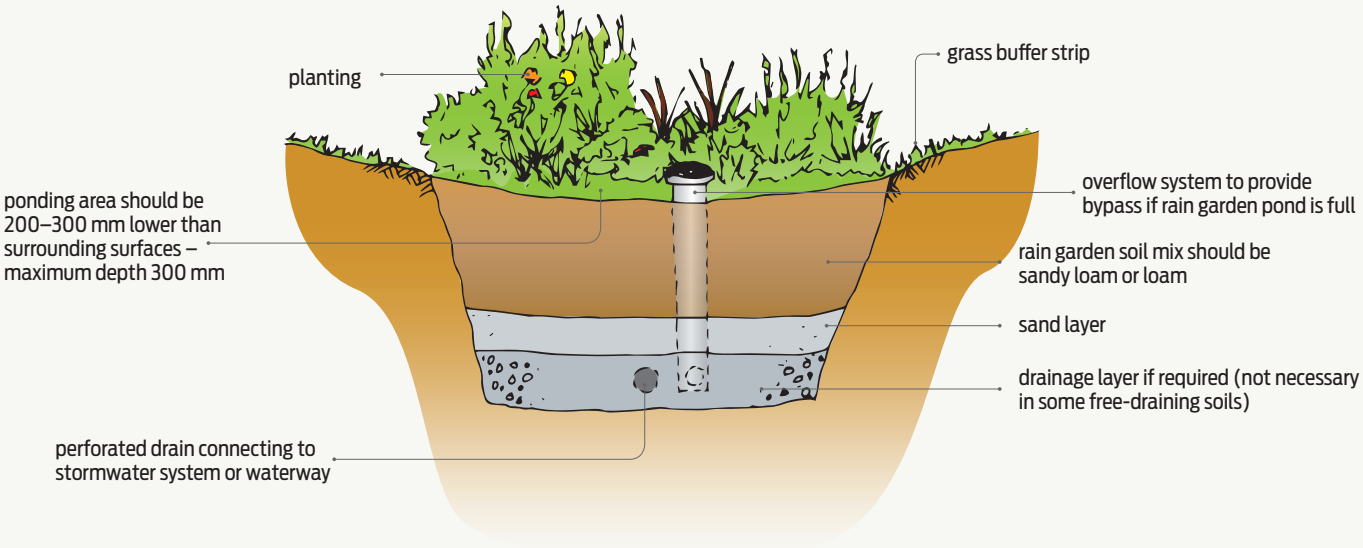

Figure 2 **Cross-section of a rain garden.**

include the details in the building consent documentation. Options include:

- incorporating drainage channels that drain to a tank or soak pit from the low point of all areas of impermeable paving or surfaces – for example, concrete driveways
- allowing sufficient space or clearance from buildings to rainwater holding tanks
- on tighter sites, incorporating innovative solutions to provide stormwater storage such as underslab or driveway tanks or fence panels that can store water.

There may also be specific rules that apply to sites being developed to compensate for any lost ponding or flood storage capacity. For example, suitable ground or floor levels and flood-free access can be achieved by raising the ground level with suitable fill, but filling one ponding area will push the water on to other properties. To avoid this, compensatory storage – adding an equivalent ponding area elsewhere – is likely to be required.