Appendix F
Management Options

Introduction

There are many pathways to improving and minimising the effects of stormwater on our waterbodies within the Wellington Region. They range from:

- Minimising the effects / impacts of new development – Stopping the cycle of degradation.
- Targeted improvement activities across our existing stormwater networks.
- Working collaboratively with others to lift our overall relationship with water through education programmes.

We have listed and discussed the options in the three tables in this appendix. We expect that most, if not all, will be used at some point during our journey to wai ora. And that over the course of that journey new options will become available and will be incorporated, following good management practice.[1]

Good management practice evolves through time and results in continuous improvement as new information, technology and awareness of issues are developed and disseminated. Examples of good management practice guidelines for stormwater can be found on the Greater Wellington Regional Council's website.

Stormwater Management Options

"A paradigm shift in stormwater management moves from "to collect, convey, discharge" to a more integrated approach of "slow it down, spread it out, and soak it in."[2]

Wellington Water will use a range of approaches to manage stormwater quality. The management options outlined below identifies integrated approaches to manage the quality of water entering the stormwater network, which is then discharged to the receiving environment.

We will encourage our wider community to deliver integrated catchment solutions, that are in line with the principle of **ki utu ki tai**. As such, we will seek opportunities for encouraging that all developments and catchments apply the principle of the Treatment Train.

The treatment train is based on a logical sequence of stormwater flowing through a catchment, beginning with stormwater runoff controls at-source, followed by capture and treatment of overland flows, and finally the enhancement of receiving environments to enhance their stormwater management function.

Stormwater can be managed at a range of scales in the urban environment. Managing it at source is one of the most efficient ways of reducing harmful impacts on waterway.

The toolbox is made up of non-structural approaches through policy and planning, education and engagement and structural approaches through stormwater management assets consistent with WSD guidelines that provide the management of stormwater runoff and contaminants. The toolbox aims to provide a holistic solution that balances both structural and non-structural components for the benefit of both the environment and the community and is shown in Figure F 1.

[1] *Good management practice is defined as: Practices, procedures or tools that are effective at achieving the desired performance while contributing to the providing for desired environmental outcomes.*
[2] *Waikato Stormwater Management Guideline 2020*

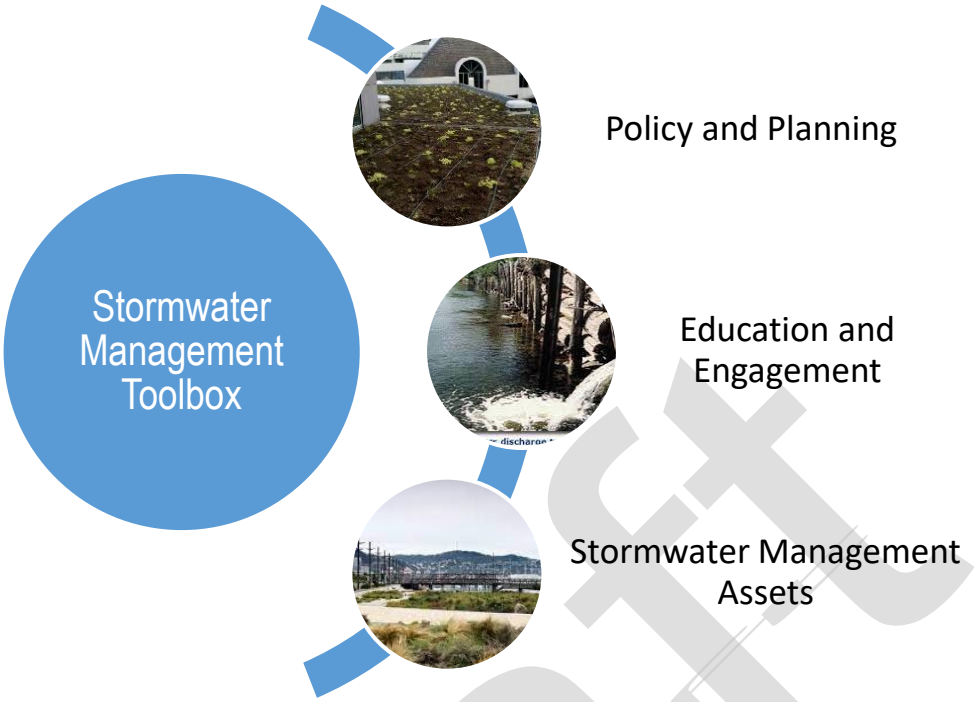

Figure F 1 Our approaches to influence better stormwater outcomes.

Water Sensitive Design

Water Sensitive Design (WSD) is a best practice approach for stormwater management to reduce run-off volume and contamination and has been successfully applied throughout the world and are becoming increasingly common practice here in Aotearoa New Zealand. It is achieved through integrating stormwater management with the ecology of a site; whilst also factoring in urban design and community values. WSD seeks to protect and enhance natural freshwater systems, sustainably manage water resources, and mimic natural processes to achieve enhance outcomes for ecosystems and our communities. WSD can also assist with hydraulic neutrality objectives by minimizing impervious areas and promoting infiltration and rainwater storage.

In 2014, Wellington City Council took the first step towards managing stormwater through WSD practices through the release of a guide for WSD of stormwater management in Wellington. This guideline introduced WSD concepts for a wide audience and outlined a high-level picture for WSD for Wellington City that can be applied at a range of scales from brownfield site specific developments through to new greenfield developments.

In 2019 Wellington Water produced a detailed design guideline for four types of treatment devices, wetlands, raingardens, swales and permeable pavements.

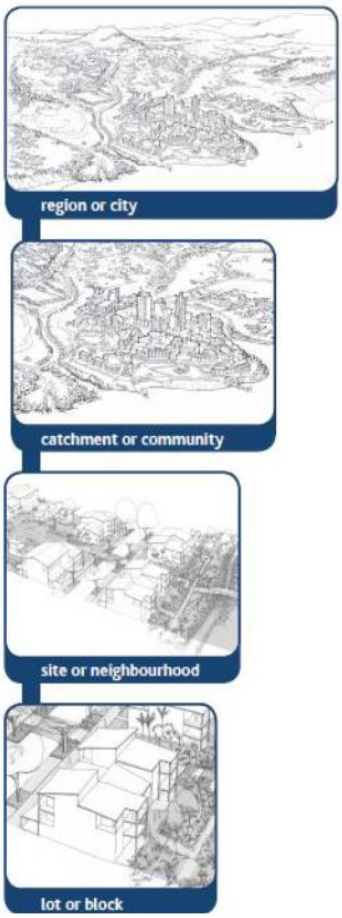

Figure F 2 Cascading WSD taken from GD04

The key principles of the WSD philosophy (GD04, 2015) are:

- Promote inter-disciplinary planning and design process
- Protect and enhance the values and functions of natural ecosystems
- Address stormwater effects as close to source as possible
- Mimic natural systems and processes for stormwater management

These principles are given life by using a combination of land-use planning controls and built infrastructure at varying scales across the region. Figure F 2 is borrowed from GD04 and depicts this idea of scale – cascading WSD from the region down to the individual lot scale.

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Preferred Option

As a starting point we have considered below in Table F 1 some common issues that we will have to manage and listed the preferred options below for addressing them in the early days of implementation.

Table F 1 Common issues that we will have to manage and preferred options for addressing these issues.

Stormwater from new impervious surfaces discharging into the network	Stormwater from new impervious surfaces from greenfield and brownfield development over 3000m²	Monitoring results identifying degraded water quality from contributing urban catchment
Follows Water Sensitive Design & Hydraulic Neutrality requirements / principles.	Development of a SCaMP*[3]	Launch a holistic catchment investigations programme
Treatment Train approach favouring source control	Follows Water Sensitive Design & Hydraulic Neutrality requirements / principles.	Identify key sources of contaminants of concern

[3] *If suitable, adopted SCaMP not already in place.*

Adheres to RSWS.	Treatment Train approach favouring source control	Review / undertake SCaMP
Identifies and shares resources to support on-going operation and maintenance.	Adheres to RSWS.	Model interventions and determine most effective approach
	Identifies and shares resources to support on-going operation and maintenance.	Invest in response: Policy response Structural or non-structural solution
		Ongoing Operation & Maintenance, and monitoring for change.

Combining Options

Many factors influence the design, implementation, maintenance, and cost of individual management options. Devices should be considered on a case-by-case basis against performance criteria which include catchment conditions, topography, soakage, and total site area through SCaMPs. A combination of devices, a treatment train, will be favoured to meet the two primary functions, attenuation and treatment.

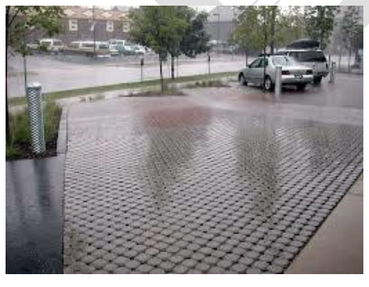
Approaches

Sustainable stormwater management requires stormwater devices that are well planned, designed, constructed, and maintained to reduce the impacts of stormwater, deliver multiple outcomes for the community, and protect waterways and harbours. Stormwater management should follow a treatment train approach by using the principles of WSD at the source and along its pathway to the receiving environments.

Structural Approaches

Table F 2 below illustrates the range of stormwater management assets that will be implemented across the urban areas covered by this SMS. The efficiency of these devices to manage flooding, scour and removal of contaminants from stormwater is dependent on the characteristics of the site where they are implemented such as, local topography and scale, as well as the specific design features of the management device.

Table F 2 Range of stormwater management assets that will be implemented across urban areas covered by this SMS.

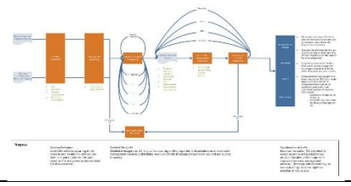
Stormwater Management Option		Type of Option & Applicability		Example of Implementation	Effectiveness to achieving Minimum Standards L=Low M=Medium H=High						Source Pathway Receptor	Location Suitability	Benefit	Drawback	Objectives Achieved?
					Nutrients		Erosion (TSS (Total Suspended Solids))	E. coli (Bacteria)	Heavy metals						
Option	Description	Option	Wellington Water Applicability		Nitrogen	Phosphorus			Zinc	Copper					
STORMWATER ASSET MANAGEMENT: Enhance natural freshwater systems, sustainably manage water resources, and mimic natural processes to achieve enhanced outcomes for ecosystems and our communities, through the combination of concrete and natural structures that involve minimal construction or earthworks, and planting vegetation to reduce or delay stormwater flow and or remove pollutants to increase the overall stormwater quality. With the goal to build maintain and improve these stormwater management assets through implementation of WSD.															
INFILTRATION SOAKAGE															
Vegetated Swales – Quality an/or Quantity	Vegetated swales can be mown grass or any vegetation types that is stable under stormwater flows. Convey and treat stormwater runoff.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		H	M	H	M	M	M	Source and Pathway	Mid-catchment High and low-density areas. Group residential and commercial land use	Filter sediments, nutrients, and other contaminants before discharge to receiving environments	Could be limited by space between properties and road.	% of Plant cover and success and survival – design standard for minimum standard New vs retrofit. What is the acceptable % for retrofit of certain catchments
Filter Strips - Quality an/or Quantity	Filter strips are gently sloping, vegetated areas adjacent to impervious surfaces. ("Vegetative Filter Strips—A Best Management Practice for Controlling ...") They are intended to reduce impacts of sheet flow and velocity of stormwater and improve its water quality.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		M	M	H	M	M	M	Source and Pathway	Mid-catchment High and low-density areas. Group residential and commercial land use	Integrated into existing or proposed landscape elements.	Limited by slope	A minimum standard could be, at a regional scale 60 % of urban catchment is treated in a swale
Pervious Pavement	A pervious pavement is designed to facilitate and maximise rainfall infiltration through the pavement for stormwater benefit. Beneath the paved surface is an aggregate material that acts as a temporary reservoir, allowing for run-off to slowly infiltrate into the ground.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	L	H	L	H	M	Source	At source Individual residential and commercial land uses Small catchment areas with low traffic volumes such as residential streets, driveways, and small carparks.	Close to source management Filtration and sedimentation of contaminants	Not suitable on site with heavy commercial vehicles Regular inspection and maintenance	

Infiltration Trenches and Site Wide Infiltration	Trench containing gravels and provides treatment and disposal of stormwater. Some treatment is provided by gravel in the trench, but most treatment is provided by adjoining soil. Usually used in treatment train with filter strips.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	M	H	L	H	H	Source and Pathway	Mid-catchment All land use types	Contributes to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes.	Risk of slope instability due to infiltration Risk of groundwater flooding due to infiltration. Limited by ground conditions and soils	Need roading to maintain. May need new targeted rate.
BIORETENTION															
Bioretention: Raingarden, tree pits, planter boxes - Quality	These practices use specific soils and plant materials to manage stormwater effects. Tree pits are essentially raingardens with a single tree rather than smaller foliage plants. Planter boxes are usually lined bioretention areas which receive point source runoff from rooftops or adjacent hard surfaces. ("Bioretention - Auckland Design Manual")	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		M	H	H	H	H	H	Source and Pathway	Mid-catchment Urban and high-density areas; often suitable for carparks and side street locations.	Treat stormwater through, sedimentation, filtration, infiltration, absorption, and biological processes. Soft engineering; adds amenity and ecological value to the landscape. Disperse device provide resilience against single device failure and supports integrated stormwater management.	Ongoing maintenance If private it relies on private property owner to undertake operation and maintenance	Experience is that private raingardens are not maintained or understood.
PROPRIETARY TREATMENT DEVICES															
Gross Pollutant Trap	Treats stormwater prior to filtration devices or discharging points into wetlands and ponds. Designed to capture large diameter sediments, plastic, litter, leaves and oils.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	L	M	L	L	L	Source	Base catchment Group residential, Commercial, and Industrial land use areas. Small to medium catchment sizes.	Removes large non-biodegradable pollutants. Can be used stand alone or in a treatment train Pre-treatment to other options	Not suitable for removing fine sediment and dissolved pollutants Regular maintenance to clear system	

Sand Filters - Quality	Capture sediments, oils, and grease before solids before it is disposed to secure landfills.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		M	M	H	M	H	H	Pathway	Mid-catchment High density residential, commercial, and industrial areas where the percentage of impervious surface is high and there are space restraints. Best suited to catchments less than 4 ha.	Can be easily added to existing structures Groundwater recharge		
Hydrocarbon Management / Oil and Water Separator	Designed to separate hydrocarbons, oil, and grease from stormwater. Best used in combination with non-structural controls such as oxidation and biological microbial decomposition mechanisms	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	L	L	L	L	L	Pathway	Mid-catchment Commercial and industrial areas	Can be located underground to minimise visual impact	Not efficient in removing nutrients, sediment, and heavy metals.	
STORAGE AND DETENTION SYSTEMS														
Wetlands	Mimics the treatment processes of natural wetlands for detention, fine filtration, and biological adsorption, to remove contaminants from stormwater runoff.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		M	M	H	M	H	H	Pathway and Receptor	Base catchment Group residential, Commercial, and Industrial areas. Suitable for large and low-density catchment areas with sufficient open space	Attenuation of flood flows, water quality treatment, and supports aquatic plants and wildlife. Provides biodiversity and habitat opportunities. Increases amenity and aesthetics	Requires a large area to receive and treat stormwater so not suitable for small and high-density catchment areas	
Dry Detention Ponds (with extended detention)	Primarily used to store water during a particular storm event and slowly release the water over an extended period to alleviate peak flow	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	L	M	L	L	L	Pathway and Receptor	Base catchment Suitable for large low-density catchment areas with sufficient surface area. Group residential and Industrial	Helps to control volumes and flood risk in the downstream receiving environment.	Pre-treatment is needed to remove contaminants in the upstream network to assist with long-term operation and maintenance of these devices	

Wet Retention Ponds	Natural means to store stormwater. Pond that holds stormwater runoff permanently. Contains, and holds runoff allowing stormwater to build up on site.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		L	M	H	M	N/A	N/A	Pathway and Receptor	Base catchment Suitable for large low-density catchment areas with sufficient surface area. Group residential and Industrial	Can cater to both quality and quantity management Can be used when groundwater is vulnerable High ecological, aesthetic and amenity benefits. Retention promotes pollutant removal through sedimentation and the opportunity for biological uptake mechanisms.	Not suitable for steep sides, due to requirement for high embankments Without proper maintenance, nutrients such as nitrogen and phosphorus that are typically found in stormwater runoff can accumulate in stormwater ponds and wetlands leading to degraded conditions such as low dissolved oxygen, algae blooms, unsightly conditions, and odours.	
CONVEYANCE SYSTEMS														
Riparian Buffers	Riparian buffers act as biological filters between catchments and receiving environments, intercepting a significant proportion of groundwater nutrients. Stormwater runoff is slowed and filtered, with direct uptake and transformation of contaminants by plants. Vegetation and humus layers attenuate significant volumes of water, promoting infiltration into the soil and releasing it over a longer time to contribute to stream base flows and to support riparian vegetation.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence through controlling access to network (Regional Standards)		H	H	M	H	H	H	Pathway and Receptor	Mid to base of the catchment Areas where streams and rivers have no buffer between the stream and infrastructure.	Biological filter between catchments and the receiving environment Greater width of buffer the more benefits to stream health. However, effectiveness is influenced by slope, soil composition and drainage patterns etc.	Need the area and room between the stream and associated infrastructure.	

Living Streams	Constructed or retrofitted waterways that mimic the characteristics of natural streams. Usually come with riparian buffers that provides habitats for ecosystem health	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence key stakeholders and support Whaitua initiatives.		H	H	M	H	H	H	Pathway and Receptor	Mid-catchment Area with degraded natural streams or open drains with significant flows	Conveys runoff in highly urbanized areas and provide treatment. Healthy fringing and aquatic vegetation act as a biological filter. Organic and inorganic material can be filtered by living streams.		
Stream Daylighting	Process of restoring a stream which was once diverted to its original channel aboveground. These streams were channeled underground to accommodate for the development of an area. Obstructions that cover a river or creek are removed and the waterway is restored to its previous condition.	Existing / New Assets (Projects)	Limited to WWL sites / projects. Influence key stakeholders and support Whaitua initiatives.		M	M	M	L	L	L	Pathway and Receptor	Mid-catchment Highly urbanised areas with remaining open space	Increases the area available for water to pass through an area which increases storage capacity and reduces peak flows Enhance nutrient retention, improve channel habitation, and restore floodplains		
ASSET MANAGEMENT / OPERATIONAL & MAINTENANCE PROGRAMMES														
Asset Investigation Programme	Inclusive of cleaning, repairs, and condition assessment. All WWL Assets	Program / A.M / Operations	High								ALL				
Street Cleaning	Sweeping & Sump cleansing of paved assets.	Program / A.M / Operations	Limited. Influence Road Controlling Authorities								Source & Pathway				
Modelling & Mapping Programmes	Comprehensive programme of modelling and mapping flood risk, water quality & water quantity	Program / A.M / Operations	High								ALL				

Urban Watercourse Assessment programme	Baseline information on the existing condition of waterways in both urban and rural settings.	Program / A.M / Operations	High Support erosion & sediment			ALL				
Green Infrastructure Maintenance Programmes	Inspection and ongoing maintenance of G.I assets – Cyclical renewal of asset	Program / A.M / Operations	Limited. Influence Asset Owners.			ALL				Potential way to measure – 100% of the maintenance programme delivered (effectively)
Non-Residential Site Assessments	On site evaluation of Commercial & Industrial properties that have the potential to contribute to poor water quality in the stormwater discharges	Program / A.M / Operations	High. Controlled activity through Waste Permits		Need to look to high-risk sites and more frequently. Engagement survey approach to ensure a positive image of WWL. Potential way to measure success – 60% of all industrial sites are investigated annually.	Source				

*Note:
The above removal effectiveness of each device is only to be used for guidance. Many things influence stormwater pollutant removal devices, specific plant traits, filter media specification, stormwater device dimensions and appropriate regular maintenance, thus the removal rates will change depending on these factors. The level of contaminant removal will be subject to the provision of treatment system volume or surface areas relative to catchment run-off.

References:
Effectiveness of the removal of TSS, nitrogen, phosphorus, E.coli, zinc and cooper for proprietary treatment devices, bioretention devices, infiltration devices and detention, storage devices and conveyance systems listed above have been taken from the Waikato Stormwater Management Guideline, Stormwater Management Guidelines for the Bay of Plenty Region, Stormwater Management Devices in the Auckland Region (GD01) and Water Sensitive Design for Stormwater: Treatment Device Design Guideline (Wellington Water Document)

Non-structural Approaches

Non-structural stormwater management approaches are designed and implemented at the regulatory or community level to minimise contaminants from entering the stormwater network and to mitigate the effects of flooding and scour. The approaches are complimentary to structural approaches and involve shifting mindsets and behaviour through policy, planning, education, and engagement, such as awareness programs, government regulation and policy or economic incentives.

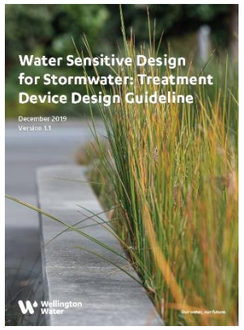
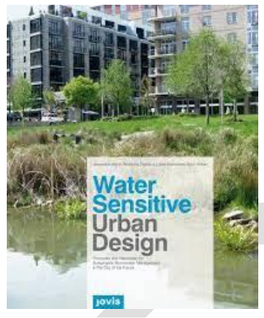
The identification of policy and planning initiatives enable good management practices for urban stormwater runoff through strategic planning, statutory controls, and regulatory actions. These are set in place before physical works begin therefore providing clear direction and guidance which can minimise contaminants in our stormwater. To ensure this, Wellington Water will work closely with regional and district councils to address stormwater management in new and existing urban areas. Table F 3 below illustrates the range of stormwater management related to policy and planning that can be implemented.

Education and engagement programs are a catalyst for behavioural change and a tool to raise awareness for stormwater management and reconnect communities with their waterways. Table F 4 below illustrates the range of education and engagement approaches that can be used as management options for stormwater quality.

Table F 3 Range of stormwater management related to policy and planning that can be implemented.

Stormwater Management Options		Type of Option & Applicability		Example of Implementation	Effectiveness to achieving Minimum Standards L=Low M=Medium H=High						Source Pathway	Location Suitability	Benefits	Drawbacks	Objectives Achieved?
					Nutrients				Heavy Metals						
Option	Description	Option	Wellington Water Applicability		Nitrogen	Phosphorus	Erosion (TSS)	E. coli (Bacteria)	Zinc	Copper					
STRATEGIC POLICY, PLANNING AND REGULATIONS: Identification of framework of requirements, policy, and initiatives to enable good management practices for urban stormwater runoff through strategic planning, statutory controls, education, and regulatory actions. Set in place before physical works begin therefore providing clear direction and guidance which can prevent, minimise, or remedy adverse effects.															
STORMWATER DESIGN GUIDELINES															
Green Roofs Policy	Green roofs are a layer of living plants growing on top of a roof. A green roof is not a collection of individual plants but an extension of a conventional roof that involves installing a layer of membranes, substrate, and plants.	Policy / Program	Low Influence District Plan		H	H	H	L	L	L	Source	At source Suitable for any type of catchment. Good option for high density urban areas where there is less space for larger treatment devices	Decrease urban temperature Low contaminant discharge potential and hence it is considered that runoff from these surfaces does not require water quality treatment. Noise insultation, enhance air quality, reduced the energy demand of buildings Provides biodiversity and habitat opportunities Mana whenua alignment.	Cost and supply to install Added structural design requirements. Potential fire risk if not designed properly. Building materials needed for roofs to be suitable to hold plants and soil matter etc.	Uncertainty around how we could require private developers to implement this due to perceived maintenance costs.
Roof Materials Policy	Painting galvanised iron roofs to prevent zinc entering stormwater, avoiding the use of copper roofing and guttering materials and those incorporating permanently exposed zinc coated surfaces	Policy / Program	Limited to WWL owned facilities. Influence District Plan		H	H	H	L	H	H	Source	At Source Residential, commercial, and industrial	Ideal in places where source control is likely to be a more appropriate option than providing treatment of stormwater practice Illuminates the source of heavy metals that	Cost to implement and source roof materials. Buildings will have to be retrofitted with roof linings that can hold new materials etc.	Not just roofs but all building materials Creates an opportunity to strengthen industry links What about existing roofs?

													usually come from corrugated iron roofs		
Rainwater Harvesting Policy	Rainwater tanks attenuate and re-use stormwater from rooftops of buildings and landscape areas. Provides a non-potable source of water. Can be placed partially underground or underneath eaves of buildings.	Policy / Program	Limited to WWL owned facilities. Influence District Plan		M	L	H	M	H	H	Pathway	At source Below ground in high density areas as limited space Above ground in areas with more available space such as rural properties	Removes contaminants from roofs. Meet some the developments water demand, delivering sustainability and climate resilience benefits Reduces pressure on existing Puna for water supply Reduced volume of runoff from a site.	Required periodic checking and maintenance Cost of the system, pump and the power required for the operation, especially if for private residential use.	Design guides can be changed more easily than the planning policy which often already addresses this. So could require treatment prior to discharge as part of an update to the design guide, integrating this into the DP however would require a schedule 1 process. This should also consider internal plumbing for toilets etc. This reduces potable water demand and enhances retention performance. There are also technologies that allow for centrally controlled rain tanks that can purge before rain events. potentially add measure that will incentivise retrofit of devices to areas that are not planned for redevelopment
CODE OF PRACTICE														
Risk assessment and environment management systems by	Risk assessments and environmental management systems can identify, characterise, and manage the associated	Policy / Program	High Programme level		It is challenging to manage stormwater at the catchment or region wide scale due to the range of pollutant sources and resource limitations. Risk assessments involves assessing the different sources of pollutants, prioritising them and allocating resources to manage them. For example, using a risk-based approach to prioritise catchments.						Source, Pathway, and receptor	Everywhere in the catchment All land use types.	Identifies key risk and concern areas within the region/ catchment		

local authorities	stormwater risks with each catchment.									
Develop stormwater management strategies at a “city scale”	Plans to guide decision-making on how stormwater quantity and quality is managed in a holistic and integrated matter in urban development, which is the over-arching purpose of this SMS.	Policy / Program	High Inform WWL activities		These strategies can then guide and inform the development of stormwater management plans which document the design proposed for a particular development area.	Source, Pathway, Receptor	Everywhere in the catchment All land use types.	Provides an integrated and holistic view towards stormwater management		
Stormwater Design Guidelines (For example: Water Sensitive Design for Stormwater: Treatment Device Design Guideline)	Communicates the requirements for the design of stormwater treatment devices in publicly owned assets and provides best practice guidance for the design of stormwater treatment devices where devices are to remain privately owned.	Guidelne	High Influence through controlling connection to network		Supports the use of good management practices through the release of standards, guidelines, and technical practice. Provides guidance for the concept, preliminary and detailed design phases pf a stormwater treatment system Ensures new treatment devices are functional, optimised, maintainable, safely designed, and mindful of community values.	Source, Pathway and Receptor	Everywhere in the catchment. All land use types.	Incorporates WSD principles In alignment with Whaitua Documents and mana whenua.		
Hydraulic Design	Takes into consideration, Safety during construction, maintenance and operation, Integration with other design elements, Integration with and around other services, Constructability, Maintenance requirements, Whole of life considerations.	Guideline	High Influence through controlling connection to network		Seeks to protect and enhance natural freshwater systems, sustainably manage water resources, and mimic natural processes to achieve enhanced outcomes for ecosystems and our communities. WSD (Water Sensitive Design) provides an approach which will contribute to achieving the vision and strategies of the Whaitua Documents and Resource Consent Conditions.	Source, Pathway and Receptor	Everywhere in the catchment All land use types.	Incorporates water sensitive and low impact design principles Utilises stormwater management areas for multiple uses.		
Servicing and infrastructur e standards	Servicing and infrastructure that is planned to service proposed development is to connect with the wider infrastructure network in an integrated, efficient, coordinated, and future proofed manner	Guideline	High Influence through controlling connection to networ		Standards within regional and district plans that for do not allow for use and development in areas where it is unable to be efficiently integrated within the existing infrastructure in an efficient and cost-effective manner.	Source, Pathway and	Everywhere in the catchment All land use types.			
OTHERS										
Target Rates through stormwater bylaws.	Setting target rates for operating devices and including them in SCaMPs (stormwater Sub-Catchment Management Plan). E.g., in Auckland, community elected to pay an additional	Policy / Program	Low Invfluence District Plan			Source, Pathway and Receptor	At Source Residential, industrial, and commercial	Helps mitigate a range of storm intensities and volumes Initiatives to decrease contamination of stormwater	Willingness of public to get behind – increase in costs may deter people	

	stormwater tariff to invest in water quality														
Copper-free or reduced copper brake pads	Metallic brake pads are commonplace throughout the world. Here in New Zealand most brake pads fitted to our vehicles contain copper and other heavy metals like mercury, lead, cadmium, and chromium. Low copper and copper-free friction materials used in brake pads can now outperform other friction materials and they do not compromise vehicle safety or performance. ("The hidden pollutant in our brake pads - Environment Canterbury") The cost of installing copper-free or reduced copper brake pads is only about $10-15 more expensive than traditional pads and they are easily available.	Policy / Program	Limited to WWL asset fleet procurement decisions. Influence National Policy and Direction.		N/A	N/A	N/A	N/A	H	H	Source	At source Suitable for all locations	Decrease in copper contaminants from vehicles Sustainable and resilient option	Supply demand. People not wanting to spend more	Electrification of the vehicle network (regenerative braking is much lower in contaminant generation)
Financial Levers, Incentives and Assistance	May involved but not limited to, rates rebates, grants and subsidies, targeted rating schemes, repayment schemes etc.	Policy / Program	Medium. Influence Funding regimes through negotiations with parent Councils.		Incentives based on 'polluter pays' and 'user pays' principles may be used to assist in implementing stormwater management controls. This should be decided upon through consultation with community groups to minimise resistance. Existing similar schemes include 'warm wellington' and the insultation grant schemes.						Source, Pathway and Receptor		Financial incentives or support may be useful in enabling privately owned infrastructure repairs replacement, or to incentivise uptake of new materials and technologies to replace dated infrastructure known to be prone to failure.		

Table F 4 Range of education and engagement approaches that can be used as management options for stormwater quality.

Stormwater Management Options				Benefits	Drawbacks	Objectives Achieved?
Option	Type	Wellington Water Applicability	Description			
EDUCATION AND ENGAGEMENT: Education and participation programs are a catalyst for behavioural change and a tool to raise awareness for stormwater management and reconnect communities with their waterways. Leads to community led initiatives and volunteer effort. Can be developed through Open Databanks, Public outreach, and educational campaigns, and Educational WSD.						
EDUCATION						
Short course or training on aspects of stormwater management	Program / Capability	Medium	For volunteer residents or 'champions' that focus on source controls that minimise stormwater pollution, particularly nutrients. Topics that can be covered include water conservation, plant selection, fertilizer use, irrigation practices, composting and shallow groundwater reuse.	Programs/courses can range from community level to regional scales. Holistic approach to promote best practice in stormwater management. Community become aware/champions in different topics such as water conservation, plant selection, fertiliser use, irrigation practices, composting and shallow groundwater use	Cost of courses Willingness of the public to participate	Are there enforcement options that can be attached to not following best behaviors? Like bylaw restrictions or does this fit in regulatory options?
Education campaign for residential property owners	Program / Public Outreach	Medium – Low	Awareness of potentially damaging household practices and opportunities such as stormwater capture. Aimed at informing to elicit a behaviour change and minimise pollution at source	Awareness of potentially damaging practices - with the aim of informing elicit behaviour change. Educational campaigns can encourage facilities to adopt environmental management and cleaner production techniques.	Willingness of the public and commercial and industrial premises to participate	
Education campaign for commercial or industrial premises, and educational facilities	Program / Public Outreach	Medium – High	Specific to industries that have a significant risk of contaminating stormwater because of their activities. Training and environmental accreditation programs are undertaken to encourage facilities to adopt environmental management and cleaner production techniques.	Awareness of potentially damaging practices - with the aim of informing elicit behaviour change. Awareness of industries to the significant risk of contaminating stormwater because of their activities. Educational campaigns can encourage facilities to adopt environmental management and cleaner production techniques.	Willingness of the public and commercial and industrial premises to participate	
Technical education on water sensitive urban design	Program / Capability	High	Capacity programs can range from community-level to regional scales. It is a holistic approach to promote good practice in stormwater management with communities, governments, and industry professionals.	Awareness of potentially damaging practices and origins of pollutants and contaminants. Awareness into WSD practices and how these could be incorporated at the individuals, residents, and commercial, industrial, and educational facilities.	Willingness of the public to participate	
COMMUNITY GROUPS						
Encourage citizen participation by the community in all aspects of stormwater management	Program / Public Outreach	Medium / High	It is important for residents to understand the nature of stormwater pollution and ways to manage stormwater effectively. Allocating budget to engage with communities can lead to residents positively contributing to future stormwater management approaches. A 'bottom-up' approach has proven more effective in changing the behaviour and perceptions of communities.	Community awareness of the origin of contaminants and pollutants leading to positive contributions in the future. Behaviour changes	Willingness of the public to participate	Enable and empower ownership and connection with water and environment

Identifying community groups or individuals to be champions for stormwater management	Program / Public Outreach	High	Community volunteers are valuable to ensuring stormwater management occurring at the local level. Community champions may assist in hosting community education programs to address stormwater management issues and represent the communities voice or opinions at council or local government meetings.	Community engagement and providing opportunities to build and transfer knowledge cultivates and grows institutional capacity and capabilities. Behaviour changes towards positive stormwater management.	Willingness of the public.	How do we empower these groups? Diversification of community group - from all areas (planning, infrastructure, engineering etc.) Need to consider the long-term viability. Is there a lack of collaboration within the group? Identification of skill gaps in the community groups.

Appendix G
Programmes of Work

Programmes of Work

Table G 1 Programme of Works implemented through this SMS

WORK PROGRAMME	PROJECT	DESCRIPTION	SHORT-TERM ACTIVITY 2024 - 2033	MED-TERM ACTIVITY 2034 - 2043	LONG-TERM ACTIVITY 2044 - 2053
Strategy and Planning	SP1 - Mana whenua relationships	Stormwater collaborative governance group is requirement under global consent and is associated with a secretariat role.	24 mtgs/yr	24 mtgs/yr	24 mtgs/yr
	SP2 - Working with others	Working with others in the stormwater space including council riparian programmes, mana whenua crews, Waka Kotahi, community groups, construction industry practices and standards. Integrate with Education & Outreach. We can't do it alone.	establish programme	ongoing coordination	ongoing coordination
	SP3 - Integrated green infrastructure management	Currently assets in the roads are operated and maintained by council roading departments and assets in reserves are operated and maintained by Parks departments. Can also include DP rules for rainwater reuse to reduce first flush events. WIP has recommendation to ensure adequate capitalisation and depreciation to provide for O&M.	Develop Service Level Agreements with all parties. Establish a programme of activity		
	SP3-1 - IGIM - Capex Delivery		Opex, Capital maintenance investment needs falling out of surveys/		

			investigations		
	SP4 - Policy through others	Advocating for Regional/District plan changes (e.g., rules requiring implementation of WSD) and Central govt legislation (ego ban on Cu brakes) to help implement stormwater management	as needed		
	SP5 - Securing funding and resourcing of SCaMPs and assets required	This can include targeted rates, development contributions, public-private partnerships, organisational structuring and other means to deliver the SCaMPs. Includes risk management but needs to acknowledge consent requirement associated with approved SMPs. This also includes Service Planning's role of securing investment through LTP process.	Modify investment planning templates Identification of funding needs & sources.	BAU	BAU
	SP6 - Planning for growth	Identify major developments (including infill/intensification) and new road works that offer opportunities for catchment-scale stormwater assets and development-funding assistance. Part of integrated catchment planning			
	SP7 - Leading by Example	Assessing and reducing the WWL "Stormwater footprint" from depot yards, building roof materials, fleet vehicle brake materials and car washing facilities, etc. Integrate this into Education and Outreach (demonstration projects). Review of all company documents including procurement, contracts, design gateways to reflect Te Mana o Te Wai and this SMS	Baselining of current sites/operations. Setting programme of improvement and innovation activities. Cross over to our education	ongoing	ongoing

			and communication		
	SP7-1 - LbE - Capex Delivery	Capital/Delivery of remedial activities (on depots, facilities, treatment plants etc)	Delivery of 6 site improvements	Delivery of 6 site improvements	Delivery of 6 site improvements
	SP8 - SW Discharge consent Compliance and SMS Update	The SMS will need to be reviewed every 6 years and prioritisation of sub-catchments for development of SCaMPs need to be redone. Compliance is currently in O&M. Compliance will include ensuring connections comply with universal responses related to Cu/Zn roofs, hydraulic neutrality, and gross pollutant traps as well as compliance documents to GW related to consent conditions.	1 review	2 reviews	2 reviews
	SP9 - Ensuring all company policies drive ICMP	Integration with WWNO programme, flood management programme, climate change, etc	Review policies		
	SP10 - Emergency works / Emergency Funding	Reactive works and planning to be ready to go if central govt becomes available (major event based) Space in Capital Programme to capture / chase additional funding to support delivery of the outcomes sought	Create a plan to maximise opportunities (being ready to go and call in extra $)		

Operation and Maintenance	OM1 - Enhanced Streams Works programme	Routine works in the beds of streams or weed suppression related to infrastructure maintenance needs to be integrated with identified need for habitat enhancements in the SMS and SCaMPs.	Develop integration & investigations programme Link to Training & Ed of operational teams	ongoing	ongoing
	OM1-1 - ESW - Capex Delivery	Capital works programme	5	10	10
	OM2 - Monitoring stormwater discharges	Condition of stormwater discharge consent. Opportunity to combine with working with mana whenua (Mātauranga Māori), working with others (citizen science), and monitoring for wastewater consents.	Revise monitoring plan and include mātauranga māori	ongoing	ongoing
	OM3 - Operations and maintenance of vested stormwater water quality devices		Identify all green infrastructure sites across council areas to derive a maintenance programme.	ongoing activities	ongoing activities

	OM3-1 – WQ Devices-Periodic-Capex Maintenance	Maintenance activities - Periodic work to keep on top of asset performance and condition. 5 - 10 yearly more involved capital maintenance	Periodic	Periodic	Periodic
	OM3-2 – WQ Devices-Cyclical Maintenance	Maintenance activities - Annual operational activities to keep on top of condition	Cyclic	Cyclic	Cyclic
	OM4 - Condition assessments Programme	Part of Renewal planning basis and Very High Criticality Planning	Develop a proactive works programme (aligned to VHCA)	BAU	BAU
	OM4-1 - CA- Capital Delivery Programme	Part of Renewal planning basis and Very High Criticality Planning	BAU - Assume 20 projects are delivered at cost of $500k each	BAU - Assume 20 projects are delivered at cost of $500k each	BAU - Assume 20 projects are delivered at cost of $500k each
	OM5 - Street sweeping	Currently this is funded and managed through council roading departments.	Review SLA with Council Departments and understand coverage, frequency. Undertake Investigation to enhance programme and share	With Council	With Council

			with Councils		
	OM6 - Compliance of private stormwater quantity and quality devices	Regular inspection or gathering of inspection/maintenance records on stormwater detention tanks and gross pollutant traps	Derive register & inspections programme Identify how to deliver.	ongoing activities	ongoing activities
	OM7 - High Risk Sites health checks	To be combined with Trade Waste inspections. There is a Porirua WIP recommendation 44 related to trade waste also.	Derive Audit programme	ongoing activities	ongoing activities
	OM8 - Cross Contamination Elimination Programme (see DC9)	Programme to identify/detect (Including the Knowing your pipe programme) and delivery of Capital solutions to enhance	Investigation & Decision to fund	ongoing activities	ongoing activities
	OM9 - Dry weather overflow programme	New programme focused on blockages based on smart manholes to be managed as part of the wastewater programme/consents - could result in lots of reactive work	Part of the WWNO Programme		
Modelling and Investigations	MI1 - Flood Management Programme	This is a new programme. Needs to be integrated with the SMS, growth programmes, etc.	Programme and dollars separate		
	MI2 - Regional Contaminant Load Model	Although led by GWRC, WWL has a collaborative role	Officer support and meetings	Officer support and meetings	Officer support and meetings

	MI3 - Site-specific contaminant load model	Wellington WIP recommends WWL develops tool by 2025 that can be used to assess a development - potential contribution of contaminants and hydrological impacts -	Determine approach to support Growth achieving ongoing AEH		
	MI4 - Aquatic Habitat Assessments	A baseline assessment of habitat (including Fish Passage) and scour	10 Assessments	10 Assessments	10 Assessments
Education, Outreach and Training	ED1 - Supply Chain staff training	Best practice and capturing innovation and new ideas, including mana whenua values and Kaupapa around water. D&C, O&M staff.			
	ED2 - Industry education	Integrated with High-Risk Site Health Audits. Also includes engagement with plumbers and drainlayers	Determine programme needs and support for other groups doing similar		
	ED3 - Community outreach	Integrated with other existing programmes through council, business community, community groups and mana whenua. Includes social media. Adopt a drain. Storm drain marking programme.	establish programme and budget		
	ED4 - Pilot / Demonstration projects	Contribute to appropriate pilot / demonstration projects to enhance industry capability and capacity			

	ED5 - Promote Knowledge Sharing	Industry workshops to share information and reduce gaps in stormwater management at industrial sites (identified with partners)	1 per annum	1 per annum	1 per annum
	ED6 - Stream signs / Stormwater 'Tourism'	Install signs at freshwater outlets into the harbour, including pipes, to indicate that they are streams and use art or other interactive ways to identify and communicate about piped and open streams.			
Design and Capital Projects	DC1 - Stormwater Sub-Catchment Management Plan (SCaMP) Programme	The SMS provides a means to prioritise, and the global discharge consent requires the development of sub-catchment scaled stormwater management plans. These will identify and cost needed stormwater quality assets such as raingardens and wetlands. 28 sub-catchments. NB this is in Capex because the Wastewater network overflow programme is in Capex	8 SCaMPs developed	8 SMPs developed	8 SMPs developed
	DC2 - Stormwater quality assets	Stormwater quality assets such as raingardens and wetlands identified as needed in each SCaMP. Spend starts at year 4 after investigation, design and procurement	1 wetland, 6 gross pollutant traps, 4 raingardens per SMP delivered	1 wetland, 6 gross pollutant traps, 4 raingardens per SMP delivered	1 wetland, 6 gross pollutant traps, 4 raingardens per SMP delivered
	DC3 - Restoring and/or daylighting natural channels.	New programmes: - identify and seek to daylight culverted watercourses - Identify and restore channels affected by stream scour	Desk based investigation to identify potential approaches to assessing potential erosion sites.	T.B.C	T.B.C

	DC4 - Innovative trials	Enabling technology and process innovations to be trialled into the network	Assume one trial in period	2 trials	2 trials
	DC5 - Design guide for WSD	Like Auckland's GD04 - to inform design of development and to inform choice of appropriate stormwater devices (which we already have WWL guidance for)	2 per cycle	2 per cycle	1 per cycle
	DC6 - Review RSWS - Stormwater	Update cycle for review of RSWS documentation to maintain consistency and be informed by best practice in stormwater	2 per cycle	2 per cycle	1 per cycle
	DC7 - Integrate stormwater management where relevant into all Wellington Water capital projects	This is like the Leading by Example programme (e.g., green roofs on WTPs) Influence the likes of Let's Get Wellington Moving programmes and support SW delivery	Identify capital delivery programme and review opportunities to implement 'best practice' SW quality Mgt approaches on WWL sites	Every project on WWL facilities capture SW runoff for quality treatment	All facilities (where appropriate) have best practice SW quality management
	DC8 - Wastewater Network Overflow Programme	Review of SMS and development of SCaMPs here also			
	DC9 - Cross Contamination Elimination Programme	Delivery of Capital solutions, especially if contamination to stormwater is from the public network, either due to a fault or cross-connection design (see OM8)	Part of the WWNO Programme	ongoing activities	ongoing activities
Asset and Data Management	ADM1 - Stormwater quality data management	Expand on pilot projects to provide public with monitoring results. (WQ & GI)			

		Support data needs for modelling, investigations, and education. Ensure all water quality data is linked. Also register of GI devices and as-builts. Tie in Opex programme so that ongoing activity is captured on asset in programme.			
	ADM2 - Data / Visualisation Programme	Investigation programme to support sharing with community. Include trial of 'SafeSwim' type programme.			

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