



City of Richmond

Report to Committee

To: Public Works and Transportation Committee
From: John Irving, P.Eng. MPA
Director, Engineering
Date: March 1, 2018
File: 10-6060-03-01/2017-Vol 01
Re: Integrated Rainwater Resource Management Strategy

Staff Recommendation

That the "Integrated Rainwater Resource Management Strategy" as attached to the staff report titled "Integrated Rainwater Resource Management Strategy," dated March 1, 2018 from the Director, Engineering be approved.

John Irving, P.Eng. MPA
Director, Engineering
(604-276-4140)

Att. 1

REPORT CONCURRENCE		
ROUTED TO:	CONCURRENCE	CONCURRENCE OF GENERAL MANAGER
Sewerage & Drainage	<input checked="" type="checkbox"/>	
Policy Planning	<input checked="" type="checkbox"/>	
Parks	<input checked="" type="checkbox"/>	
Corporate Communications	<input checked="" type="checkbox"/>	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	INITIALS: 	APPROVED BY CAO

Staff Report

Origin

Municipal Commitment 3.4.7 of Metro Vancouver's Integrated Liquid Waste Resource Management Plan dated May 2010 commits member municipalities to develop and implement integrated stormwater management plans at the watershed scale that integrate with land use to manage rainwater runoff. Richmond's integrated stormwater management plan, titled the Integrated Rainwater Resource Management Strategy (the "Strategy"), fulfils this requirement and supports Council's Term Goal #4 *Leadership in Sustainability*.

At the May 24, 2016 Regular Council Meeting, Council adopted the following motion:

That the "Integrated Rainwater Resource Management Strategy" as attached to the staff report titled "Integrated Rainwater Resource Management Strategy," dated April 29, 2016 from the Director, Engineering be endorsed for the purpose of public consultation.

The Strategy was taken to public stakeholders and feedback has been incorporated. This report summarizes the outcomes of engagement activities and presents the final Integrated Rainwater Resource Management Strategy for Council's consideration.

Analysis

Richmond's Integrated Rainwater Resource Management Strategy

The City of Richmond is comprised of a series of islands in the delta of the Fraser River, with the majority of the land mass located on Lulu Island. Lulu Island forms a single watershed with carefully engineered drainage catchments that include channelized watercourses, sloughs and ditches that serve drainage, irrigation and habitat functions. As a floodplain municipality with soft soils, low gradients and a naturally high water table, the City of Richmond has unique stormwater management issues and needs compared to regional neighbours. The development of the Strategy is guided by four main goals to address these specific needs:

1. Minimize the impacts of future development and redevelopment on drainage infrastructure and ecological health;
2. Reduce potable water use;
3. Address existing and future sedimentation issues; and
4. Support the City's Ecological Network.

The Strategy identifies four key strategies to address these goals, with a series of initiatives and an implementation plan outlined for each strategy:

1. Strategic detention of water;
2. Water quality treatment and sediment control;
3. Rainwater harvesting and reuse; and
4. Protection, enhancement and building of green infrastructure.

Stakeholder Engagement and Feedback and Strategy Updates

Staff engaged the development community through presentations made to the Urban Development Institute and Small Builders Group. Staff also engaged the public through the City's community engagement website, Let'sTalkRichmond.ca, where the Strategy was made available online for public feedback. 170 people viewed this site and 66 people participated in the online survey and provided feedback. The majority of public respondents felt that the Strategy adequately addresses Richmond's stormwater management needs. Feedback received through the stakeholder presentations and public surveys are summarized below:

- Of the strategies presented, residents most favoured exploring opportunities for rainwater re-use in parks and conservation lands.
- Approximately 40% of participants who completed the online survey have not previously heard of stormwater management. Residents support hearing more about stormwater management opportunities and initiatives such as the City's rain barrel program.
- There was mixed feedback from both the public and the development community regarding daylighting initiatives and stormwater re-use on private property. While some respondents support these initiatives, others are concerned that these initiatives would become mandated requirements. The current strategy aims to identify, encourage and strategically implement these initiatives on an opportunistic basis.
- Residents expressed the desire to see the retention of tree canopies to promote stormwater retention assessed and incorporated into the strategy. The assessment of Richmond's Urban Forest is addressed through the City's Urban Forest Management Strategy and is regulated through the Tree Protection Bylaw, Zoning Bylaw, Environmentally Sensitive Areas and Public Parks and Schools Grounds Regulation Bylaw. The Urban Forest Management Strategy which addresses trees on public property is currently under review and will be updated in 2018. The Strategy has been updated to include reference to the Urban Forest Management Strategy based on feedback received.
- Residents felt that although stormwater management may be important, flood protection is of a greater concern for the City. The Strategy works in conjunction with Richmond's Flood Management Protection Strategy, which provides a guiding framework for continual upgrading and improvement of the City's flood protection.
- Residents expressed concern at building massing and the impacts of increased impermeable surface areas on stormwater management and ecological health of green infrastructure. Development applications are reviewed by staff to ensure compliance with City bylaws, policies and initiatives.

In addition to revisions to incorporate stakeholder feedback, the strategy has also been updated to include examples of stormwater re-use at a detention pond within the Garden City Lands that will be used for the irrigation of farm fields within the park.

Next Steps

The Strategy has been updated to incorporate stakeholder feedback received. If the proposed strategy is approved by Council, staff will begin execution of the implementation plan identified in the Strategy. Projects and policies that are developed according to this Strategy will be presented to Council for review prior to implementation.

Financial Impact

None.

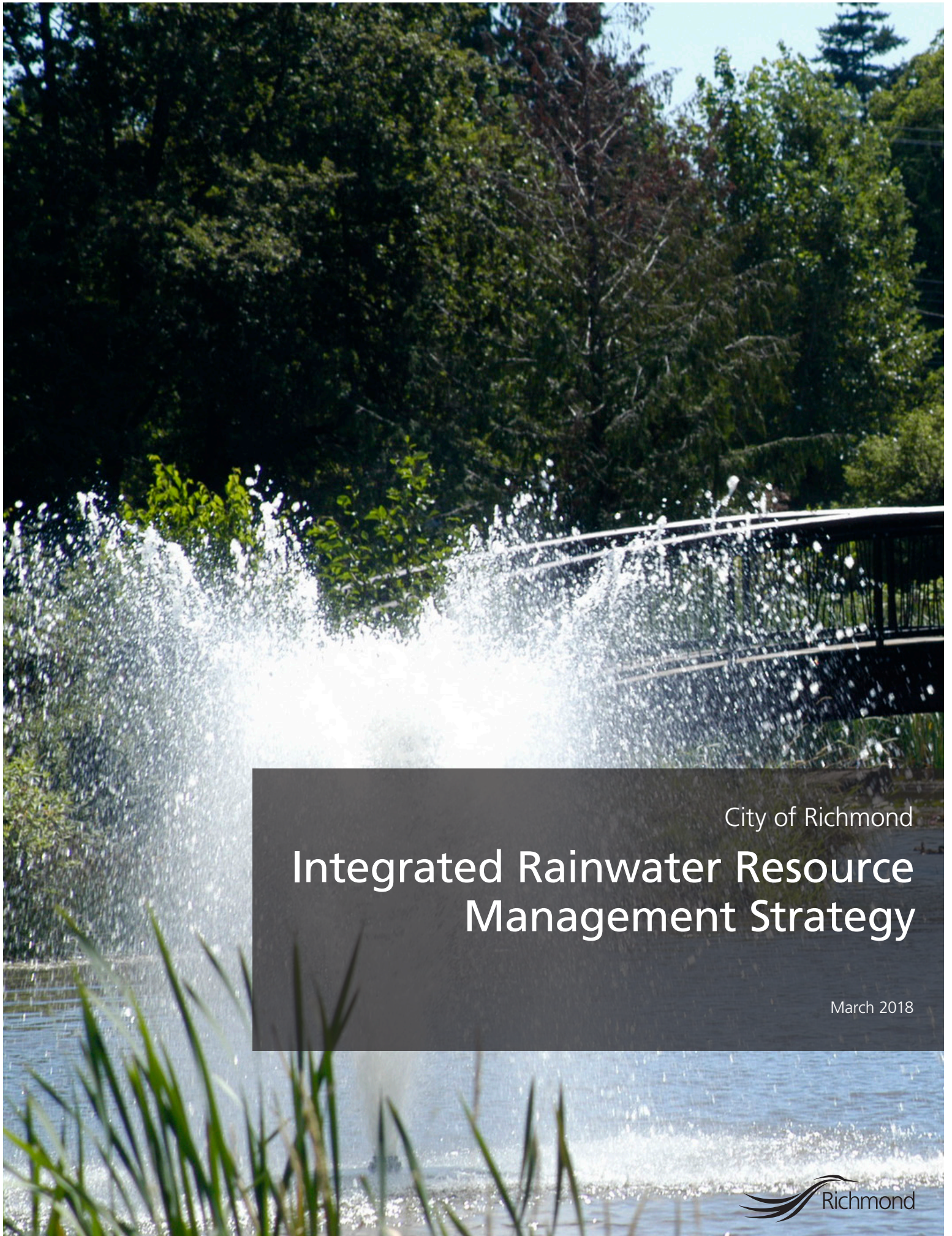
Conclusion

Richmond's Integrated Rainwater Resource Strategy introduces a number of initiatives and strategies to address the City's unique stormwater management needs. The Strategy complements existing City strategies and initiatives such as the Official Community Plan, Flood Protection Management Strategy, Ecological Network Management Strategy and Urban Forest Management Strategy, and fulfils Richmond's obligations in Metro Vancouver's Integrated Liquid Waste Resource Management Plan to develop an Integrated Stormwater Management Plan.



Lloyd Bie, P.Eng.
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Att. 1: Integrated Rainwater Resource Management Strategy – March 2018



City of Richmond

Integrated Rainwater Resource Management Strategy

March 2018

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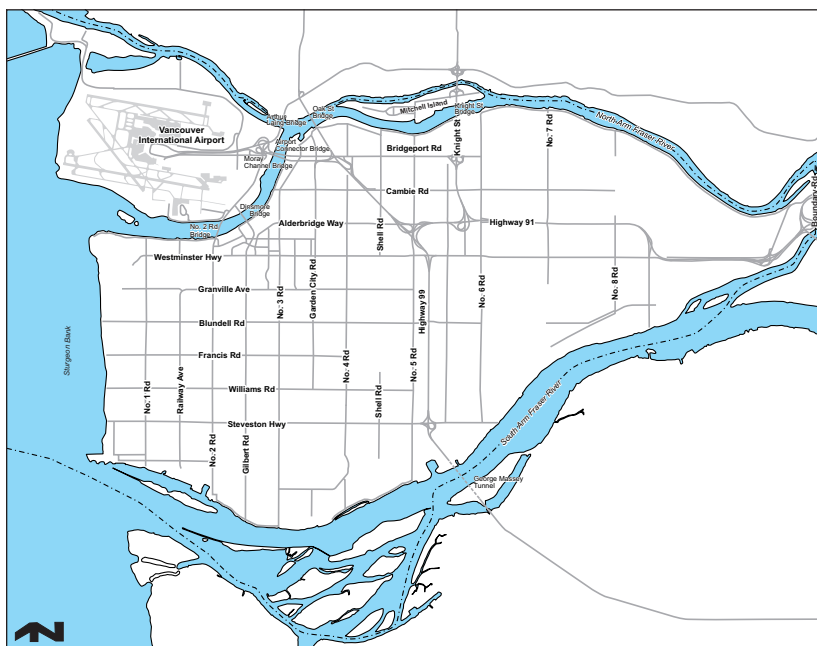
Introduction

Geographic Context

The City of is comprised of a series of islands in the delta of the Fraser River, with the majority of the land mass located on Lulu Island. Early settlers built dikes and drained the land to farm. Today, agriculture remains an important part of Richmond's economy and character. While West Richmond is predominantly urban, East Richmond is considered to be rural and agricultural.

Lulu Island is characterized by a relatively flat topography with an average elevation of one meter above sea level. Since much of the island is below the elevation of high tide, the perimeter of the island has been diked to prevent flooding. Stormwater runoff is either drained by gravity during low tides, or pumped out of the City during high tides.

The island forms a single watershed with carefully engineered drainage catchments that include channelized watercourses, sloughs and ditches that serve drainage, irrigation and habitat functions. The peat bog substrate, high water table and limited gradient typical of flood plain ecosystems result in slow flowing watershed drainage and water that has elevated temperatures, low dissolved oxygen, and high dissolved iron and other metals when compared to traditional watersheds. The City's inland watercourses are generally considered to be not hospitable to anadromous fish species, but do however, flow into and support an abundance of fish life in the receiving waters of the Fraser River Estuary.



Richmond's Needs for Stormwater Management

Growth: The City of Richmond's population is projected to grow substantially in the next 30 years, as described in the City's *2041 Official Community Plan Update*. Significant development activities anticipated within Richmond result in the following consequences that are addressed through rainwater management in the City:

- Additional **demands on the City's drainage infrastructure** due to increased stormwater runoff from increases in impervious land area.
- **Reduced storage capacity** due to the replacement of roadside ditches and watercourses with pipes or culverts.
- **Increased maintenance demands** for the City's stormwater system due to increased sediment from construction sites and increased road runoff.
- **Impacts to the ecological health** of receiving water bodies due to a proportional increase in pollutant load.

Topographic and Water Quality Challenges: Richmond's distinct topography creates the following unique challenges and opportunities that guide the development of our *Integrated Rainwater Resource Management Strategy*:

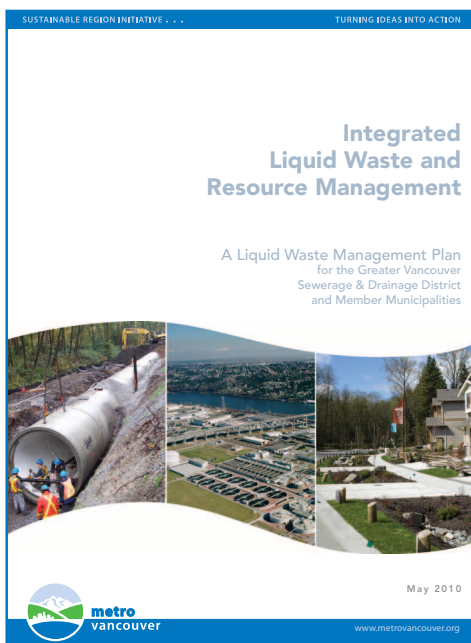
- Low gradients in Richmond's gravity drainage system results in slow conveyance, increased temperatures, and lower levels of dissolved oxygen when compared to traditional watersheds.
- A naturally high water table limits the capacity to infiltrate rainwater.
- Richmond's peat bog substrates contribute to naturally occurring dissolved iron and other metals to water and the inland watercourses are generally considered to be inhospitable to anadromous fish species.

Richmond's *Integrated Rainwater Resource Management Strategy* provides a strategic approach to address Richmond's unique stormwater management issues and needs. This results in an approach that differs from many other municipalities. The strategy aims to protect and enhance the City's stormwater conveyance infrastructure and ecological assets under more frequent rainfall events, and considers rainwater as a resource to be utilized.

Regulatory Context

As a member of the Greater Vancouver Sewerage and Drainage District, the City of Richmond is committed to the stormwater management requirements set out in the *2010 Metro Vancouver Integrated Liquid Waste Resource Management Plan* and the terms of the *Minister of Environment's Letter of Acceptance (2011)*. Specifically, the plan commits member municipalities to:

- Develop and implement integrated stormwater management plans that integrate with land use to manage rainwater runoff.
- Update municipal bylaws and utility design standards to meet the criteria set out in the integrated stormwater management plan and enable and encourage on-site rainwater management.



- Develop a program to monitor stormwater, assess and report the implementation and the effectiveness of the integrated stormwater management plan.

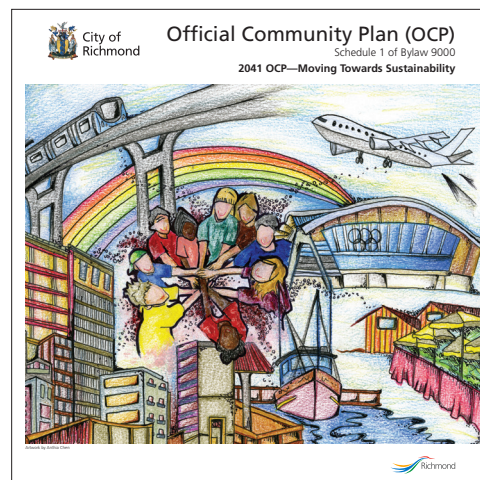
Richmond's *Integrated Rainwater Resource Management Strategy* aims to fulfill requirements of the *Integrated Liquid Waste Resource Management Plan* for stormwater management.

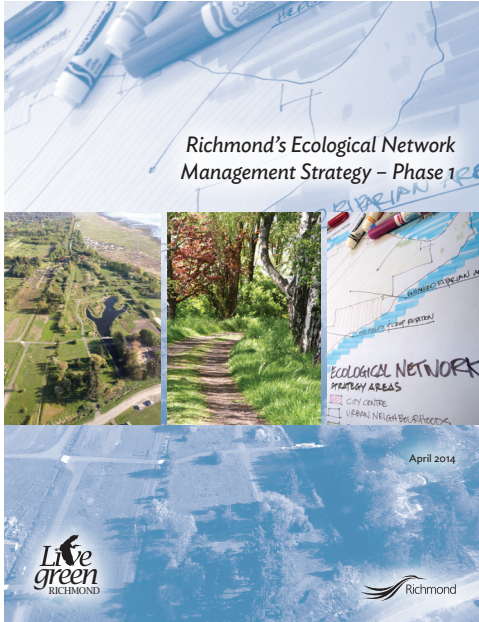
In addition, 119 km of Richmond's 223 km of open waterways are designated Riparian Management Area protected under the provincial *Riparian Area Regulation* and the *Federal Fisheries Act* as they flow into and support fish life in the Fraser River. The new provincial *Water Sustainability Act* also applies to the City's drainage infrastructure. This *Integrated Rainwater Resource Management Strategy* will work to address requirements of these provincial regulations.

Municipal Strategic Context

The *Integrated Rainwater Resource Management Strategy* supports and is congruent with the mandates of several Richmond policies, plans and objectives, including the:

- **2041 Official Community Plan (OCP)**, updated in 2012 forms the City's framework in establishing the City's social, economic, land use, urban design, servicing, transportation and environmental future. The Plan anticipates the City's population to grow by 80,000 people by 2041 and mandates that the City's infrastructure be maintained and improved upon to meet growing needs. The *Integrated Rainwater Resource Management Strategy* aims to address these needs.
- **Flood Protection Management Strategy**, originally adopted by Council in 2008, provides an integrated flood protection framework to minimize flooding and its impacts. While the objectives of the strategies differ, recommendations in the Flood Protection Strategy overlap with those of the *Integrated Rainwater Resource Management Strategy*. Overlapping strategies include the utilization of stormwater retention and detention, strategic raising of land levels through development, and establishment of a Floodplain Bylaw.
- **East Richmond Agricultural Water Supply Study (2006)** and **East Richmond Agricultural Water Supply Update (2013)**, provides a strategy for improving the drainage system in East Richmond to address flood protection and irrigation needs for agricultural lands. As rainwater management strategies within East Richmond's agricultural lands are addressed in the *East Richmond Agricultural Water Supply Study* and its update, the *Integrated Rainwater Resource Management Strategy* will aim to complement that, with a greater focus placed on land uses within West Richmond.
- **Ecological Network Management Strategy (ENMS)**, adopted by Council in 2015, identifies and describes Richmond's Ecological Network and recommends goals, strategies, and actions for protecting, enhancing and connecting natural lands within the City. The strategy addresses similar issues to the *Integrated Rainwater Resource Strategy* including water and habitat quality, impervious surfaces, riparian habitat issues such as bank erosion and green infrastructure enhancement opportunities to increase ecosystem services.





- **Riparian Response Strategy (RRS)** protects Riparian Management Areas that form part of the City's Ecological Network. The strategy, adopted by Council in 2006 identifies 5 m and 15 m riparian setbacks on minor and major watercourses that flow into and support fish life in the Fraser River. The RRS is the City's response to the *Provincial Riparian Area Regulation* (RAR) to protect habitat from industrial, commercial and residential development. Following a Provincial Ombudsperson review of local government's RAR implementation methods in 2012, the City is working with the Province to implement new legislated protection and enhancement measures that is compliant with the directive. The Provincial RAR applies to the City's inland watercourses, but not the foreshore of the Fraser River. The Fraser River foreshore is also part of the City's Ecological Network and is designated Environmentally Sensitive Area in the City's OCP protected under development permit.
- **Urban Forest Management Strategy**, originally adopted by Council in 2001, guides the management and protection of the City's urban forest on public property, which includes trees in City Parks, right-of-ways and boulevards. The strategy is supported by the Tree Protection Bylaw, adopted by Council in 2006. The urban forest supports stormwater management by providing rainwater detention and treatment. The Integrated Rainwater Resource Management Strategy compliments the Urban Forest Management Strategy in supporting initiatives for the protection and maintenance of tree canopies.

Goals

The development of Richmond's *Integrated Rainwater Resource Management Strategy* is guided by four primary goals:

1. To **minimize impacts of future development and redevelopment** on drainage infrastructure and ecological health of receiving water bodies;
2. To **reduce potable water use** consistent with Richmond's sustainability goals;
3. To **address existing and future sedimentation issues** and the associated impacts on the conveyance system; and
4. To **support the City's Ecological Network** through enhancement of green infrastructure.

Strategies

A series of key strategies have been developed to address Richmond's stormwater management needs:

1. Strategic detention of stormwater.
2. Water quality treatment and sediment control.
3. Rainwater harvesting and re-use.
4. Protect, enhance and build green infrastructure.

Management Strategies

Strategy #1: Strategic Detention of Stormwater

IRRMS Goal:

#1: Minimize impacts of future development and redevelopment

As a result of Richmond's growth and ongoing development activities, impervious area in West Richmond is projected to increase. This leads to an escalation in water runoff volumes during major storm events and capacity demands on the City's drainage infrastructure.

The strategy proposes to utilize stormwater detention as a means to reduce excess runoff and consequently minimize or eliminate the need for potential drainage capacity upgrades.

Select Initiatives and Outcomes:

- **Strategic implementation of water detention measures.** Because of the City's low hydraulic grade line, stormwater detention is most effective for developments located near the central areas of the island. The City will pursue opportunities for detention in conjunction with other strategic benefits such as rainwater re-use and ecological and aesthetic enhancements. Applications of detention facilities in The Gardens Agricultural Park and Garden City Community Park set precedence for ongoing collaboration between the City, developers and community groups to incorporate rainwater detention to create innovative and mutually beneficial rainwater management schemes.
- **Increase storage capacity in the City's drainage conveyance system.** Open watercourse and ditches provide greater storage capacity than an enclosed pipe system. The City will continue to preserve open watercourses and is considering daylighting strategies to convert existing drainage pipes to open watercourses as a means to provide detention as well as ecological values.
- **Encourage stormwater detention on private properties** through development and provide guidance and support for voluntary implementation. Examples of potential detention measures include green roofs and rain gardens.



Implementation of rain gardens and rock trenches for detention on private properties.

Application Examples



The Gardens Agricultural Park: The multi-family development located at the corner of Steveston Highway and No. 5 Road utilizes a pond located within the City's The Gardens Agricultural Park to serve as stormwater detention for the development. The City worked with private development to identify opportunities to reduce stormwater run-off and improve water quality while providing aesthetic enhancements for the park.



Garden City Community Park: The Garden City Community Park incorporates a central pond, wetland and swale network that serves as a stormwater detention area during heavy rainfall events. The central pond, together with surrounding trails and a pedestrian bridge, forms a main feature in the park and provides users with a highly liveable and beautiful environment.

Strategy #2: Water Quality Treatment and Sediment Control

IRRMS Goals:

- #1: Minimize impacts of future development and redevelopment
- #3: Address existing and future sedimentation issues

Sediment Control

Ongoing development activities place additional sediment demands on the City's stormwater infrastructure. Primary sources of sediment demands include construction activities such as sand preloading, the filling of sites to meet flood protection levels and vehicular runoff from additional impervious areas introduced through development.

Sediments are introduced to watercourse and storm sewers during significant rain events, leading to increased maintenance demands for Richmond's watercourses and sewers, and impacts downstream ecology, including the Fraser River.

Sediment and erosion management is important as it allows for future development and redevelopment while protecting environmental values and existing infrastructure.

Select Initiatives and Outcomes:

- **Strengthen and enforce erosion and sediment control requirements** for construction activities. Consider the development of a specific Erosion and Sediment Control Program that includes a bylaw with regulatory requirements. The program should address erosion and sediment control expectations, acceptable Best Management Practices, sampling and reporting requirements for construction sites and specific controls for preload activities.
- **Enhance riparian vegetation and implement bank protection works** for areas of watercourses vulnerable to sloughing.
- **Encourage water quality improvement** for runoff from impervious areas to mitigate the migration of pollutants into the drainage network. Strategies for improving water quality for specific land uses include:
 - **Single-family residential:** Pollutant removal through absorbent landscaping or rain gardens.
 - **Multi-family residential, Industrial, Commercial and Institutional:** Pollutant removal through absorbent landscaping, rain gardens or manufactured oil-grit separators.
 - **Parks and Conservation Lands:** Pollutant removal through absorbent landscaping or rain gardens.



Additional sediment demands are introduced by construction activities and increasing impervious areas.



Water Quality Treatment and Monitoring

The BC Minister of Environment's approval of Metro Vancouver's *Integrated Liquid Waste Resource Management Plan* requires that municipalities monitor stormwater to assess and report on the effectiveness of the stormwater management plan implementation. To fulfill this provincial requirement, Metro Vancouver developed a *Monitoring and Adaptive Management Framework* (MAMF) with recommended parameters to monitor watershed health and assess the effectiveness of stormwater management throughout the region.

Due to Richmond's unique water quality conditions, the recommended MAMF parameters do not adequately reflect the effectiveness of Richmond's stormwater management plan. Under pre-development conditions, naturally occurring water quality parameters may exceed the water quality guidelines due to slow conveyance and natural soil conditions, and it is not the intent of the *Integrated Rainwater Resource Management Strategy* to alter naturally occurring conditions. As such, Richmond **will pursue a modified MAMF to guide water quality monitoring** for development activities within Richmond. Monitoring and reporting may include the following parameters:

- **Physical:** pH.
- **Sediment:** Total suspended sediment, turbidity.
- **Nutrients:** Nitrate.
- **Microbiological indicators:** E. coli, fecal coliforms.
- **Metals:** Total copper, total lead, total zinc, total cadmium.
- **Flow monitoring:** MAD, TQ Mean, Low Pulse Count, Low Pulse Duration, Summer Baseflow, Winter Baseflow, High Pulse Count, and High Pulse Duration.

Monitoring should be undertaken on Richmond's larger watercourses, near pump station or other locations that capture the majority of catchment flow.

Strategy #3: Rainwater Harvesting and Re-use

IRRMS Goals:

- #1: Minimize impacts of future development and redevelopment**
- #2: Reduce potable water use**

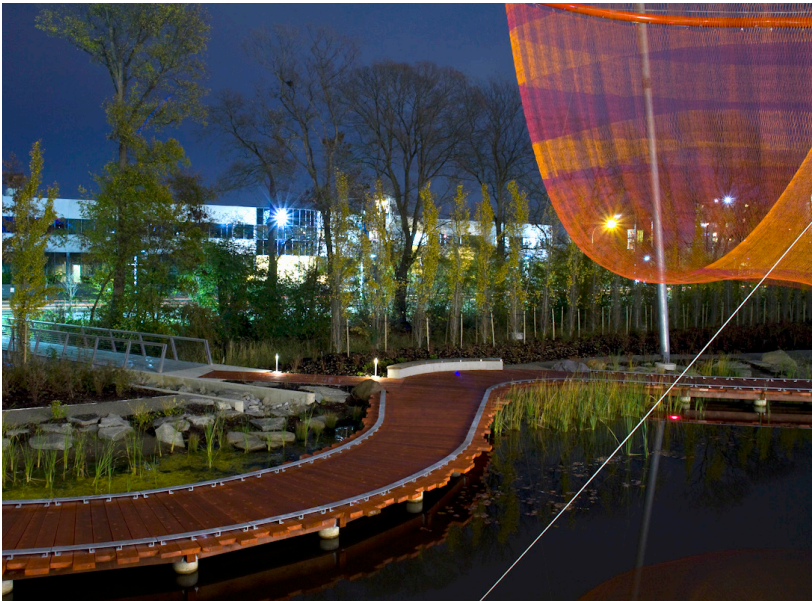
Rainwater harvesting and re-use strategies utilizes water as a resource and offer the two-fold benefit of reducing stormwater runoff volumes as well as potable water consumption. It is a key aspect in addressing the “resource” component of the *Integrated Rainwater Resource Management Strategy*.

Rainwater, primarily from building roofs, can be collected, stored, and treated as required depending on its intended application. Primary applications for rainwater re-use include indoor use for toilet flushing and outdoor use for irrigation and vehicle washing. Richmond currently utilizes potable water for these applications.

Select Initiatives and Outcomes:

- **Address barriers to implementation** for the utilization of harvested rainwater for indoor, non-potable uses such as toilet flushing. The City will review internal and external guidelines and work to enable rainwater re-use for a wider range of applications.
- **Explore further opportunities to incorporate rainwater re-use strategies in parks and conservation lands** through continued ongoing collaborations between the City of Richmond Engineering, Parks and Sustainability departments, as well as developers and community groups.
- **Provide education and support** to improve public knowledge and acceptance of rainwater re-use practices.
- **Monitor the prevalence of re-use technologies inside and outside Richmond.** The price of potable water is currently \$1.26/m³. Potable water-use thresholds for economical benefits of rainwater re-use strategy applications in residential, industrial and commercial applications are as follows:
 - Single-family residential: \$4/m³
 - Multi-family residential (medium- to high-density developments): \$3/m³
 - Office (medium- to high-density developments): \$2/m³

Application Examples



Water Sky Garden at the Richmond Olympic Oval:

The Water Sky Garden at the Richmond Olympic Oval contains a wetland treatment pond which serves as a component of a public art piece and provides runoff detention as well as stormwater re-use. Rainwater from the Olympic Oval's two-hectare roof is drained into the pond, where it is treated by vegetation and aerated through a fountain. The harvested and treated water is used for toilet flushing in the Oval and irrigation of plants in the surrounding space.



Garden City Lands: Upon completion, the Garden City Lands will host a number of water bodies that serve both as aesthetically pleasing landscape features as well as measures for stormwater detention and re-use. In 2017, a pond was constructed within the park to serve both as irrigation storage for farm fields within the park and stormwater detention. Several other water storage bodies are planned for future phases of the park. Additionally, the Bog located on the eastern half of the site serves both as a site for restoration of sensitive ecological habitat as well as a large stormwater detention measure.



Rain Barrel Program: In 2005, the City of Richmond implemented the rain barrel program aimed at encouraging residential water conservation. The program invites Richmond residents to purchase rain barrels from the City at a subsidized rate. Rain barrels are used by residents to collect and store water for outdoor usage such as watering gardens and washing vehicles. As of January 1, 2016, the City has sold 1,247 barrels to Richmond's residents.

Strategy #4: Protect, Enhance and Build Green Infrastructure

IRRMS Goal:

#4: Support the City's Ecological Network

Green infrastructure encompasses the components of the natural and built environment that provide ecosystem services such as drainage, water filtration, green space and wildlife habitat. The development of these green infrastructures for stormwater management purposes opens opportunities to enhance watercourse habitat and provide other ecosystem services.

This strategy aims to support Richmond's *Ecological Network Management Strategy* through the protection and enhancement of green infrastructure including watercourses, riparian areas and wetlands.

Select Initiatives and Outcomes:

- Improvement of watercourse health through restoration and enhancement of riparian areas.
- Creation of wildlife habitat values and temperature mitigation services (ecosystem services) through the creation or restoration of wetlands for the retention, detention and treatment of runoff.
- Improvement of ecosystem services through green infrastructure projects such as rain gardens and green roofs.
- Enhancement of the Ecological Network's connectivity and maximization of ecosystem services through the protection, enhancement and connectivity of natural lands including the daylighting of watercourses.

Daylighting Strategy

A key component of the strategy involves the daylighting, or exposing, of previously covered waterways or stormwater drains. Daylighting of watercourses re-introduces ecosystem services to a catchment, which serve to improve water and habitat quality, flood mitigation and conveyance, provide community amenities and connecting existing isolated ecological lands.

Daylighting opportunities will be identified through assessment of daylighting benefits and triggers.



Typical watercourse conditions in Richmond's RMAs.

Implementation Plan

The implementation plan outlines recommended actions and corresponding target implementation timeframes for each strategy. Timeframes for the implementation plan are defined as follows:

- Short-term: 1-2 years
- Medium-term: 3-5 years
- Long-term: 5+ years
- Ongoing: Initiatives the City is currently undertaking and will continue to undertake

The implementation plan will be subject to annual review to measure progress towards achieving the strategy's outcomes. The plan will be updated as required to address and incorporate emerging needs and priorities, new science, information, techniques and best practices.

Strategy	Action	Timeframe
Strategy #1 Strategic Detention of Stormwater	1. Update the City of Richmond's Engineering and Design Specifications Manual to include recommendations on the design of rock trenches and rain gardens.	Short-term
	2. Update policies to provide more clarity regarding requirements for rainwater management and lot coverage for landscaping.	Short-term
	3. Work with external agencies such as Metro Vancouver and other municipalities in developing and promoting the implementation of stormwater detention facilities.	Ongoing
	4. Continue to collaborate with Parks, Sustainability and other City departments in implementing stormwater detention facilities in parks and other special projects.	Ongoing
Strategy #2 Water Quality Treatment and Sediment Control	Undertake an internal review to develop an effective and comprehensive Erosion and Sediment Control program.	Short-term
	Update the City of Richmond's Pollution Prevention and Clean-up Bylaw No. 8475 and Engineering and Design Specification Manual to include the following: <ul style="list-style-type: none"> • Details on erosion and sediment control measures that should be implemented for construction projects, including site monitoring and reporting requirements. • Inspection and enforcement for sediment control and erosion management in non-ALR areas. 	Short-term
	Collaborate with Metro Vancouver to establish a modified MAMF specific for Richmond to guide water quality monitoring.	Short-term
	Collaborate between the City of Richmond's Engineering, Sustainability and Operations departments to identify areas of watercourses vulnerable to sloughing for implementation of bank protection works.	Short-term
	Evaluate the need to establish Total Suspended Solids (TSS) removal criteria to address road runoff.	Medium-term

Strategy	Action	Timeframe
Strategy #2 Water Quality Treatment and Sediment Control (con't)	Evaluate the effectiveness of this strategy through periodic monitoring according to modified MAMF guidelines specific for Richmond.	Long-term
	Monitor annual sediment removal volumes by municipal maintenance crews. Review and evaluate the effectiveness of existing Erosion and Sediment Control policies on a 5-year basis.	Long-term
	Monitor contractor compliance with Erosion and Sediment Control requirements and consider the implementation of additional measures to improve compliance.	Long-term
Strategy #3 Rainwater Harvesting and Re-use	Monitor the implementation and success of water re-use technologies inside and outside Richmond.	Ongoing
	Education to eliminate public unfamiliarity with rainwater re-use practices, with a target towards homeowners, regulatory staff, contractors, designers and trades.	Ongoing
	Complete pilot studies to obtain information on actual costs and potable water use reductions for residential and ICI applications.	Short-term
	Implement rainwater re-use for medium- and high-density office developments for toilet fixture applications.	Medium-term
	Update the Drainage, Dyke and Sanitary Sewer System Bylaw No. 7551 to allow rainwater re-use as an alternative to collection and conveyance of all surface drainage to the municipal stormwater sewer system.	Medium-term
	Work with external agencies to: <ul style="list-style-type: none"> • Remove regulatory barriers that limit re-use applications. • Establish water quality treatment and local Health Authority approval requirements to address various re-use applications. • Develop regulations, guidelines and established practices for rainwater harvesting. 	Medium-term
	Monitor changes in the price of water.	Long-term

Strategy	Action	Timeframe
Strategy #4 Protect, Enhance and Build Green Infrastructure	Update the City's Riparian Response Strategy to meet Provincial requirements for compliance with the Riparian Area Regulation.	Short-term
	Incorporate projects and opportunities identified through the Daylighting Strategy in the City's drainage capital planning process and through collaboration with the development community.	Short-term
	Update the criteria for the City of Richmond's Protection of Environmentally Sensitive Areas document to include best management practices for managing and enhancing habitat as part of rainwater management.	Short-term
	Identify and map opportunities for wetland creation in parks and other public land and develop guidelines for the use of parks and other public lands for rainwater management, habitat enhancement, and other green infrastructure projects to be incorporated into the Parks and Open Space Strategy.	Medium-term
	Collaborate on the development of an Erosion and Sediment Control program to address water quality in watercourses.	Medium-term
	Support invasive species management activities under the direction of the Invasive Species Action Plan to improve watercourse health and reduce long-term maintenance cost.	Ongoing