City of Maple Ridge

COUNCIL WORKSHOP AGENDA October 12, 2021 11:00 a.m. Virtual Online Meeting including Council Chambers

The purpose of the Council Workshop is to review and discuss policies and other items of interest to Council. Although resolutions may be passed at this meeting, the intent is to make a consensus decision to send an item to Council for debate and vote or refer the item back to staff for more information or clarification. The meeting is live streamed and recorded by the City of Maple Ridge.

REMINDER: Council Meeting – October 12, 2021 at 7:00 p.m.

1. APPROVAL OF THE AGENDA

2. ADOPTION OF MINUTES

2.1 Minutes of the September 27, 2021 Council Workshop Meeting

3. PRESENTATIONS AT THE REQUEST OF COUNCIL

4. UNFINISHED AND NEW BUSINESS

4.1 Integrated Stormwater Management Plans Update

Staff report dated October 12, 2021 providing information on Integrated Stormwater Management Plans (ISMPs) for the South Alouette River, Kanaka Creek, Blaney Creek, North Alouette and Fraser River watersheds developed to preserve watershed health while facilitating the requirements of community growth.

Link to full version of the ISMP - South Alouette and Kanaka Creek

Link to full version of the ISMP - Blaney, North Alouette and Fraser River

5. CORRESPONDENCE

BRIEFING ON OTHER ITEMS OF INTEREST / QUESTIONS FROM COUNCIL

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7. MATTERS DEEMED EXPEDIENT

8. NOTICE OF CLOSED COUNCIL MEETING

The meeting will be closed to the public pursuant to Sections 90 (1) and 90 (2) of the Community Charter as the subject matter being considered relates to the following:

Section 90(1)(a) Personal information about an identifiable individual is being considered for a position as an officer, employee or agent of the municipality.

Section 90(1)(c) Labour relations or employee negotiations.

Section 90(1)(e) The acquisition of land or improvements, if the council considers that disclosure might reasonably be expected to harm the interests of the municipality.

Any other matter that may be brought before the Council that meets the requirements for a meeting closed to the public pursuant to Sections 90 (1) and 90 (2) of the Community Charter or Freedom of Information and Protection of Privacy Act.

9. ADJOURNMENT

APPROVED BY:

DATE:

DATE:

PREPARED BY

DATE:

CHECKED BY:

City of Maple Ridge

SPECIAL COUNCIL WORKSHOP MINUTES

September 27, 2021

The Minutes of the City Council Meeting held on September 27, 2021 at 9:34 a.m. held virtually and hosted in the Council Chambers of the City Hall, 11995 Haney Place, Maple Ridge, British Columbia for the purpose of transacting regular City business.

PRESENT	Appointed Staff
Elected Officials	A. Horsman, Chief Administrative Officer
Mayor M. Morden	C. Carter, General Manager Planning & Development Services
Councillor J. Dueck	C. Crabtree, General Manager Corporate Services
Councillor C. Meadus	S. Hartman, General Manager Parks, Recreation & Culture
Councillor G. Robson Councillor A. Yousef	P. Hlavac-Winsor, General Counsel and Executive Director,
	D. Pollock, General Manager Engineering Services
ABSENT	S. Nichols, Corporate Officer
Councillor K. Duncan	
Councillor R. Svendsen	Other Staff as Required
	C. Goddard, Director of Planning
	A. Bowden, Planner 2
	M. Halpin, Manager of Transportation
	F. Smith, Director of Engineering

These Minutes are posted on the City Web Site at www.mapleridge.ca

Note: Due to the COVID-19 pandemic, Councillor Yousef participated electronically. The Mayor chaired the meeting from Council Chambers.

Note: Councillor Robson was not present at the start of the meeting.

1. APPROVAL OF THE AGENDA

R/2021-WS-067

It was moved and seconded

That the agenda of the September 27, 2021 Council Workshop Meeting be approved as circulated.

CARRIED

2. UNFINISHED AND NEW BUSINESS

2.1 Draft Regional Growth Strategy Metro 2050 - Request for Comments

Staff report dated September 27, 2021 recommending that comments regarding the report titled "Draft Regional Growth Strategy Metro 2050 - Request for Comments" be summarized and a report provided for consideration of a formal resolution prior to November 26, 2021.

The Director of Planning introduced the item and spoke to the purpose of the draft regional growth strategy in terms of Maple Ridge and the City's relationship with Metro Vancouver.

Note: Councillor Robson joined the meeting electronically at 9:37 a.m. during the staff introduction.

A. Bowden, Planner, provided a detailed presentation of the five goals included in the regional plan and recommended actions. She outlined changes to implementation and performance measures and gave a summary of recommended actions.

Staff responded to questions relative to economic development.

- Note: Councillor Yousef let the meeting at 11:16 a.m. and returned at 11:19 a.m.
- Note: Councillor Robson left the meeting at 11:50 a.m. and returned at 11:59 a.m. during comments from Council.
- Note: Councillor Robson left the meeting at 12:25 p.m.

R/2021-WS-068

Moved and seconded

That the meeting be recessed and be reconvened at 1:00 p.m.

CARRIED

- Note: The meeting was reconvened at 1:03 p.m. Councillor Robson was not in attendance when the meeting reconvened. He was absent for the presentation of Item 2.2.
- Note: Item 2.2 Strategic Transportation Plan Project was dealt with when the meeting reconvened. Further discussion of Item 2.1 continued following Item 2.2. The minutes reflect this order. Item numbers have not been altered.

2.2 Strategic Transportation Plan Project - Preliminary Input for Phase 3

Presentation by John Steiner, Urban Systems

Staff report dated September 27, 2021 outlining an opportunity for the provision of input and direction on the Vision, Goals, Principles and Targets which will provide material for stakeholder and public consultation.

The Director of Engineering introduced and provided background on the item.

Mr. Steiner from Urban Systems provided a detailed presentation on the strategic directions of the Maple Ridge Strategic Transportation Plan.

Note: The meeting lost quorum at 1:46 p.m. during the presentation with Councillor Yousef leaving the meeting. Quorum was re-established at 1:48 p.m. when Councillor Yousef returned to the meeting.

The consultant and staff responded to questions from Council.

Note: Councillor Robson joined the meeting at 2:21 p.m. prior to the continued presentation of item 2.1.

2.1 Continued Discussion of Draft Regional Growth Strategy Metro 2050 - Request for Comments

The Planner proceeded with the presentation of Item 2.1 at 2:21 p.m.

Note: Councillor Yousef left the meeting at 2:23 p.m. during the presentation and returned at 2:28 p.m.

The General Manager advised that all recommendations must be provided to Metro Vancouver via Council resolution. The Planner outlined the proposed next steps.

R/2021-WS-069

Moved and seconded

That the comments from the September 27, 2021 Council Workshop and comments from the missing members of Council within one week, regarding the staff report titled "Draft Regional Growth Strategy Metro 2050 - Request for Comments" be summarized and brought back to Council for consideration of a formal resolution prior to November 26, 2021.

CARRIED

Councillor Robson - OPPOSED

3. **ADJOURNMENT** – 2:51 p.m.

M. Morden, Mayor

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Certified Correct

S. Nichols, Corporate Officer

City of Maple Ridge



TO:	His Worship Mayor Michael Morden and Members of Council	MEETING DATE: FILE NO:	October 12, 2021 11-5255-20-061
FROM:	Chief Administrative Officer	MEETING:	Workshop
SUBJECT:	Integrated Stormwater Management Plans Upd	late	

EXECUTIVE SUMMARY:

Integrated Stormwater Management Plans (ISMPs) are high level watershed reviews developed to preserve watershed health while facilitating the requirements of community growth. To achieve this, the ISMP process examines the relationship between land use planning and development, environmental performance, existing drainage infrastructure and environmental protection.

ISMPs have been developed for the South Alouette River and Kanaka Creek watersheds (by Urban Systems Ltd.) as well as the Blaney Creek, North Alouette and Fraser River watersheds (by Kerr Wood Leidal Associates Ltd.). These ISMPs were developed over multiple years and provide an overview of the watersheds, review how rainwater is currently managed, evaluate the performance of drainage trunk systems, outline challenges and provide recommendations for improvements. Both plans have been enhanced by feedback and information received from the Environmental Advisory Committee, a public survey and a number of internal and external stakeholders. Given the size and complexity of the ISMP documents, the Executive Summary reports are attached as Attachments A and M (links to the full reports are provided in the Council Agenda).

This report is submitted for information, noting that a subsequent meeting with Council will be scheduled to respond to questions, provide clarification and seek Council endorsement.

RECOMMENDATION:

For information.

DISCUSSION:

a) Background Context:

Why we do ISMPs

As a commitment to the Minister of Environment through the Liquid Waste Management Plan, Metro Vancouver municipalities are required to develop Integrated Stormwater Management Plans (ISMPs) for all watersheds that are anticipated for development spanning more than 20% of the watershed.

ISMPs are developed to preserve watershed health while facilitating the requirements of community growth. To achieve this, the ISMP process examines the relationship between land use planning and development, environmental performance, existing drainage infrastructure and environmental protection.

Page 1 of 7



Scope of current ISMPs

The City of Maple Ridge consists of 10 distinct watersheds. Figure 1 below identifies these watersheds and provides ISMP updates per catchment. The area identified within the red outline is the subject of this report.

- **Yellow** Urban Systems developed an ISMP for the South Alouette River and Kanaka Creek watersheds.
- **Green** Kerr Wood Leidal Associates Ltd. (KWL) developed an ISMP for the Blaney Creek, North Alouette and Fraser River watersheds.
- **Orange** ISMPs have not been initiated for these areas. Pitt Meadows developed an ISMP for the Kennedy Drainage Area; however, the area is shown in orange on Figure 1 because the ISMP did not assess the portion of area within Maple Ridge.

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 South Alcuette

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 Blare

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 Lafe 2' stri

 Kennedy
 Lafe 2' stri

 Kennedy
 Lafe 2' stri

 Fraser (Nets Mpl)
 Kanka

 Fraser (Nets Mpl)
 Lafe 2' stri

Figure 1: Watersheds and ISMPs in Maple Ridge

Consistent with regional direction, both ISMPs evaluate trunk main capacity equivalent to pipes 400mm or 16" in diameter or greater. Therefore, while covering the majority of the City's land mass, the ISMPs (outlined in red) in combination represent approximately 25% of the City's drainage infrastructure. The remaining drainage infrastructure is comprised of:

- City-wide drainage systems smaller than 400mm or 16" (64%)
- Other watersheds (6%)
- Urban locations with no dedicated drainage servicing (3%)
- Urban locations with access to roadside ditch only (2%)

Integration of ISMPs

Stormwater infrastructure is a unique infrastructure class which includes at-grade features (ditches, detention ponds, dykes, weirs, etc.) as well as traditional below-grade utility features (storm mains, property services, pump stations, etc.). Accordingly, drainage infrastructure has historically competed with transportation infrastructure for right-of-way allocation. As a result, corridor-based decisions require consideration of both asset classes. This interdependency is mapped below in Figure 2.

Figure 2: Integration Map of ISMPs



As per the figure above, regional commitments and direction in combination with the City's Official Community Plan are macro-level drivers. The meso-level includes City plans which span multiple neighbourhoods, followed by neighbourhood level analyses including Sub-watershed Drainage Master Plans, the Fraser River Escarpment Risk Assessment and Neighbourhood Area Plans. All of these parameters guide decisions made at the micro-level or "street level". This includes appropriate street designs, incorporating development proposals, ongoing operation and maintenance schedules and identification of funding options to progress these projects.

In general, the ISMPs develop recommendations over the following areas:

- 1. Regulation and Enforcement
- 2. Asset Management
- 3. Environmental Monitoring
- 4. Environmental Measures
- 5. Collaboration, Education and Outreach
- 6. Adaptive Management and Continuous Learning
- 7. Capital Planning and Infrastructure Improvements

The ISMPs identified Maple Ridge as an early adopter of policy and criteria that has improved sustainable development practices while supporting community growth. Key successes achieved to date have been progressive watercourse setbacks and designation of environmentally sensitive protection areas, and the formation of three-tiered rainwater management criteria. While considered progressive, further investigation into the effectiveness of the criteria is recommended.

To assess the system under future conditions, consideration was given to the impact of climate change on the performance of stormwater infrastructure. Current rainfall intensities were scaled by both 10% and 20%. This is aligned with the most recent climate projection data identifying the potential for a 20% increase by 2050. Despite the primary focus of climate change increasing precipitation, the impacts will also extend to heat, drought and wind. This will inevitably impact summer base flows in creeks and further emphasizes the importance of groundwater recharge and tree canopy protection.

Overall, the ISMPs identify investments of approximately \$2-3M in planning, policy and monitoring work and an initial \$60M to address infrastructure deficiencies, support growth and the address the impacts of climate change.

Further, the ISMPs include recommendations to review the City's tiered drainage criteria, and proposed a multitude of projects to promote and protect watershed health. In addition to these recommendations, and to fulfil provincial requirements, a monitoring and adaptive management framework is required. Tracking watershed health trends over time through repeat sampling allows for regular feedback on the efficacy of measures implemented and provides opportunities for course-corrections over time.

Advancing the recommendations of the ISMP to address current and emerging challenges will require ongoing effort and funding. The financial and business planning implications associated with the ISMP's recommendations are provided in Section E, below.

Consultation and Feedback:

The ISMP benefited from public and various stakeholder feedback throughout the process. This feedback was incorporated where possible, thereby strengthening connections between the City, community and other government agencies. A summary of the feedback received is provided below.

Public Survey

An online public survey was conducted for both ISMPs over the course of one month in 2019. Large advertisements for the survey were published in two issues of the Maple Ridge-Pitt Meadows News, Facebook posts, the front-page City Spotlight section of the City's website and the Maple Ridge This Week newsletter via a mailing list with 181 subscribers. The outcomes of the surveys are documented in the ISMP reports and responses are included as Attachment B and N to this report.

Review by Environmental Advisory Committee

The City's Environmental Advisory Committee received both ISMP drafts along with presentations from the City's consultants. The Committee provided their support for both ISMPs.

Participation from Internal Stakeholders

Internal stakeholders provided feedback on the draft ISMPs and participated in meetings with external stakeholders. Staff from Corporate Communications, Finance, Engineering, Engineering Operations, Parks & Facilities, Environmental Planning, Community Planning and Building all contributed to the process.

Participation from External Stakeholders

The draft ISMPs were shared with external stakeholders identified below, along with an invitation to provide input and feedback. A virtual presentation was also offered to all stakeholders including options for communication by telephone or email exchange. Most groups met with the City and provided feedback on the report.

- Agricultural Land Commission
- Alouette River Management Society
- Alouette Valley Association
- BC Conservation Foundation WildSafeBC
- BC Hydro
- BC Ministry of Agriculture, Food and Fisheries
- BC Ministry of Environment
- BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development
- BC Parks
- City of Pitt Meadows
- D.K. Bowins & Associates Inc.
- Fisheries and Oceans Canada
- Kanaka Education & Environmental Partnership Society
- Katzie First Nation
- Kwantlen First Nation
- Metro Vancouver Regional Parks
- Morningstar Homes
- Thornhill Aquifer Protection Society
- UBC Malcolm Knapp Research Forest
- Wayne Stephen Bissky Architecture Urban Design Incorporated

A summary of stakeholder feedback and discussions is provided in Attachments C and O to this report. Where received, specific stakeholder feedback is included in Attachments D to L and Attachments P to V to this report.

b) Strategic Alignment:

Integrated stormwater management planning supports Council's strategic priorities of Community Safety, Inter-Government Relations and Growth and Natural Environment. The ISMP also fulfills a directive of the Official Community Plan.

c) Citizen/Customer Implications:

The improvements to watershed health and drainage infrastructure recommended in the ISMP will benefit the community.

d) Interdepartmental Implications:

Implementing the recommendations of the ISMPs will affect Finance, Engineering, Engineering Operations, Parks & Facilities, Environmental Planning, Community Planning and Building. The implications for these areas will be varied, including providing internal stakeholder feedback on proposed solutions, budgeting, monitoring, analysis, planning, community consultation, construction and maintenance work.

e) Business Plan/Financial Implications:

Both ISMPs recommend significant investments in stormwater management. These recommendations require further synthesis and prioritization.

In general, there are elements which can be incorporated into the 2022-2026 Business and Capital Plans; however, the majority of investments identified require further evaluation and prioritization. Balancing the needs of existing infrastructure replacement with the desire for service level enhancements (new infrastructure) will also be required.

Sub-watershed Drainage Master Plans are necessary to validate the assumptions of the ISMP model, study overland flow paths and analyze pipes smaller than 400mm or 16". The first of these plans was recently initiated in the Eagle Avenue and Gee Street neighbourhood (northeast of Dewdney Trunk Road and 228 Street) and the Lower Hammond Neighbourhood is scheduled to commence in 2022.

Sub-watershed Drainage Master Plans, in conjunction with the Fraser River Escarpment Risk Analysis and the ISMP work completed to date will inform the cumulative scope of existing drainage infrastructure improvements required. Once determined, staff will review the available funding options for Council's consideration.

f) Policy Implications:

In addition to existing stormwater management considerations, there is a discussion to be had with Council regarding the City's approach to neighbourhoods without access to stormwater infrastructure and urban neighbourhoods with rural road cross sections. Staff recommend this discussion be deferred until the following are complete in order to support a holistic approach:

- Sub-watershed Drainage Master Plans
- Strategic Transportation Plan
- Fraser River Escarpment Risk Assessment
- Applicable Neighbourhood Area Plans

CONCLUSION:

Given the size and complexity of the ISMP documents, this report is submitted for information at this time. A subsequent meeting will be scheduled for questions, clarifications and endorsement to meet the City's regulatory requirements.

Prepared by: Joe Dingwall P.Eng. Manager of Utility Engineering

Reviewed by: Forrest Smith, P.Eng. Director of Engineering

pproved by: David Pollock, P.Eng. General Manager Engineering Services

Concurrence: Al Horsman Chief Administrative Officer

Attachments:

South Alouette River and Kanaka Creek Watersheds

- (A) Integrated Stormwater Management Plan South Alouette & Kanaka Creek Executive Summary Report, September 2021
- (B) Public Survey Results
- (C) External Stakeholder Feedback Summary
- (D) Letter from Agricultural Land Commission
- (E) Letter from Alouette River Management Society
- (F) Letter from Alouette Valley Association
- (G) Letter from BC Conservation Foundation WildSafeBC
- (H) Letter from BC Ministry of Environment & Climate Change Strategy
- (I) Letter from BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development
- (J) Letter from Kanaka Education & Environmental Partnership
- (K) Email from Thornhill Aquifer Protection Society
- (L) Email from UBC Malcolm Knapp Research Forest

North Alouette River, Blaney Creek and Fraser River Watersheds

- (M) Integrated Stormwater Management Plan Blaney, North Alouette, and Fraser River Executive Summary Report, September 2021
- (N) Public Survey Results
- (0) External Stakeholder Feedback Summary
- (P) Letter from Agricultural Land Commission
- (Q) Letter from Alouette River Management Society
- (R) Letter from Alouette Valley Association
- (S) Letter from BC Conservation Foundation WildSafeBC
- (T) Letter from BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development
- (U) Email from Morningstar Homes
- (V) Emails from UBC Malcolm Knapp Research Forest



INTEGRATED STORMWATER MANAGEMENT PLAN SOUTH ALOUETTE & KANAKA CREEK

EXECUTIVE SUMMARY REPORT

September 2021

Revision: •	Working Copy
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- Draft
- ✓ Final
- **Date:** 2021-09-28
- Prepared by: Urban Systems Ltd. 550 – 1090 Homer Street Vancouver, BC V6B 2W9 Canada 604.235.1701 www.urbansystems.ca
- Contact: Glen Shkurhan, P Eng gshkurhan@urbansystems.ca
- File: 1279.0025.01

Certification:



Glen Shkurhan, P Eng Professional of Record



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SOUTH ALOUETTE-KANAKA CREEK ISMP

1 INTRODUCTION

1.1 What is an Integrated Stormwater Management Plan?

The minimum regional objective of integrated stormwater management planning is to "strive to maintain existing watershed health and achieve no-net-loss on a watershed basis"¹. To achieve this, the ISMP process examines the relationships between land use planning and development, drainage servicing, and environmental protection.

An ISMP outlines actions and plans to support and promote the growth of a community in a way that maintains (and ideally enhances) the health of a watershed. Because of the integrated nature of its scope and the way in which it is developed, as a watershed-level document an ISMP can be a powerful tool to help a community realize its vision.

Core components of an ISMP include the following:

Land Use

- Growth projections, land use patterns and priority watersheds
- Area Plans

Environment

 Identify aquatic and terrestrial habitat values and opportunities

- · Senior government regulations and approvals
- Geosciences (geotechnical and hydrogeology / groundwater)
- Monitoring and watershed health tracking

Infrastructure and Drainage Systems

- Inventory and performance assessment of existing components, including natural assets
- Identify pieces required to effectively support growth, while protecting environmental values
- Monitoring and adaptive management

Engagement and Communication

- Establish effective inter-departmental linkages
- · Leverage community members and other authorities
- Secure support from community leaders and senior officials
- Draw on knowledge of other organizations and interest groups

Policy and Finance

- Policy and criteria to guide future growth and redevelopment
- Ensure policy documents are complete and aligned

1 Metro Vancouver's Template for Integrated Stormwater Management Planning (2005)

SOUTH ALOUETTE-KANAKA CREEK ISMP

- Implementation priorities, responsibilities, and schedules
- Financing and cost recovery considerations

1.2 Drivers for Integrated Stormwater Management Planning in the City

Legislative Requirements

The City's initial regulatory driver for conducting ISMPs was Metro Vancouver's 2002 Liquid Waste Management Plan (LWMP), which was updated in 2010 as the Integrated Liquid Waste and Resource Management Plan (ILWRMP).

As a condition to the approval of the ILWRMP, the BC Ministry of Environment (MOE) stipulated that all member municipalities in Metro Vancouver must complete ISMPs for their urban and semi-urban watersheds. As a member municipality of Metro Vancouver, the City of Maple Ridge is required to do so. The LWMP endorses the view that stormwater is a resource that, when managed properly, can be utilized to protect and ideally enhance watershed health. The LWMP outlined an approach to integrated stormwater management planning that considered drainage, environment and land use planning functions within a watershed. The intent was to address potential stormwater management impacts on a community and its values, such as population growth and densification, recreation, agriculture, fisheries, wildlife, flood protection, transportation, and other related issues.

City Directives Related to Watershed Health and Climate Change Adaptation

The importance of environmental values and protecting watershed health has long been recognized by the City. Through key corporate documents – the 2013 Official Community Plan (OCP); the 2007 Corporate Strategic Plan (CSP); the 2007 Sustainability Action Plan (SAP); and the City of Maple Ridge Strategic Plan 2019-2022 - the City provides strategic direction that supports integrated stormwater management planning. These documents include highlevel objectives and policies that support ISMP objectives. The OCP places emphasis on healthy watersheds and acknowledges the significance of surrounding Crown lands and partnerships with other jurisdictions to overall sustainability. It also includes a natural features framework for watershed health. The OCP also includes statements regarding smart growth; biodiversity conservation; ecological health; movement corridors for wildlife, fish and people; climate change adaptation; economic accountability and responsibilities; natural assets; and social objectives related to liveability, and mental and physical wellbeing.

The notion of integration is inherent in the City's value statement on stewardship, which states that the City will "consider the long-term consequences of actions, think broadly across issues, disciplines and boundaries and act accordingly". This statement mirrors the core objectives of an ISMP.

In addition to these high-level directives, the City has also developed numerous bylaws and corporate policies that support integrated stormwater management, as discussed further in Section 3.0.

Climate Change

Climate change, and the uncertainty around what exactly it will bring and when, means that communities need to take an adaptive approach to watershed management and community development. Warmer summers and changes in annual precipitation are just a couple of the anticipated impacts of climate change to communities in the Lower Mainland, and this will have implications for stream health and how stormwater is managed. Contemporary integrated stormwater management planning needs to have some adaptive capacity to address these issues, and this is explored in the ISMP.

Growth & Development

A regional Urban Containment Boundary (UCB) has been established as a long-term area for urban development across Metro Vancouver. Within the UCB, nine urban centres have been identified, including the City's Town Centre. The City's OCP also identifies specific areas of growth, including the Town Centre and Silver Valley area (which are located within the South Alouette watershed) and the Albion area (which is located within the Kanaka Creek watershed). Integrated stormwater management planning is a strong tool for achieving these growth objectives as well as environmental protection.

1.3 An ISMP for the South Alouette and Kanaka Creek Watersheds

TThis ISMP has been prepared for the South Alouette and Kanaka Creek watersheds in the City of Maple Ridge, British Columbia (BC). The City is jointly developing ISMPs for these watersheds because of the overlapping objectives and benefits the process provides to the City. The City is making a significant investment in the future of Maple Ridge and the watersheds through the development of these plans.



The Study Area is comprised of the approximately 310 square kilometers (km2), or 31,300 hectares (ha), of the South Alouette and Kanaka Creek watersheds, of which 160 km2 (16,360 ha) lie within the municipal boundary of the City of Maple Ridge (**Figure 1.1**). Included within the watershed boundaries but beyond the jurisdiction of the City are parts of Golden Ears Provincial Park, the City of Pitt Meadows, the District of Mission, and the University of British Columbia Research Forest. The Study Area is located within the traditional territory of the Coast Salish People, including Katzie First Nation and Kwantlen First Nation.

1.4 Planning Process

This ISMP was prepared in three Parts:

Part 1 summarized the background information and established the baseline (existing) conditions of the watersheds and considerations for the ISMP as it is further developed.

Part 2 explored the likely outcomes of future conditions through the application of planning future land use change, climate change, and potential changes in criteria or standards. This assessment provides the basis for the management strategy.

Part 3 defines the management strategy and adaptive management framework to best address the issues identified in Part 1 and Part 2.

1.5 Desired Outcomes

A desired outcome of the ISMP planning process is that the ISMP is ultimately endorsed by City Council. For this to happen, the following outcomes must also be achieved:

- The ISMP aligns with and supports the City's OCP;
- Stakeholders are engaged and supportive;
- The ISMP reflects the City's unique regulatory, land use, and environmental conditions;
- Existing stormwater and environmental management practices are considered and improved upon; and
- Recommendations are justifiable, clear, feasible, and prioritized.

SOUTH ALOUETTE-KANAKA CREEK ISMP

1.6 Building On Our Foundation

The City has a long history of watershed and environmental management, having been an early adopter of the environmental management paradigm. Over the years, the City has undertaken numerous studies and planning initiatives, which has provided a strong foundation on which to develop its ISMPs. Furthermore, a comprehensive set of regional, local, and provincial/federal regulations and policies guide integrated stormwater management practices in the City.

In Part 1 of the ISMP, city staff from various departments participated in a workshop to initiate the project and set the stage for working collaboratively to make decisions to guide and shape the ISMP. The workshop was complemented by an online survey distributed to City staff in advance, which helped shape the content of the workshop. Workshop #1 focused on the following outcomes:

- Collective understanding of what an ISMP is and the process for developing an ISMP for the South Alouette and Kanaka Creek watersheds;
- Collective understanding of the importance of participating in the process for developing the ISMP;
- The sharing of insights on limitations or challenges that may influence the recommendations of the study; and
- Making key decisions to inform the development of an effective C&E strategy.

A key takeaway of the first workshop was the list of desired outcomes of the ISMP planning process. Throughout the course of developing the ISMP, other workshops were held with city staff from various departments.

Figure 1.1 – Study Area



SOUTH ALOUETTE-KANAKA CREEK ISMP

1.7 Collaboration, Communication, and Engagement

Leadership to implement the ISMP will ultimately come from the City, and inter-departmental collaboration will be required to successfully do so. Ultimately, City Council will decide whether to endorse the ISMPs. This will happen when there is understanding and support for the ISMP recommendations across City departments and the local community. Input into the ISMP process is therefore sought from all those who have an interest in the ISMP outcomes, with a strong focus on working together to achieve the desired outcomes of the process.

As evidenced by the desired outcomes of the ISMP, engagement with external stakeholders is important to earning their support and achieving the ultimate desired outcome of Council endorsing the ISMP.

To help assess the general public's perceptions of the watershed and its overall health the City of Maple Ridge published a public online survey from July 19 to August 19, 2019. The survey was advertised on the City website, their Facebook page, and in the local newspaper. Results are presented in Section 6 Community Survey Summary, herein.

In November 2019 an early draft of the ISMP was presented to the City's Environmental Management Committee ahead of the report being presented to Council on March 31, 2020.

In early 2021 an updated Draft copy of this ISMP was distributed to a number of external stakeholder groups and

agencies for feedback. A number of them responded with written comments, following which one on one consultation discussions occurred through spring and early summer 2021. Some communities and stakeholders invited to provide feedback did not respond to the invitation or did not have comments on the ISMP.

The following stakeholder groups are acknowledged and thanked for the valuable input to this final document.

- Agricultural Land Commission
- Alouette River Management Society (ARMS)
- Alouette Valley Association (AVA)
- BC Hydro
- BC Parks
- Department of Fisheries and Oceans
- DK Bowins and Associates
- Kanaka Education & Environmental Partnership Society (KEEPS)
- Metro Vancouver
- Ministry of Agriculture, Food and Fisheries
- Ministry of Environment
- Ministry of Forests Lands Natural Resource Operations and Rural Development
- Thornhill Aquifer Protection Society
- UBC Malcolm Knapp Research Forest
- BC Concervation Foundation (Wildsafe BC Program)



BACKGROUND & BASELINE ASSESSMENT



2. OVERVIEW OF THE WATERSHEDS

South Alouette

The South Alouette watershed is illustrated on **Figure 2.1**. The South Alouette is a 5th Order² stream with a length of approximately 31 km. The South Alouette River originates on Mount Robie Reid where drainage flows into Alouette Lake. Flows from Alouette Lake are controlled by the Alouette Dam, operated by BC Hydro. Flows from Alouette Lake are then conveyed west by the South Alouette river, where it converges with the North Alouette to form the Alouette River. The Alouette River flows west to the Pitt River and ultimately to the Fraser River, which conveys flows to the Salish Sea (Strait of Georgia). The Alouette River is a proclaimed BC Heritage River. The lower 8 km of the South Alouette is tidally influenced. Parts of the South Alouette River are also diked.

The South Alouette watershed is a large watershed, approximately 250 km2 (25,128 ha) in size, of which approximately 100 km2 (10,197 ha) lie within the City's municipal boundary. The remaining area falls within the jurisdiction of the City of Pitt Meadows, the District of Mission, and the Province of BC Parks (Golden Ears Provincial Park). The South Alouette watershed is bound by the Kennedy watershed to the west; the Fraser watershed to the southwest, the Kanaka Creek watershed to the southeast; and the North Alouette and Blaney Creek watersheds to the north.

² Stream order is a measure of the relative size of a stream, based on the number of tributaries to it, and it ranges from 1st Order through 12th Order. The smallest streams are 1st through 3rd Order, and are considered headwater streams.





Figure 2.1 – South Alouette Watershed – Watercourses

Kanaka Creek

Kanaka Creek is a 3rd Order stream with a length of 22 km that originates in mountainous terrain on Blue Mountain to the east of Alouette Lake, and generally flows southwest to its confluence with the Fraser River. The lower 4 km of Kanaka Creek are influenced by the tidal portion of the Fraser River.

The Kanaka Creek watershed is approximately 60 km2 (6,180 ha) in size, and it is almost wholly within the City's municipal boundary (6,160 ha). Within the municipal boundary, it is characterized by the following "zones" (illustrated on **Figure 2.2**) with each zone having similar land use, drainage and environmental characteristics:

- · Zone 1: Urban area in the lower watershed
- Zone 2: Rural area, spanning the lower and parts of the upper watershed
- · Zone 3: Natural area in the upper watershed

A key feature of the watershed is Kanaka Creek Regional Park, which is under the jurisdiction of Metro Vancouver and runs the length of Kanaka Creek from Dewdney Trunk Road southwest to its confluence with the Fraser River.

The Kanaka Creek watershed is bound by the Fraser watershed to the west; the Fraser River to the south; the Thornhill and Whonnock watersheds to the south and southeast; and the South Alouette Watershed to the northwest.





Figure 2.2 – Kanaka Creek Watershed – Watercourses

2.1 Effects of Land Use Change

The graphic below depicts the impacts of development and loss of vegetative cover. Environmental health is closely linked to the Mean Annual Flow (MAF). Vegetation and soils absorb and retain significant water, some of which is slowly released as seepage into receiving watercourse. In a natural state where vegetative cover is vast, the MAF is at its lowest and the receiving watercourses establish their geometry based on that flow. As development and removal of vegetation occurs, the land's ability to retain water is reduced, thereby raising the MAF. The receiving watercourse then adjust their geometry to a new MAF, getting wider and deeper through erosion. Low Impact Development, or Green Infrastructure is to integrate water retention features into the development area to compensate for the reduction of natural vegetation and to minimize the change to the MAF.



(Credit to Kerr Wood Leidal for image)

SOUTH ALOUETTE-KANAKA CREEK ISMP

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2.2 Existing Land Use

Existing land use in the South Alouette watershed is a wide range from natural woodlot to urban centre, as portrayed in **Figure 2.3**. The Kanaka Creek watershed also has a wide range from rural to urban, as portrayed in **Figure 2.4**. The land use distribution by area for each watershed is presented in **Table 2.1** below.

Table 2.1 - Land Use Distributions (based on City zoning)

WATERSHED ZONE	TOTAL AREA SOUTH ALLOUETTE WATERSHED (HA)		TOTAL AREA KANAKA CREEK WATERSHED (HA)	
	Total	Municipal	Total	Municipal
Agricultural	3%	3%		
Natural	88%	29%	34%	33%
Rural	3%	3%	45%	45%
Urban	5%	5%	19%	19%
Resource	1%	1%	2%	2%
Total	100%	41%	100%	99%

Note: Within the Kanaka Creek watershed the Albion Flats area is currently within the Agricultural Land Reserve, however, City zoning is Suburban and Rural Residential.

2.3 Topography

Topography in the South Alouette watershed ranges from roughly sea level in the agricultural lowlands to approximately 2,085 meters (m) above mean sea level (mamsl) in the natural uplands. Topography in the Kanaka Creek watershed ranges from 0.5 mamsl in the urban lowlands to 1,057 mamsl in the natural uplands



SOUTH ALOUETTE-KANAKA CREEK ISMP

Figure 2.3 - South Alouette - Existing Land Use







2.4 Terrestrial Systems Inventory

The South Alouette and Kanaka watersheds support a wide variety of terrestrial habitats across the range of zones previously described, from relatively undisturbed forested areas in the natural uplands, to rural and urban residential areas with riparian buffers, to agricultural lowlands behind a dike.

The riparian areas within the South Alouette and Kanaka watersheds are also likely to have a diversity of wildlife species, including: black-tailed deer, black bear, river otter, mink, deer mouse, coyote, raccoon, osprey, snowy owl, ruffed grouse, numerous waterfowl species and shorebirds, garter snakes, painted turtle, western toad, red-legged frog, bullfrog, northwestern salamander, long-toed salamander and rough-skinned newt.

A search of the BC Conservation Data has indicated the following Species At Risk have confirmed habitat within the Alouette River watershed:

- · Mountain Sneezeweed (Helenium autumnale)
- Pointed Rush (Juncus oxymeris)
- · Green Heron (Butorides virescens)
- Painted Turtle (Chrysemys picta)
- · Great Blue Heron (Ardea herodias fannini
- Northern Red-legged Frog (Rana aurora)
- · Grappletail (Octogomphus specularis)
- Emma's Dancer (Argia emma)

Kanaka Creek is largely within the Kanaka Creek Regional Park. This park covers over 10 km of the length of the stream, from Dewdney Trunk Road to the Fraser River. The habitat along the creek within this park is largely forested, with a mix of residential and agricultural land surrounding the park. Lower Kanaka Creek is a low velocity, meandering stream with wetlands and other low-lying grassy habitats. Upper Kanaka Creek flows through steeper forested terrain. A search of the BC Conservation Data has indicated the following Species At Risk have confirmed habitat within the Kanaka Creek watershed:

- Roell's Brotherella (Brotherella roellii);
- Green Heron (Butorides virescens);
- Oregon Forest Snail (Allogona townsendiana); and
- Northern Red-legged Frog (Rana aurora).

2.5 Aquatic Species & Habitat Inventory

The City's Environmental Management Strategy served as a strong foundation for developing the environmental inventory in this ISMP, in addition to other environmental reports and provincial databases.

The South Alouette is known to provide habitat to at least 29 fish species, including several invasive fish species. No major fish barriers are known to exist on the South Alouette with the exception of the dam at the outlet of Alouette Lake. Of the tributaries to the South Alouette River, several are fishbearing, some of which do have fish migration barriers.

Kanaka Creek is known to provide habitat to 11 species of fish; however, given its direct connection to the Fraser River, it is likely that more species inhabit this system. Fish Habitats for each watershed are shown in **Figures 2.5** and **2.6**.



Figure 2.5 - South Alouette Watershed - Fish Habitat



Figure 2.6 – Kanaka Creek Watershed - Fish Habitat
2.6 Water Quality Analysis

Recent Monitoring

In 2014 and 2015, water quality monitoring was conducted as part of an ongoing program undertaken specifically to support the ISMP program and to fulfill the requirements under Metro Vancouver's Monitoring and Adaptive Management Framework (MAMF).

Two sub-watersheds from each of the South Alouette and Kanaka watersheds were selected for water quality monitoring as part of the City's monitoring and adaptive management program. These were monitored over two periods for water quality: one during wet season flows (November-December 2014) and one during dry season flows (July-August 2015). In both cases, monitoring was undertaken on a weekly basis for a period of five consecutive weeks, as per MAMF protocol, which allows for comparison with the BC Water Quality Guidelines. All four sites had mean water quality parameter values that were either approaching or exceeding guidelines in either the wet or dry season.

2.7 Benthic Invertebrates

Benthic invertebrates, or aquatic insects, can be used to provide an indication of the health of a stream or watershed given their diverse and abundant nature, their sensitivity to human disturbance, and the ease in their identification and sampling (HB Lanarc & Raincoast Applied Ecology, 2009). A multi-metric rating system known as the "Benthic Index of Biotic Integrity" (B-IBI) measures benthic communities and assigns a score to a watershed or stream based on the presence or absence of benthic invertebrates. B-IBI has been shown to be a function of impervious area and riparian forest integrity in a given watershed, and for these reasons it is one of three key indicators used to assess watershed health and assign a Watershed Health Tracking Score under the Template for ISMPs.

In 2015, benthic invertebrates monitoring was conducted as part of an ongoing program undertaken specifically to support the ISMP program and to fulfill the requirements under Metro Vancouver's MAMF.

Two sites from each of the South Alouette and Kanaka Creek watersheds were selected for benthic invertebrates monitoring.

Based on the biological condition rankings found in the MAMF biological conditions were fair in Dunlop Creek and Millionaire Creek, poor in Spencer Creek, and very poor in T2 Creek.



2.8 Watershed Health Tracking System

Overview of the System

In addition to the general environmental inventory from the background review, monitoring results, and the site visit, the overall health of the South Alouette and Kanaka Creek watersheds was assessed using the Watershed Health Tracking System (WHTS), which is outlined in the Template for ISMPs.

Under Metro Vancouver's MAMF, an overall "biological condition rank" is assigned to the watershed based on the B-IBI score. In the absence of actual B-IBI monitoring data, a predicted B-IBI score, and therefore biological condition rank, can be determined by assessing two other key indicators of watershed health:

- Percent Riparian Forest Integrity (%RFI); and
- Impervious area, as percent total impervious area (%TIA) or percent effective impervious area (%EIA).

A high %RFI value and a low %TIA value characterize a watershed that is in very good health, and will have a relatively high predictive, and theoretically actual, B-IBI score. Conversely, watersheds with low %RFI and high %TIA are generally considered to be in poor health and will have a relatively low B-IBI score.

OBSERVATIONS

Based on results of the WHTS, the following observations are made:

- The observed patterns of results generally correlate with the level of riparian forest and impervious area observed in each of the subcatchments sampled at the time.
- The range in results is to be expected, with T2 Creek having the lowest biological condition rank and Millionaire Creek and Dunlop Creek having the highest. T2 Creek is a highly urbanized sub-watershed, with older upstream development. Conversely, the Millionaire Creek sub-watershed has recently undergone development and current stormwater management practices have been applied there. In theory, modern stardards and practices should result in better habitat protection than historic ones. There is an opportunity to improve watershed health in the T2 subcatchment (and similar subcatchments) using appropriate stormwater management practices at the time of redevelopment and infill development, such as by reducing TIA (or EIA), or increasing setbacks and RFI.

2.9 Hydrogeological Conditions

The hydrogeological conditions of a watershed (i.e., the soil and groundwater conditions) play a strong role in the watershed's response to rainfall events. Hydrogeological conditions are often highly variable, even within the same watershed, contributing to the complex nature of stormwater management.

South Alouette

Most urban areas within the South Alouette watershed are underlain by moderately well- to well-drained soils. Some of the rural zone is moderately poor to poor draining. Agricultural areas in the watershed generally are poor to very poor draining. Soils in the natural zone are generally moderately well to rapidly draining.

Kanaka Creek

The soils in the urban and rural areas of the Kanaka Creek watershed are variable, ranging from very poor to welldraining. Soils in the natural zone are generally moderately well to rapidly draining.

By filtering the soil properties according to drainage, texture and water table characteristics, four soil groups were distinguished, as presented in **Table 2.2**.



Table 2.2 – Soi	l Groups Based	on Soil Drainag	ge & Flow Ch	aracteristics
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SOIL GROUP	GENERAL DESCRIPTION OF SOIL DRAINAGE CHARACTERISTICS	RUNOFF CHARACTERISTIC	INFILTRATION CHARACTERISTIC
1	Imperfect to Very Poor. Seasonally high water table, flooding, seepage. Potential discharge; slow recharge, if any.	High runoff	Low infiltration
2	Moderately Well to Well. Perched water table or observed seepage, indicating a confining low-permeability layer. Variable recharge or discharge, depending on season and location.	Moderate runoff	Moderately low infiltration
3	Moderately Well to Rapid. Rapid infiltration, no confining layer. Potential recharge.	Low runoff	High infiltration
4	Moderately Well to Rapid. Relatively thin overburden over bedrock or till confining layer; steep terrain. Mountain block / bedrock recharge.	High runoff	Low infiltration

The implications of these characteristics for stormwater runoff and discharge are summarized below:

seepage zones and seasonally high water table.

Soil Group 1

Areas with poor drainage characteristics due to the prevalence of fine-grained material with low infiltration rates. These areas correspond to groundwater discharge zones primarily. Groundwater discharge or high water table conditions will also typically occur in low-lying areas, reducing the capacity of infiltrating rain water and runoff.

Soil Group 2

Areas that are well to moderately well-drained that nevertheless have a perched water table or where seepage is observed, indicating a confining impermeable layer, and likely a lack of direct connectivity with the deeper groundwater regime. These areas likely correspond to groundwater discharge areas, locally confirmed by the presence of springs, Areas that are well to moderately well-drained that also display potential connectivity between the shallow and deeper groundwater regimes. These correspond to areas with the highest potential for rain water infiltration and groundwater recharge.

Soil Group 4

Soil Group 3

Areas that are well or rapidly drained due to the presence of a thin overburden layer over bedrock, or consolidated till, combined with steep terrain. These are typically upland areas where recharge to the fractured bedrock aquifer system is likely to occur.

The extents of these four soil groups are shown on **Figure 2.7** and **Figure 2.8**.



Figure 2.7 – South Alouette Watershed - Soil Drainage & Aquifer Recharge Potential



Figure 2.8 - Kanaka Creek Watershed - Soil Drainage and Aquifer Recharge Potential

3. EXISTING DRAINAGE INFRASTRUCTURE

3.1 Overview

Drainage infrastructure in the South Alouette and Kanaka Creek watersheds was inventoried from the City's GIS data and background reports. The drainage system is generally comprised of piped infrastructure, open channels / ditches, natural watercourses, and detention ponds. The original natural drainage patterns in the watersheds (with the exception of the undeveloped upper watersheds) have been altered over time due to development, including the addition of ditches, embankments, dikes, and land filling.

South Alouette

Piped infrastructure in the South Alouette watershed is shown on **Figure 3.1**. In general, runoff is directed to the piped or open channel system before discharging to surface water. For localized developments with a drainage pond, stormwater is directed first to the pond before being conveyed further downstream. In the natural uplands, runoff is generally conveyed overland to the natural watercourses, except for the Silver Valley Area, in which engineered stormwater management practices have been implemented.

Stormwater generated in the Silver Valley Area Plan has been managed according to the City's recent regulations such as the Watercourse Protection Bylaw, and industry best management practices (BMPs) for low-impact development (LID). Developments within Silver Valley have utilized stormwater management practices to meet the City's new standards for stormwater management, which has included road-side rain gardens discharging to detention ponds and on-lot stormwater management practices (City of Maple Ridge, 2014; KWL).

Kanaka Creek

Piped infrastructure in the Kanaka Creek watershed is shown on **Figure 3.2**. In general, runoff is directed to the piped or open channel system before discharging to surface water. For localized developments with a drainage pond, stormwater is directed first to the pond before being conveyed further downstream. In the natural uplands, runoff is generally conveyed overland to the natural watercourses.

The North East Albion Area Concept Plan has been prepared on the same premise as the Silver Valley Area, with a strong emphasis on a three-tiered, distributed rainwater management source controls focused on both water quality and quantity.



3.1.1 Lot Serviceability

The serviceability of properties is variable across the city. Some properties in the developed urban area are not provided with any drainage servicing, or have no drainage servicing other than a roadside ditch. Drainage improvements for these areas would generally involve extending the storm sewer network into these areas. To date, residents wishing to have storm sewers installed on their block have had the option of doing so through Local Area Servicing (LAS). Storm sewers have also been constructed at developer's cost to service new development as it occurs.

Two urban areas with a number of parcels not having drainage receptors are within the bounds of Laity-216 Street and Dewdney Trunk Road-124 Avenue, and an area between 216-222 Streets and River Road to Lougheed Highway. These areas exist within the Fraser River Escarpment. The City's Escarpment policy titled Control of Surficial and Groundwater Discharge in the Area Bounded by 207 Street, 124 Avenue,

224 Street and the Crest of the Fraser River Escarpment limits opportunities for on-site drainage in this area. The policy includes statements prohibiting water discharge to ground or rock-pits. Landscape ponding is also not permitted.

Given the policy, actions to improve drainage on private property are limited. The City is completing a review of the Fraser River Escarpment policy in 2021/2022. The outcome of this study is expected to provide supportive information for developing drainage improvement plans/policy in these areas. This will inform Master Drainage Plans that can examine these areas in more detail



Figure 3.1 – South Alouette Watershed - Piped Drainage Infrastructure

SOUTH ALOUETTE-KANAKA CREEK ISMP

PART 1 | BACKGROUND & BASELINE ASSESSMENT



Figure 3.2 - Kanaka Creek Watershed - Piped Drainage Infrastructure

3.2 Reported Drainage Issues

Reported drainage issues as reported by City staff and external stakeholders include:

- High stream levels have been observed at Millionaire Creek and Fern Crescent (South Alouette Watershed), which is of possible concern since the upstream catchment is still developing and more impervious area is expected.
- Metro Vancouver's Kanaka Creek Regional Park Management Plan (2004) discusses concerns related to water quality, summer base flows and 'flashy' response to rain events. More recently, Metro Vancouver staff mentioned observing erosion along the Kanaka Creek.
- Flooding of lands in the Albion Flats area.
- Flooding southwest of 123rd Avenue and 230th Street
- Flooding in and around the Town Centre area during the 1 in 100 year event rainfall that occurred in September 2018
- McKenney Creek south of Golden Ears Way, between 210th and 203rd Streets overflows to an adjacent farm field during large rain events
- Localized flooding at various locations

3.3 Performance Analysis

For this watershed scale study, modelling (analysis) of the trunk drainage infrastructure under historic climate conditions was conducted to determine stormwater runoff volumes and flow rates under various storm events, and to define potential improvements to drainage management practices necessary to service future growth and to adapt to climate change.

The trunk drainage system elements included manholes, pipes that are 400 mm in diameter or greater, watercourses comprising the primary system (rivers and major creeks), culverts, ditches, online flow control structures, detention ponds connected to the truncated system, and subcatchments.

The drainage criteria described in the City's Design Criteria Manual (Updated October 2015) were used to define standard modeling parameters and the drainage infrastructure design criteria:

- The minor system must convey runoff from a 10-year design event. This is an event that has a 10% chance of occurring in any given year. The minor system is primary represented by storm sewers and detention ponds.
- Minor system flows must be detained and released at the 2-year predevelopment rate unless otherwise approved by the City. This is a flow that has a 50% chance of occurrence in any given year (a frequent event).
- The major system must convey runoff from a 100-year design event. This is an event that has a 1% chance of occurrence in any given year (a rare event). The major system is primarily represented by watercourses and their culverts. It's also represented by roadway corridors. In some rare instances it may include some storm sewers as well, but generally storm sewers are not sized for the 1:100 year design event. Flows over ground surface are

permitted for the major event provided they do not impact public safety or property. However, there are exceptions to this rule in floodplains, whether in the ALR or not.

3.3.1 Minor System Capacity Analysis

The 10-year design storm was simulated to assess the hydraulic capacity of the existing minor drainage system (storm sewer system and detention facilities). The results described below should not be considered definitively conclusive; rather, they point to potential capacity limitations and areas of potential concern within the system. They are not definitively conclusive because this study is being conducted at a macro scale and there are many complexities that will affect system performance at the local level. Conclusion as to their adequacy or deficiency should be reached through greater observation and assessment at a more refined level.

South Alouette Watershed:

Potential capacity limitations in the trunk piping system were found primarily in older neighbourhoods, such as the Town Centre, where other forms of stormwater management have not been applied. Capacity limitations also appear southwest of 123rd Avenue and 230th Street where flooding in the past 15 years has been observed.

Limited concerns were found in the Silver Valley area where recent stormwater management practices have been applied.

Kanaka Creek Watershed

Performance of the minor drainage system in the Kanaka Creek watershed was found to be variable. There are a significant number of on-line control manholes that intentionally induce surcharging to detain water within the pipe system to protect downstream watercourses. As a general statement, the portions of the system with the greatest limitation are those along Dewdney Trunk Road at and east of 240th Street, and trunk pipes in the vicinity of 232nd Street between 116th Avenue and 118th Avenue.

123rd Avenue at 230th Street Sub-Catchment

Over the last 15 years, there is a sub-catchment along 230th Street near 123rd Avenue that has been hit by repeated flooding incidents. The stormwater network in the study area consists of 3.3 km of sewers, servicing approximately 200 single-family homes. The network discharges to Balbanian Creek, a tributary of the South Alouette River.

This ISMP analysis has identified that for the 1:10 year design event significant surcharge is expected for the portion of trunk sewer on Gee Street between Rogers Avenue and Eagle Avenue.

In 2019, the City engaged WSP to conduct a preliminary allpipe analytic study of this system. The City has now completed flow monitoring and is proceeding with model calibration and results verification. The City will also review options for improving drainage for rainstorm events that exceed a 10year return period.

3.3.2 Major System Capacity Analysis

The 100-year design storm was simulated to assess performance of road crossing culverts and confirm where surface major flow paths are required. Modeling identified a number of road crossing culverts as under capacity for the 100 year event and confirmed the minor system does not have additional capacity for the 100 year event, in particular west of 240 Street. This cursory assessment highlights the need for culvert upgrades as well as improved understanding of overland flow route deficiencies and options for either upgrades or flood mitigation.

Modelling indicated that the main channel of Kanaka Creek fills during a 100 year event (and in some reaches the 10 year event), however Kanaka has a floodplain which is expected to activate during major flows.

The model showed McKenney Creek overflowing its banks in a section between 203 and 210 Street, matching reports that the stream overflows its banks (an agricultural dike/ spoil from channel excavation) during heavy rains at this location. In February 2016 Northwest Hydraulic Consultants (NHC) completed a complementary study for the City titled "North Alouette and South Alouette Rivers Additional Floodplain Analysis, Phase 2 – Technical Investigations Completion Final Report"³. This was a detailed and focused study of the hydraulic performance of the floodplain which was not the intent of this ISMP. Therefore, this NHC study should be consulted for more information about the floodplain areas.



3 http://www.mapleridge.ca/DocumentCenter/View/B145/North-amd-South-Alouette-Rivers-Floodplain-Study?bidId=

4 COMMUNITY SURVEY SUMMARY

To help assess the public's current perceptions of the watershed and its overall health the City of Maple Ridge published a public online survey from July 19 to August 19, 2019. The survey was published on the City website from July 19, 2019 to August 19, 2019, posted on Facebook August 1, 2019 reaching 1,760 people, and advertised in the local newspaper August 2, 2019 and August 7, 2019. Participation was voluntary and the City received a total of 25 responses, with most respondents living within the ISMP study area. Given the size of the area and the number of residents, 25 responses is a very small sample and not statistically significant. It may also not represent a balanced viewpoint. However, it does provide insights that there are residents with concern for the health of the watersheds and support addressing the problems.

4.1 Current Impacts and Awareness

Survey participants were asked about the current impact and awareness of the watersheds in their neighbourhoods. Based on our survey responses, 60% of respondents (15 out of 25) have been impacted by flooding in their neighbourhood and 88% of respondents (22 of the 25) are aware of the importance of natural features for drainage.

4.2 Impressions and Importance of the Watershed

Respondents were asked about their impression of the watershed health for three separate areas: rural, suburban, and urban areas. Comments were interpreted on a scale ranging from "Poor" to "Good" with additional "No Comment / No Response" and "I don't know" options.

REPRESENTATIVE COMMENTS

"I'm not sure that enough is being done to protect these natural features from the effects of urbanization"

"The way the area is being developed puts severe pressure on the natural environment and is destroying the forests and watersheds"

"Excessive stream side development is degrading the natural flood control"

"There has been a large amount of development...where too many homes have been built too close together and note enough grass, trees, etc. has been maintained"

"New developments will be better equipped to deal with drainage and work with/around existing watershed elements"

"We need to think about using new technologies of pervious pavements and move away from using so much impervious surfaces to channel and move stormwater out of our systems"

"Too much concrete & pavement. Not enough green spaces and permeable surfaces"

Based on respondent comments, there was a common theme throughout each of the areas. The majority of respondents believe the watershed health to be poor and attribute the new developments in the area to be largely responsible for this.

In regard to the rural watershed health, 8 of 25 respondents believe the health of the watershed is poor, and 10 responses specifically mention how development has negatively impacted the watershed.

When asked about the suburban areas, 12 of the 25 respondents believe the health of the watershed to be poor, and 13 of 25 respondents mention the negative impacts of development near the watershed. A few participants speak to the fact that newer developments appear to be taking the natural drainage features into consideration and build around them, and several respondents also mention that they would like to see developers utilizing better materials and technologies to help with drainage.

The majority of survey respondents believe the watershed health in urban areas to be poor (15 of 25 respondents). Again, respondents believe the main culprit for this is development that removes natural drainage features and is too close to the waterway. Participants said that old development and infrastructure is seen as not able to address the additional runoff, and new developments are not considering or maintaining the existing natural drainage features.

4.3 Support for the Watersheds

Participants were asked to identify how important the health of the watershed is, and the level of investment they would support for drainage improvements. Participants overwhelmingly responded that the health of the watershed is important to them, with more than 70% (18 or 25) saying significantly important. When asked about how much investment into drainage improvements they would support, the majority of respondents (19 of 25) would support moderate to significant investment.





FUTURE CONDITIONS ASSESSMENT



5 FUTURE LAND USE

The City's 2013 Official Community Plan (OCP) (Bylaw No. 7060-2014, Schedule B Generalised Future Land Use Plan) lays out how the City of Maple Ridge will grow and what and where land uses will be. The most recent land use files received from the City were on April 26, 2017. Part 2 of the ISMP process assesses the City's current watershed management practices and predicts what the expected watershed outcomes are likely to be based on those practices and applying the OCP land use. The exception is the Kanaka Business Park area, which is designated primarily as residential in the OCP but which we have assigned as industrial based on direction from City staff.

5.1 Rainwater Management Controls and Criteria

Precipitation and watershed hydrology are highly variable. The formation of natural drainage courses and environmental health are directly linked to the magnitude and frequency of rainwater runoff. Rainfall tiers have been created for managing the complete spectrum of rainfall events; rainfall capture (source control), runoff control (detention), and flood risk management (contain and convey). These three components are described in sub-sections below.

The City's Design Criteria Manual (October 2015) specifies three levels of controls are to be applied. Beyond what is stated in the manual, a review with City staff further clarified the application of the criteria and the typical practices to achieve them, as summarized below:

5.1.1 Tier A – Retain Rainwater

Tier A events are small rainfall events that are less than half the size of the Mean Annual Rainfall (MAR) and represent approximately 90% of the annual rainfall. This captured rainfall should be infiltrated, evapotranspired or re-used at the source. This is often achieved by surface features such as rain gardens or biowales, and sub-surface features such as drywells and infiltration trenches.



Rain Garden (photo by Urban Systems Ltd.)



Detention Ponds (photos by Urban Systems Ltd.)

For a variety of reasons (space limitations, slope stability concerns, etc.) there are many instances where the Tier A criteria is not being entirely achieved as part of development.

5.1.2 Tier B – Detain Rainwater

Tier B events are larger rainfall events that exceed Tier A up to and including MAR. These events represent approximately 10% of the annual rainfall and result in the majority of the peak flows in downstream watercourses. Source control facilities are required to store the runoff from impervious surfaces resulting from the large rainfall events and release it at a controlled rate of a 1:2 year forested / woodlot flow. Typical source control facilities include detention/retention ponds, oversized storm sewers, and storage tanks (on-lot and off-lot).

Tier B controls are applied to all land use designations, both for infill and Greenfield Development



Similar to Tier A, there are instances where Tier B is not being entirely achieved, particularly with single family infill.

5.1.3 Tier C – Convey Rainwater

Tier C events are extreme storm events that exceed Tier B rainfall events and may or may not occur in any given year. At a minimum, the 1:10 year event must be detained and released at the 1:2 year predevelopment rate. Where directed by the City, the 1:100 year flow may sometimes be detained to a 1:10 year pre-development rate. However, in discussion with City staff, it is understood that a more stringent criterion of controlling the 100 year to 10 year is done in only few instances.

For Infill development, Tier C controls are not applied to single family residential but are to higher density and ICI land uses.



Trunk Storm Sewer (photo by Urban Systems Ltd.)

5.2 Current Water Quality Treatment in Maple Ridge

The Watercourse Bylaw and design criteria requires that the stormwater management plans include water treatment.

For single family developments in close proximity to an outfall the City typically sees proprietary systems installed within a roadway which become City owned. The City currently has 52 such units in public right-of-way across the entire City. For multi-family (townhouse, bare land strata and apartment), institutional, industrial, or commercial sites it becomes increasingly important that appropriate type and size units are utilized on site because there is typically a larger amount of impervious surface area on site to support traffic, parking, storage of vehicles, etc. and subsequently water quality concerns associated with hydro-carbons, heavy metals, etc. Length, size, and number of roads/parking areas also comes into consideration. For these sites, usually oil/grit separators are applied, sometimes in combination with other proprietary treatment systems, all remaining on site as private systems.

5.3 Future Conditions Impact Assessment

5.3.1 Design Storm Events

To assess the system under future conditions, several design storm events are simulated, including single storm events, single storm events with consideration of climate change, and extended period rainfall for continuous simulations.

Single event storms

A broad set of design storms were modelled to determine the critical event for each system component. In addition to the minor and major event return periods, the Mean Annual Rainfall (MAR) event is modelled.

Climate change

One-day rainfall depths were scaled by both 10% and 20% to test system sensitivity to changing rainfall intensities. Most recent climate projection data suggests that the magnitude of design precipitation in Maple Ridge is to increase in the order of 20% by year 2050. Despite the primary focus here being on the effects of climate change on precipitation, the potential impacts will extend to heat, drought, and wind. Climate change alone may result in diminished groundwater during summer months, which may be compounded by expanded urban development that increases impervious surface in absence of recharge management techniques. Sufficient groundwater to sustain summer base flow in creeks is important to supporting aquatic habitats, including providing thermal refuge for spawning and rearing salmon. This further emphasizes the importance of rainwater recharge into the ground and to maximize the potential for tree canopy within the urban areas as a heat shield.

5.3.2 Future Land Use Analysis

What is most helpful to understand about the future condition is how system performance is predicted to change over current condition.

For land use change alone, hydrological and hydraulic modeling results indicate that for the 1:10 year minor event, overall changes are minimal, which signals that for the storm events considered (and the modeling assumptions, namely the successful attainment of Tier A/B targets), the City's current stormwater management criteria abate the negative effects of development.

5.3.3 Future Land Use with Climate Change Analysis

As described above, existing design storms were scaled up by 10% and again by 20% to simulate two different possible impacts due to climate change. The drainage system was then reassessed using the intensified MAR, 10-Year, and 100-Year design storms. Overall future condition system performance worsened under the influence of climate change assumptions, as compared to the future baseline condition. Once land and drainage systems are saturated, there is a relatively direct relationship between precipitation and runoff. Therefore, not surprisingly, as the precipitation is scaled up, system performance gets incrementally worse.

5.4 Floodplain Analysis

As previously noted, Northwest Hydraulic Consultants (NHC) completed a complementary study for the City titled "North Alouette and South Alouette Rivers Additional Floodplain Analysis, Phase 2 – Technical Investigations Completion Final Report". The NHC report presents the updated 200-year (an event that has a 0.5% chance of occurrence in any given year) floodplain maps for the North and South Alouette River. Flood estimates incorporate a 10% increase in flows on all unregulated basins for projected climate change impacts to year 2100. The study made a series of recommendation around emergency planning, emergency response, managing the floodplain through regulation, and further technical assessment work.

5.5 Future Land Use Summary and Conclusions

Results are summarized as follows:

 For a variety of reasons, current development practices for Low Density and Medium Density developments do not always satisfy the City criteria to retain the first 50% MAR (mean annual rainfall) precipitation (40 mm). In cases where on-lot Tier A is unachievable, consideration should be given to communal facilities in public lands that can attempt to satisfy the Tier A target. This will require dedicated space based on the service area and soil infiltration capacity. Most importantly, the City is recommended to work with internal and external stakeholders review options for a more successful implementation of Tier A criteria and develop more prescriptive design criteria. The City could also track how/where Tier A is not fully attained and trend potential impacts on lager areas.

- Similarly, Tier B is not being fully achieved, particularly on smaller lots. Again the City is advised to work with stakeholders to developed improved solutions for attaining Tier B.
- Low and Medium Density developments are by far the most dominant land use. Not fully achieving Tier A retention may contribute to diminished creek base flows; not fully achieving Tier B contributes to mean annual flows; both put stronger emphasis on the need to achieve Tier C criteria (detention of 1:10 year post development flows to 1:2 year woodlot condition flows).
- For conveyance systems, predicted future system
 performance remains comparable to existing condition
 for events up to and including the 1:10 year event, based
 on the assumption that Tier A and Tier B are being
 achieved. Performance worsens to a modest degree
 during a 1:100 year event, largely due to the fact that the
 standard criteria only requires flow attenuation for the
 1:10 year event (Tier C). In some circumstances, the City
 requires attenuation of the 1:100 year event, however it is
 currently not well defined where that is a requirement.
 At this time, analysis herein has discounted attenuation
 of the 1:100 year event.
- Despite the two bullets above, based on stream data collected and provide by the City, sample catchments suggest that the City's current stormwater criteria should, at minimum, abate the impact development may have on stream erosion and watershed health. Under current climate conditions, current practices, and assuming current climatic conditions, are expected to generally maintain, or minorly reduce, the risk of erosion

in areas that had been previously developed without the application of controls. However, this is with a caveat that developers are not consistently achieving Tier A/B controls. Where they are not achieved, development impacts are expected.

- It is very difficult to fully replicate nature in a built environment. At best, new developments will near the performance of nature, therefore Greenfield Development will not provide an opportunity to improve watershed health. The only opportunity to improve watershed health will be in infill development zones, where the application of current criteria can in some cases repair historic impacts.
- Watershed health has been negatively impacted by historic urbanization and there is a need and opportunity to improve water quality through the application of Green Infrastructure.

- The degree to which climate change will affect
 precipitation is still uncertain, but climate science is
 showing significant increases in intensity during the wet
 season for all storm events up to 24 hours. Summers are
 expected to get drier. Should this occur, and without
 the adjustment to the design of stormwater controls,
 impact is expected in both the hydraulic performance of
 conveyance systems, the erosion potential in receiving
 streams, and watershed health.
- The City can best adapt to climate change by controlling infrastructure and development moving forward with new criteria that includes a factor for climate change, through gradual infrastructure renewal, implementing green infrastructure that reduces runoff volume at their source and through flexible criteria and priority-based decisions.



PART 3

RECOMMENDATIONS & IMPLEMENTATION STRATEGY



6 ISMP GOAL AND OBJECTIVES

As a summary recap, the goal and objectives of the ISMP provide the strategic direction for recommendations in improvements in integrated stormwater management practices and processes.

6.1 Goal

The primary goal of integrated stormwater management in the South Alouette and Kanaka Creek watersheds is to *maintain*, *and ideally enhance, watershed health*. It is a regulatory requirement to achieve "no net loss" in watershed health.

6.2 Objectives

Objectives describe what the City strives to achieve in the South Alouette and Kanaka Creek watersheds through effective integrated stormwater management:

- 1. Maintain watershed health in areas experiencing greenfield development
- 2. Enhance watershed health in areas experiencing infill development
- 3. Effectively manage risk to public health and safety
- 4. Deliver sustainable services that are adaptive to climate change



7 RECOMMENDED PROGRAM AREAS

Recommendations to address issues and opportunities identified, and to make progress on the goal and objectives of the ISMP, are organized into five program areas. Recommendations under each program area, and an implementation action plan, are detailed on the following pages.

- Regulation and Enforcement
- 2. Asset Management
- 3. Environmental Monitoring
- 4. Collaboration, Education, and Outreach
- 5. Adaptive Management and Continuous Improvement

Program Area 1: Regulation and Enforcement

As a general statement, Maple Ridge has a solid foundation of policy, goals, objectives and criteria. While some alterations to these are warranted, supplemental efforts are also needed on converting them into reality through enhanced consideration for implementation, funding, and operations. Particular emphasis is recommended for reviewing and expanding Tier A and B controls as well as Green Infrastructure.

There would be benefit in refining design criteria to recognize variable conditions across the City and to address unique challenges that various City departments have experienced through implementation, operation, and maintenance.

Adoptingchangeinvolveslearningandadaptivemanagement.

Adopting a pilot program will assist with the learning process. It is suggested a pilot program be implemented to focus on Green Infrastructure within roadway corridors to clean polluted stormwater before release to sensitive aquatic environments. This commitment is important to mitigate the effects of stormwater pollution on the natural environment; understand and optimize maintenance costs and aesthetics associated with different design options; develop preferred designs for inclusion in future design criteria documents; and for the City to be seen as leaders towards meeting its own stormwater policies and objectives.

In areas of historic urbanization, the application of Green Infrastructure through redevelopment and roadway retrofits provides an additional opportunity for betterment and offsetting the impact of climate change.

Program Area 2: Asset Management

Because many of the recommendations relate to asset management (for example, condition, risk, and funding), we recommend the City approach their implementation through a dedicated asset management program.

The City defines asset management in its Corporate Asset Management Policy No. 9.13 (July 11, 2017) as follows:

Asset Management (AM) is a comprehensive framework to guide the planning, acquisition, operation and maintenance, rehabilitation, disposal and ultimate replacement of municipal infrastructure assets. The objective is to maximise asset service delivery potential, manage related risks and minimize costs of ownership while delivering acceptable levels of service in a sustainable manner that does not compromise the ability of future generations to meet their own needs.

Program Area 3: Environmental Monitoring

Environmental monitoring is a core component of the ISMP because environmental data tell the City how it is doing in terms of meeting the goal and objectives of the ISMP. The City can then use the data to inform decisions about changes and improvements to its management practices as part of an overall "adaptive management and continuous improvement" process, which is described under Program Area 5.

Program Area 4: Collaboration, Education, and Outreach

These are vast watersheds that extend well beyond the City's urban boundary and even beyond the jurisdiction of the City. Watershed management programs can be enhanced by collaboration, education and outreach; internally within the City departments, and externally with stewardship groups, stakeholders, and property owners / operators.

Various City departments may collaborate to explore opportunities for siting community detention / retention facilities, or other forms of Green Infrastructure, preferably within Parks (either existing or acquired) where they can provide co-benefits. There is also benefit for all departments involved in the implementation of Green Infrastructure to collaborate in the Green Infrastructure Management Strategy Policy Review initiative. There are various groups and organizations with active programs and initiatives specific to the well being of the watersheds. Volunteer stewardship groups make a significant contribution to the environmental wellbeing of a community. The City has well established groups - KEEPS (Kanaka Education and Environmental Partnership Society) and ARMS (Alouette River Management Society). Both do a lot of education activities (www.keeps.org and https://www. alouetteriver.org/), engage in restoration projects and give updates to Council. The City recognizes the excellent work and valued contributions that KEEPS and ARMS make to the community and will continue to support and partner with them.

Within the Kanaka Creek watershed is the Bell-Irving Hatchery and Watershed Stewardship Centre , which has been a partnership among KEEPS, Metro Vancouver Regional Parks, and the Department of Fisheries and Oceans since 1983 focussed on education and environmental stewardship. The Stewardship Centre is a community asset, providing education through facilities such as a classroom, stormwater management landscaping and a "roof to creek" demonstration.

The Kanaka and South Alouette watersheds exist within the traditional territories of the Katzie and Kwantlen First Nations. Additional information on the approximate territorial extents and links to the First Nations' websites can be found at the following: <u>https://native-land.ca/maps/territories/kwantlen/</u>, <u>https://native-land.ca/maps/territories/katzie/</u>

In the Alouette watershed, BC Hydro's Alouette Dam and Reservoir represent a significant feature. In recognition of the past impact creation of the dam had on fish migration, the Fish Passage Decision Framework is a seven-step process that outlines the advancement, evaluation, implementation and funding of fish passage restoration projects at their facilities. It was developed in 2008 by BC Hydro, the Department of Fisheries and Oceans and the Government of B.C. to ensure proposed fish passage is both biologically and technically feasible. The framework is a structured process designed to ensure proposed fish passage improvements will be biologically, technically and financially feasible.

The Alouette River Salmon Restoration Program (ARSRP) is within the Fish Passage Decision Framework noted above. The ARSRP Committee (formerly known as the Sockeye Re anadromization Program) consists of representatives from Indigenous Nations, DFO, the Government of B.C., BC Hydro, Alouette River Management Society and technical support.

Alouette Lake Reservoir is a popular spot for swimming, windsurfing, water-skiing, canoeing, boating and fishing. Golden Ears Provincial Park, one of the largest parks in the province is situated next to the reservoir and hosts over 600,000 visitors annually⁴.

BC Parks plays a major role in managing Golden Ears Park (Golden Ears Park Management Plan, BC Parks, 2013). Its vision is centred around being a place where visitors can experience and learn about wilderness and ecosystems, can recreate,

- 4 Golden Ears Park Management Plan, 2013
- 5 WildsafeBC Program (rmrecycling.org)
- 6 WARP | WildSafeBC (https://warp.wildsafebc.com/)

and learn to better respect the surroundings. A place where First Nations can practice their culture and a place where visitors can learn about and celebrate First Nation' traditions and history. Volunteerism is a core asset to Golden Ears Park. BC Parks has a relationship with institutions such as the UBC Malcolm Knapp Research Forest and partners with them on projects to improve understanding of the park. Currently, BC Parks is seeking to inventory amphibian species in the park.

Similarly, the Malcolm Knapp Research Forest (MKRF) was established primarily for research and education purposes by UBC. They provide a wide variety of educational opportunities to elementary schools, high schools, post-secondary groups, youth groups, corporate groups and more. They welcome self-guided tour groups throughout the year.

The City of Maple Ridge, in partnership with WildSafe BC and Ridge Meadows Recycling, has offered education and advocacy work to "keep wildlife wild and our communities safe"⁵. The goal is to teach people about how to avoid potential conflicts with wildlife such as bears and cougars, and how to manage attractants, which is the biggest problem the community faces when it comes to the presence of bears. WildSafe BC also has a GIS based database website "WARP" – the Wildlife Alert Reporting Program which provides an inventory of near-term animal sightings⁶.

To minimize the impact of farming on the environment, the Province has developed the Environmental Farm Plan Program (EFP)⁷ to support farm operations to complete agrienvironmental risk assessments. The Program is delivered by the BC Agricultural Research & Development Corporation (ARDCorp.⁸). It is a voluntary and confidential program, but for some industry associations are seeking increased involvement in the EFP program to fulfill the needs of buyers.

The Salmon-Safe Standards⁹ is a third-party certification program that recognizes and rewards responsible, ecofriendly management practices that protect Pacific salmon habitat and enhance water quality on agricultural and urban lands. Salmon-Safe was brought to B.C. by the Pacific Salmon Foundation and Fraser Basin Council, who launched Salmon-Safe B.C. in 2011. To date, more than 40 farms and vineyards across British Columbia have achieved Salmon-Safe certification. In 2018, the Fraser Basin Council became the sole delivery organization of Salmon-Safe BC. Salmon-Safe has a specific Agricultural Site Certification Process.

Additionally, the City of Pitt Meadows, Fisheries and Oceans Canada, the Agricultural Land Commission and Provincial ministries have jurisdiction and vested interests in the watersheds. Continuing to build on established relationships among all groups is hoped to strengthen the spirit and effectiveness of watershed stewardship and improvement. It's recommended that a Watershed Management Committee be established for Kanaka Creek watershed, and the Alouette (north and south) watershed formed by representatives of the various groups and agencies noted above.

Program Area 5: Adaptive Management and Continuous Improvement

The City can strive for continuous improvements through adaptive management - a process of monitoring, reviewing, learning, and adjusting.

Monitoring and Assessment

Monitoring is broken into several categories, including physical (eg. are the desired flows and quality of water being achieved?), regulatory (eg. are the City's regulatory tools successfully guiding development?), and process (eg. are City staff properly informed and are inter-departmental processes in place to successfully direct the plan's implementation). Data collected should be assessed on a 5 year or more frequent cycle, depending on parameter and risk/rate of change. Key Performance

⁷ Environmental Farm Plan Program - Province of British Columbia (gov.bc.ca)

⁸ https://ardcorp.ca/programs/environmental-farm-plan/

⁹ The Salmon-Safe Standards | Salmon-Safe BC

Targets and Indicators

Specific performance targets are defined in criteria of established bylaw and apply largely at the site and neighbourhood level.

At a sub-watershed or watershed scale, cost effective, measurable, and reliable key performance indicators allow the City to determine whether or not the watershed vision is being achieved. Performance indicators need to be selected for things that can be observed and measured frequently. In the context of South Allouette and Kanaka Creek, potential key performance indicators are:

- · Reduced sediment deposits in streams
- Stability of creek bed and banks
- · Fewer annual service complaints due to flooding
- Increase in tree canopy as measured from aerial photos
- A positive differential between the number of trees planted to the number of trees removed
- No reduction in the riparian vegetation as measured from aerial photos
- Improved fish count data
- Successful implementation of source controls with all development and building permits that require them
- Improved water quality
- Improved benthic health
- Successful implementation of the Capital Program.

Adaptive Responses

The monitoring program is important to assess the specific failure mechanism, should failure occur. Was there a poor design(s)? Has there been a significant change in weather patterns? Were there slope stability or on-site drainage design rules that rainwater management design criteria from being achieved? Was there an infrastructure failure due to insufficient maintenance? Was there insufficient parcel area to achieve rainwater management goals (supplemental off-parcel areas for rainwater management need to be considered early in the land use planning process? There can be many reasons why objectives may not be met. The response(s) need to align with the cause. It is therefore premature to articulate a specific response plan at this time, but some fundamental responses may be as follows:

- If watercourse erosion and environmental health do not stabilize, or preferably improve, the City may need to improve source controls or accelerate the implementation of communal management infrastructure through its capital program; either with high flow diversions or stormwater detention ponds. Within mature development areas land acquisition and building demolition may be required.
- 2. If development or building permits are being completed without successful source controls, the City needs to evaluate whether this was a procedural failure, a result of imposed limitations on their application and whether there is an opportunity for the City to work with stakeholders to develop improved design solutions / criteria

- If a high volume of service calls occur due to structural or maintenance failure, the City may need to strengthen its Asset Management Program.
- If maintenance of private source controls is not validated, the City should consider implementing a formal Stormwater Source Control Operating Permit program.
- If there is increased flooding not caused by structural or maintenance failure, the City may consider accelerating its pipe replacement program on a priority basis, or explore alternative mitigative measures.
- 6. If the funding for infrastructure change cannot keep up with demand (ie. worsening conditions) the City needs to revisit its funding stream and look to a program that provides more reliable funding.
- If the City is not leading by example in implementing and maintaining source controls in public spaces, the City needs to evaluate its interdepartmental collaboration and priorities.

Program Area 6: Capital Planning and Infrastructure Improvements

Hydraulic performance of storm sewer mains and culverts was determined using established criteria. For consideration of potential storm sewer improvement costs the 1:10 year event is applied for storm sewer mains and the 1:100 year event is applied for road crossing culverts. Modeling identified \$25M in existing deficiencies for the two watersheds (infrastructure 400mm and greater only). For the future condition involving growth and climate change (20% increase in rainfall intensity), further deficiencies valued at \$12M were noted. Upgrade requirements should be confirmed by observing performance data through monitoring and conducting a riskbased assessment. This would involve local flow / water level monitoring and predictive model calibration.



Interpreting the Results

While this study has identified approximately \$40M in infrastructure replacements for existing plus future growth and climate change, there are many considerations that must still be made before concluding that such replacements must be done, or when they should be done. They include:

- Analytical modeling is not an exact science. Hydrology and hydraulics are very complex processes that ideally are proven with performance monitoring and model calibration. Monitoring and calibration to date has been done at a high level, watershed scale, not at a local level where variability will exist. Areas of deficiency noted are at this point considered "points of interest" and it is recommended that a winter season flow monitoring program be conducted at these locations allow model calibration at a local level.
- The criteria applied in assessing whether a pipe is deficient or not is based on low tolerance to surcharging during its design event; in this case a 1:10 year event for storm sewers, or an event that has a 10% of occurring in any given year. It is quite possible that some of these pipes do surcharge today, but unless they cause damage or obvious surface flooding, this surcharging goes' unnoticed and is not a concern.
- Most storm sewers are designed to prevent "nuisance flooding" only, which is referred to as the "minor" system. The City of Maple Ridge has elected to use a 1:10 year event as its minor system, whereas many communities in Canada only apply a 1:5 year event.
- By designing a storm sewer system for a 1:10 year event,

the storm sewers are inherently designed to surcharge and fail on occasion, thereby activating the "major" system, which are flow paths that protect public safety and property to a 1:100 year level. The influence of climate change is a significant aspect that is changing how frequently storm sewers will surcharge.

Given the above bullets, overland flow should be expected on occasion. Where this is predicted to occur, there is need to assess the overland flow risk to public safety and property damage and develop options to mitigate the risk (storage, conveyance upgrades, flow redirection, surface flow path improvements). This ISMP highlights potential areas of concern which should be explored in greater detail.

7.1.1 Master Drainage Planning

The City is not yet able to confirm existing/future funding requirements for the drainage system because more refined monitoring and analysis should be undertaken for areas identified herein as "areas of interest". This will include further assessment of storm sewer performance at the local level, a more detailed overland flow path assessment, and an evaluation of risk. This would be done through more refined Master Drainage Plans at a sub-watershed level.

Master Drainage Plans would better recognize the unique conditions, opportunities, constraints in each area, in turn better assessing the need and ability to attain Tier A and B criteria. It would allow the City to integrate and sensitivity test the outcomes of its Green Infrastructure Strategy. Moreover, it would enable the City to sensitivity test different infill development projections and scenarios, including projections

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for changes to impervious areas versus measures intended to offset this increase. Analytical modeling could be expanded to include additional pipes within the network (this ISMP only analyzed trunk pipes) for a more refined assessment of system flood risk and mitigation strategies, in turn leading to prioritybased capital plan decisions. Lastly, the Master Plans could plan for for the addition of storm sewers to pockets within the developed urban area where storm sewer servicing does not currently exist.

Funding for Master Drainage Plans can be included in the DCC (development cost charge) program. It is recommended that each study be in the order of 200 – 300 hectares. Priority would be placed on areas of known system failure and areas that are

seeing greatest redevelopment pressures, such as the Fraser River Escarpment. The outcome of the more detailed and rigorous Master Drainage Plans can drive updates to the City's Drainage DCC Bylaw.

Similar to the Master Drainage Plans, a lowland agricultural drainage study is recommended for the agricultural lands north of 123 Avenue. The study would assess the drainage of these lands and identify opportunities for improvement with the goal of maintaining the agricultural viability of these areas.

8 SUMMARY ACTIONS, PRIORITIES, AND BUDGETS

A summary table of draft recommended actions, their relative priority, and a suggested budget amount is provided on the following pages in **Table 8.1.** Only those activities that are expected to require external consultants or contractors has been budgeted. Activities internal of City functions are not and are noted as "Internal" in the table.

Actual budget requirements are subject to development of the detailed scope and deliverables. The suggested budgets herein are planning level based on conduct of similar assignments in other jurisdictions.



Table 8.1 – Summary of Program	n Areas, Actions, and	Budgets
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PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
1. Regulation and Enforcement	Complete the "Green Infrastructure Management Strategy Policy Review" launched in 2020. Develop a dedicated Green Infrastructure (GI) Strategy document that will provide greater direction on the selection and application of the different GI typologies, linked to the updated criteria, as well as address the Operation & Maintenance and associated funding and resource requirements. This is anticipated to be a significant	High	N/A
	contributor to the overall funding strategy. Review and update the Watercourse Protection Bylaw to include appropriate on-site and off-site options for meeting 3-tier standards and water quality requirements, and how these can be coordinated with pervious area requirements and integrated into building and landscape designs.	High	\$20,000
	Update Erosion and Sediment Control Permit requirements for construction sites such that plans are to be prepared by professionals that have Erosion & Sediment Control specific training, education and certification using a numerical based performance evaluation system like the Revised Universal Soil Loss Equation.		
	Protection bylaw (and/or other appropriate documents) the need for retention of native vegetation, ditches and wetlands for the purpose of maintaining habitat, recharging groundwater (to maintain stream flows during increasingly hot/dry summers) and providing storage for runoff from increasingly intense rain events.		

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
1. Regulation and Enforcement (continued)	Further to the item above, update the Design Criteria and standards to reflect limitations and variable site conditions. Ensure criteria match practices in all departments. Map exemption areas or areas of special design consideration. Map active well capture zones and a statement of whether their aquifers are confined or unconfined from surface water within the urban reserve. In absence of this mapping, apply the Provinces "Underground Stormwater Infiltration – Best Practices for Protection of Groundwater Resources in British Columbia" (B.C. Ministry of Environment, Water Protection and Sustainability Branch, 2014). Also adopt new design precipitation to reflect climate change. Ensure coordination with the Building Bylaw.	High	\$50,000 (excluding well capture zone analysis)
	Strengthen the Design Criteria with respect to stormwater quality treatment and associated performance targets, with stronger emphasis on landscape based green infrastructure where possible.	High	\$10,000
	Formulate acceptable examples and educate developers on how to develop according to the guidelines and ideas in the Town Centre Area Plan.	Medium	Internal
	Recognizing that the City recently completed a Zoning update, consider a future update to the Zoning Bylaw to provide provisions achieving tree canopy targets.	Medium	Internal
	Complete pilot projects that provide water quality treatment of roadway runoff that is piped directly into sensitive aquatic habitats. This commitment is important to mitigate the effects of stormwater pollution on the natural environment, understand and optimize maintenance costs and aesthetics associated with different design options, develop preferred designs for inclusion in future design criteria documents, and for the City to be seen as leaders towards meeting its own stormwater policies and objectives.	High	\$100,000 Per year for 5 years plus maintenance costs to be determined

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
1. Regulation and Enforcement (continued)	Seek to achieve effective watershed habitat networks with City land use plans and educating developers on how to develop according to the guidelines, land use plans, and bylaws. The City is planning to undertake an Ecological Network Management Strategy in 2022.	Medium	Internal
	Consider recommendations by Northwest Hydraulic Consultants (NHC) - "North Alouette and South Alouette Rivers Additional Floodplain Analysis, Phase 2 – Technical Investigations Completion Final Report".	Priority not assessed as part of ISMP	Not available without further investigation
2. Asset Management	Build an inter-departmental asset management team to lead the development and implementation of asset management initiatives, with stormwater representation from Engineering and Public Works. (Asset management program has been recently launched by the City)	High	Internal
	Grow awareness among staff, elected officials, and the public of the importance of asset management and the risk of insufficient practices and funding. Budget cost is strictly to develop communication aids – basic printed material and/or PowerPoint presentation.	Low	\$5,000
	Focus inspections and condition assessments on areas of interest identified from the hydraulic modelling. Use these to inform the risk framework and subsequent decisions about operations, maintenance, and asset renewal/replacement.	Medium	Internal
	Gather data on water level and flow at areas of interest identified from the hydraulic modelling to confirm system performance. Use these to inform the risk framework and subsequent decisions about operations, maintenance, and asset renewal/replacement. Budget is to establish 5 stations as temporary installations over a 3 to 4 month winter period. This may be repeated over 2 or 3 consecutive years at different locations.	Medium	\$50,000 per year for 3 years
PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
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2. Asset	Define stormwater levels of service. Budget is for a consultant to assist City staff through workshop discussions.	High	\$5,000
ROGRAM AREA	Inventory and valuate the services provided by natural assets. Budget may be highly variable and significant depending on how many assets are to be reviewed, how they are to be assessed, and what in amount of information is currently available. Budget noted is a reasonable starting point which would be used to help determine need for additional financial commitments based on desired outcomes. A reference for scope consideration is Municipal Natural Assets Initiative at https://mnai.ca/	High	\$100,000
	Quantify required stormwater funding levels.	Medium	Internal
	Develop a risk framework to inform future stormwater asset investment planning.	High	\$10,000
	Review the City's O&M program, informed by anticipated changes in level of service over time and risk. Budget may be highly variable depending on level of detail and whether document is general to cover all system, or specific and tailored to cover unique difference for each system. Budget provided is for a general document.	Medium	\$50,000

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
2. Asset Management (continued)	Conduct a review of major overland flood paths using a risk assessment framework. This work is often done in two stages; 1) desktop analysis using digital terrain models and hydraulic modeling output and 2) site reconnaissance for areas of particular interest. Budget noted here is for stage 1 only. Budget for stage 2 would be informed by stage 1. This budget would be for Kanaka and South Alouette only, but this could be coupled with similar analysis for other watersheds. If so, the budget would be scaled accordingly. This assessment would be using currently available hydraulic model information and therefore at a course level. It is anticipated that a more refined analysis would occur through sub-watershed level Master Drainage Plans (MDP's), however, it is expected that it will take several years for the City to complete all MDP's, so there would be benefit to proceed with a high level assessment near term.	High	\$25,000
3. Environmental Monitoring	Conduct stream monitoring - water quality and B-IBI. Start with 3 continuous years to first establish inter-seasonal variability, then conduct on 3 year cycle. Budget is based on monitoring 4 sites as done in 2015, using the Metro Van MAMF protocols, for three continuous years.	Medium	\$33,000for 3 years.
	Install semi-permanent flow monitoring stations at key locations in watersheds to experience significant land use change	Medium	\$50,000 per year allows for 2 locations

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
3. Environmental Monitoring (continued)	Conduct erosion and bank stability monitoring as well as stream substrate monitoring. Pay close attention to erosion in McFadden Creek (enters Kanaka at the fish hatchery), Dunlop Creek (discharges to key spawning area in Kanaka) and other sensitive locations. At the same time, identify obstacles to habitat connectivity, in particular anthropogenic fish barriers. Update 2003-2005 mapping to track restoration opportunities. Budget will depend on the extent of the watercourses monitored. Recommend that monitoring occur in fall and winter before vegetation growth to improve visibility. Budget suggested herein is for site reconnaissance and reporting in a single year. The	Medium (5 year cycle)	\$150,000
	value is based on a unit rate of \$1,000 per kilometer of channel as experienced by the City of Surrey which has conducted such studies over several years. Jurisdiction, property ownership, natural watercourse erosion processes, climate change and responsibility for any reactive or proactive bank stabilization works should be considered when developing a program.		
	Conduct desktop monitoring of GIS-based parameters, such as riparian forest integrity, urban tree canopy, impervious surface, inventory of green infrastructure, new developments, etc. Budget assumes that all required data sets are already available in digital form. Recommend that LiDAR data be acquired every 5 years, requiring additional funding, costs to be determined.	Low (5 year cycle)	\$30,000
	Collaboration among City departments; effectively and frequently communicate in implementing the ISMP.	High	Internal

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
4. Collaboration, Education, and Outreach	Develop a communication strategy and engage external stakeholders and the general public to further explain the importance of environmental principles and actions of the ISMP. Provide educational information to developers and permit applicants.	Medium	\$15,000
	Remain connected with the Stormwater Interagency Liaison Group (SILG).	Medium	Internal
	Instigate watershed committees (Kanaka, Alouettes, and Blaney) with other jurisdictions, agencies, stewardship groups and others. A terms of reference, mandate statement for their engagement and a review of potential funding and staff time requirements should be prepared.	Medium	Funding requirement to be reviewed
	Continue to support and partner with ARMS and KEEPS	High	Internal
	Decide on key performance indicators to be monitored and tracked	High	Internal
	Notify the Provincial Comptroller of Water Rights of Maple Ridge Council's position on possible restoration of lost fish passage incurred as a result of the construction of the Alouette Reservoir.	High	Internal
	Encourage the farming community to capitalize on the Province's Environmental Farm Plan Program support and consideration for Salmon-Safe certification. Identify active farms and those which represent best opportunity for environmental improvements. Work with Ministry of Agriculture, Food and Fisheries, Agricultural Land Commission, FLNRORD, DFO and others to encourage and support environmental enhancements on farms, in achievement of a riparian buffer area adjacent watercourses.	Medium	Internal

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET
5. Adaptive	Define staff champions who will lead the Adaptive Management program	High	Internal
and	Implement systems to collect and store information	High	Internal
Continuous Improvement	Assess information and make adapted decisions on a 3 year cycle	Medium (3 year cycle)	Internal
6. Capital Planning and Infrastructure Improvements	Placeholder budget for replacement of infrastructure predicted to be under-capacity (\$28M existing deficiencies plus \$8M additional deficiencies due to growth and climate change). Replacements should be confirmed through Master Drainage Plans (see below), additional monitoring, and risk assessment. This budget is for the South Alouette and Kanaka Watersheds only, and for pipes/culverts 400mm and larger only.	TBD	\$36,000,000
	Undertake sub-watershed Master Drainage Plans. Budget assumes that analysis would build upon pre-existing analysis conducted through ISMP's. This budget would not be sufficient to build an analytical model from scratch or resolve significant infrastructure data gaps. It is considered a refinement to the ISMP focusing on conveyance and overland flood routing.	High	\$100,000 each (assume 2 within next 5 years)
	Lowland Agricultural Drainage Study for land north of 123 Avenue.	High	\$200,000

PROGRAM AREA	ACTIONS	RELATIVE PRIORITY	SUGGESTED BUDGET	
6. Capital Planning and Infrastructure Improvements (continued)	Update the City's Drainage Development Cost Charge bylaw based on the outcomes of the sub-watershed Master Drainage Plans and the Agricultural Lowland Drainage Study	High	Internal	
	Total Lov	w Priority Budget	\$35,000	
	Total Mediur	n Priority Budget	\$714,000	
	Total High Priority Budget			
	Total Infrastructure Replacement Pro	eliminary Budget	\$36,000,000	

9 CONCLUSION

Similar to other urban jurisdictions, historic development in the South Alouette and Kanaka Creek watersheds has impacted the health of natural environment systems. But the City of Maple Ridge was an early adopter of policy and criteria that strives to facilitate community growth in a more sustainable manner than it had during early settlement. Two key successes achieved to date have been progressive watercourse setbacks and designation of environmentally sensitive protection areas, and formation of three-tiered rainwater management criteria. While built examples like Silver Valley are beginning to form, the City recognizes the need to further develop its Green Infrastructure implementation strategy, with primary focus on better achieving its Tier A and B criteria (infiltrating and controlling runoff at its source). The City is undertaking a Green Infrastructure Management Strategy Policy Review in 2021.

In previously built urban areas, redevelopment poses an opportunity for betterment of conditions. Where there is to be Greenfield development, or conversion of rural lands to urban densities, there is a greater challenge to mitigate degradation of watershed health.

Climate change poses a threat to the performance of infrastructure moving forward. Planning and infrastructure decisions near term should consider an allowance of increased winter precipitation over current levels. Climate science continues to evolve and so the City should track new information and be prepared for adaptive management. Once again, the City of Maple Ridge is not alone in this challenge.

Storm sewer infrastructure is not intended to prevent flooding in all circumstances but is intended to prevent "nuisance flooding" from moderate sized storms. As such, surcharging of pipes and surface flows should be expected from time to time. It is expected to happen more frequently with the impact of climate change. This study has identified areas where surface flows are most likely to occur and the City should further investigate the potential risk of flooding at these locations and decide what actions are required, if any, to provide a flow path that is safe to public and does not result in property damage. Designated floodplains are a special case that will continue to flood. Within the designated floodplain of a natural watercourse, the municipality has discretion to develop policy on how it wishes to manage flood risk (eg. Build dikes or manage risk through regulation such as a "flood construction level"). The creation of dikes involves several senior government regulations and would create a major commitment in perpetuity for the City as the diking authority.

SOUTH ALOUETTE-KANAKA CREEK ISMP



This study has identified a number of recommendations in six different program areas to assist the City with improving on what it already does. These program areas include:

- 1. Regulation and Enforcement
- 2. Asset Management
- 3. Environmental Monitoring
- 4. Collaboration, Education, and Outreach
- 5. Adaptive Management and Continuous Learning
- 6. Capital Planning and Infrastructure Improvements

For the next 5 year capital planning cycle, action items estimated at \$2M in external costs are recommended. This includes pilot projects to remove pollutants from roadway runoff, sub-watershed Master Drainage Plans and an Agricultural Lowland Drainage Study. An additional \$36M is recommended for consideration in long range financial planning to address infrastructure improvements over time. These infrastructure improvements consider the effects of existing deficiencies, community growth and climate change. The recommended budget amount of \$36M warrants more refined investigation through local monitoring and risk assessment to make conclusive decisions in the expenditure of funds to replace existing infrastructure that has not yet reached the end of its service life.

The importance of environmental values and protecting watershed health has long been recognized by the City. The notion of integration is inherent in the City's value statement on stewardship, which states that the City will "consider the long-term consequences of actions, think broadly across issues, disciplines and boundaries and act accordingly". This ISMP is in strong alignment with this value statement. By taking actions as identified herein, the City will successfully accommodate community growth in a proactive manner that achieves the City's goals towards environment and watershed health while minimizing its system failures and liabilities.

Questions

- 1. Have you experienced flooding in your neighbourhood?
- 2. Are you aware of how natural features are important for drainage?
- 3. Your impression of watershed health (rural areas)
- 4. Your impression of watershed health (suburban areas)
- 5. Your impression of watershed health (urban areas)
- 6. How important is health of watersheds to you?
- 7. What level of investment in drainage improvements would you support?
- 8. Postal Code

Results by Respondent

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
1	Yes. On October 28/19 approx. during a heavy downpour the storm water drain at 10596 245 St. backed up causing considerable damage to my basement suite with eight inches of water. Cause was the outlet pipe for the catch basin located at the end of the SRT Field was clogged by overgrowth due to lack of maintenance.	Yes.	No comment.	Generally poor considering the amount of flooding of streets in the last year. Examples are: Seniors Centre on 224th.and the 225th. & Haney Bypass intersection.	Very poor.See 4. above.	Significant importance	Significant investment	V2W 0A2
2	No	Yes	They are excellent.	Good	They seem fine.	Minor importance	Minor investment	V2W 1C2
3	No	Yes	Fairly healthy except were development has been allowed in the upstream areas.	Fair but could be greatly improved. Would require the city or developers to invest in monitoring flows to determine what actually runoff from storms are and what is the water quality of this runoff.	Poor. Old infrastructure that does not address runoff rates or water quality. Recent downtown improvements could have integrated modern runoff facilities and did not. Not seeing the green infrastructure that should be required with new developments- a rooftop patio with a tree does not cut it.	Significant importance	Moderate investment	V2W 2C2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
4	Νο	Yes. The odd urban tree makes no difference, which is why the tree bylaw is so ridiculous - forest and parks where there is a a decent amount of vegetation on the other hand do make an impact. I would like to see an increase in planting and parks around any new development - paid for by the developer. Case in point - the sports filed at Arthur Peake has plenty of room around the edges to plant trees that would also assist the residents in screening from the light and noise at night from the field. Instead we have a poorly planted grass verge with terrible drainage in winter.	Generally OK, though building on the flood plain of any significant river/stream ought to be automatically prohibited, not only for the health of the watershed but also because when the river floods (which it will) taxpayers are indirectly on the hook for some of the bailout costs. We could just avoid it altogether and not allow any further construction on flood plains.	I think they are probably OK, though again I remain concerned about building close to streams. The construction that has happened around Cotttonwood, and now continuing close by with development at the end of 232 St seems likely to put more pressure on feeder streams to Kanaka Creek. I am also concerned that these natural watersheds/drainage are also wildlife corridors, or rather were. We should be encouraging developers to enhance some of the existing natural features and ensure separation for wildlife. Sadly we have already encroached too far within the urban and suburban areas, but we can at least, if the will is there, prevent future destruction and erosion in the name of "growth" (which everyone but me seems to think is a good and necessary thing!)	OK - it rains a lot, we get wet. We need to halt the rate of urbanization and say "enough is enough". Maple Ridge is no longer open for developers other than on existing Brownfield sites.	Significant importance	Minor investment	V2X 0G8
5	Yes, during a major rainfall last August/September, our road (228th north of Abernathy) turned into a waterway, with water shooting *out* of the storm drains as they were overwhelmed.	Yes.	The green spaces and waterways in maple ridge are a jewel, but continued further development appears to be greatly encroaching on them, with negative impacts, like increased and extreme waterflows, more debris, less shading, etc. even the required 15-30 m buffer from major waterways for new development appears very loosely enforced, and developments above watersheds tend to raise the water table below them from additional runoff.	Getting worse with more development, see my comment above to #3.	Much worse, as it's more developed, with little green space to absorb rainfall, etc. With increasing effects of climate change, we need to be able to handle storms dropping an inordinate amount of rainfall in a short period of time.	Significant importance	Significant investment	V2X 0N3
6	No	Yes. Stream side buffers are important to reduce the amount of flooding after minor rain events.	Excessive stream side development is degrading the natural flood control.	Excessive stream side development is degrading the natural flood control. Many stream banks can no longer retain enough water to prevent significant siltation and downstream flooding.	Our storm water is directed into the streams and rivers, instead of treatment. Too many people are unaware, or just oblivious, to the consequences of dumping into the storm system. (The Hoy Creek fish kill is a tragic example of this ignorance.)	Significant importance	Moderate investment	V2X 0T2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
7	"My backyard is wet most of every winter. The back boundary has a footing for the fence, which					Significant importance	Significant investment	V2X 1S3
8	prevents drainage. Muddy"	Yes. Silly question	NA	NA	In Hammond, it's not very complete	Significant importance	Significant investment	V2X 1S4
9	Not personally, but it's always a concern for nearby Lower Hammond. We were also horrified to learn the Katzie First Nation Reserve is located on the WRONG side of the dikes, that due to the politics of the day, the dikes go AROUND the outside edge of the reserve and leave their whole reserve extremely vulnerable to flooding. This needs to be rectified ASAP.	YES!! We need more of them!! Nature has spent millennia perfecting the earth's water storage (eg. glaciers) and drainage system and we are destroying it and having to deal with the consequences. Keep the green we have and let it do its job. Add more green. It improves mental health as well as helping with the water cycle.	Forested areas = good, most rural areas = not bad, depending on how much concrete/pavement/building there is.	Not so good - many of the ditches and waterways are covered over and are damaged during construction of roads & new development. NEW developments will be better equipped to deal with drainage and work with/around existing watershed elements, but older developments destroyed everything. We need to do restoration in these areas.	Terrible - look at all the damage done when there was a flash flood. Too much concrete & pavement. Not enough green spaces and permeable surfaces.	Need more information before commenting	Need more information before commenting	V2X 2L2
10	Yes.After heavy rains. 3 to 4 times a year	. yes	They have been fine up to this point.	"I am not sure exactly where you are describing. More accurate descriptions would help.		Significant importance	Significant investment	V2X 4A4
11	As a long time resident we know that the soil along the Fraser has a high amount of clay which has and will continue to create a slippage. There is poor drainage to the west of the Town Center. Water floods the basement of some homes and there are no storm drains."	This area seems to function pretty well.				Need more information before commenting	Minor investment	V2X 4J4
12	During heavy rains we regularly get water pooling in our large yard (next to ALR). We are north of 123 Avenue on 208 St.	Absolutely. They are also important for human physical and mental health, supporting biodiversity, and moderating climate change effects.	The forested areas appear to be doing well. I have concerns about the rural areas. I'm not sure that enough is being done to protect these natural features from the effects of urbanization and contamination from farming and other rural land uses.	There are many examples of streams that are paved over (at best with culverts) and non-existant set-backs. Very poor practice. By contrast, an area that was recently developed fairly close to me retained and protected the natural stream and streamside vegetation. It is a joy to walk through and I'm sure the developer(s) still received ample return on their investment.	Much much more needs to be done to restore the watershed health within the Town Centre and along major traffic corridors. This is absolutely essential in order to grow sustainably and mitigate the effects of climate change. At the same time, the community as a whole will enjoy the many interrelated benefits offered by this approach, from better air quality to more options for active transportation ("green" corridors supporting safe pedestrian and cycling modes of transportation).	Significant importance	Need more information before commenting	V2X 4K2

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	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
13	No	yes, very aware. That is why we need to preserve them!	Nature takes care of the water when it comes. I have lived here a long time and never seen a problem. If there is standing water, all it takes is a little patience and it will be absorbed by the earth and trees, which need it.	It seems to be very good.	It is perfect. And since you do not provide adequate space on this form for comments, I want to say that we should not be trying to have "ongoing urbanization" - that is the main problem here. There is too much development and not enough natural spaces left that would offset any water issues. It's time Maple Ridge put a cap on development, or we will end up with an ugly city that is simply urban sprawl (like Langley) and not the beautiful green city we are on the verge of losing.	Significant importance	Significant investment	V2X 4P3
14	Yes, mainly on the street. 124th and 227thst	Yes	We need to do better to protect our watershed	I feel that it is a bit better due to a more natural setting which is better equipped to handle water	Needs improvement	Significant ímportance	Moderate investment	V2X 4X4
15	No	Somewhat	None	Seems fine	None	Significant importance	Significant investment	V2X 4Z6
16	No flooding/pooling of water during heavy rains	Absolutely	I am very concerned. The development of housing in the East has been peeling away the protective layer of the forests and I don't see it slowing down. I'd like to know that the rural areas are going to be protected from development.	Even worse in the East/Albion areas. I'm a (home) insurance broker and the incidence of basements flooding has increased disproportionatey in recent years in these areas. The more pavement, the less absorption. Very basic common sense.	The existing drains may be at capacity already as evidenced by the street flooding earlier this year. Although some of it was caused by blocked drains, there were still several blocks 'underwater' as the systems couldn't remove the volume of water. I'd like to know that the systems are going to be upgraded or maintained to prevent collapse.	Minor importance	Significant investment	V2X 5P9
17	The house I live in has flooded 4 times over the years because the city storm drain system doesn't reach all the way up 212st	Yes			I live 2 blocks from the hospital and half the houses on our end the street do not have storm drains or connections	Significant importance	Significant investment	V2X 7N3
18	Yes in the basement 220 and lougheed area comes up in the sani main no Stromboli's in area people are pumping into sani main and sani main is 55 + old and it is AC pipe it has happen 3 times in 20 years	Yes	They are getting over tax need to do more to slow water down and clean water before it goes into the streams	Not good they are not getting cleaned or inspected	They are under sized and old not getting cleaned or inspected	Significant importance	Moderate investment	V4R OA
19						Significant importance	Significant investment	V4R 0A8

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
20	yes, flooding in neighbourhood twice per year, most years, usually spring and fall, about 4 times/yearin N. Alouette river area.	yes, very aware	very poor drainage "improvement" at corner of 232 St and 132 Aveall the runoff from silver valley hill and it's silt directed to N. Alouette (salmon bearing river). Too much development and can't handle it.	see above	big flood at Sr. Ctr., so obvious that there are problems	Minor importance	Moderate investment	V4R 0A9
21	I have seen it in the neighbourhood on 132 Av at or near 224 St. It occurs with heavy rainfall. Two or three times a year commonly with spring runoff but more volatile now with Climate Change.	Yes	I cannot say, other than that the city is more and more encroaching upon them, and that isn't good for drainage and watershed health.	Not improving because of the increased housing and pavement uphill from the lower lands especially floodplains in this area. Near where I live, the North Allouette needs dredging because of increased gravel deposits.	l cannot say.	Moderate importance	Moderate investment	V4R 0G1
22	no	no	seems fine to me	128 near 224th seems fine	good	Significant importance	Significant investment	V4R 1R8
23	The intersection/bridge at 224th & 132nd. It has happened several times per year during the last few years. It never used to occur so frequently.	Yes	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River.	"Answer same as above (not sure which area is considered rural vs. suburban)		Need more information before commenting	Need more information before commenting	V4R 2P7
24	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."	"Answer same as above (not sure which area is considered rural vs. suburban)				Significant importance	Significant investment	V4R 2R2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
25	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."					Significant importance	Significant investment	V4R 2R2

Results by Question

Question 1: Postal Code



Vec. On Optober 29/10 entry during a begun downnow the storm water drain at 10506 245 St. begind up cousing considerable domage to my becoment with with eight inches of water. Opus
was the outlet pipe for the catch basin located at the end of the SRT Field was clogged by overgrowth due to lack of maintenance.
No
No
No
Yes, during a major rainfall last August/September, our road (228th north of Abernathy) turned into a waterway, with water shooting *out* of the storm drains as they were overwhelmed.
No
"My backyard is wet most of every winter. The back boundary has a footing for the fence, which
prevents drainage. Muddy"
Not personally, but it's always a concern for nearby Lower Hammond. We were also horrified to learn the Katzie First Nation Reserve is located on the WRONG side of the dikes, that due to the politics of the day, the dikes go AROUND the outside edge of the reserve and leave their whole reserve extremely vulnerable to flooding. This needs to be rectified ASAP.
Yes.After heavy rains. 3 to 4 times a year
During heavy rains we regularly get water pooling in our large yard (next to ALR). We are north of 123 Avenue on 208 St.
No
Yes, mainly on the street. 124th and 227thst
No
No flooding/pooling of water during heavy rains
The house I live in has flooded 4 times over the years because the city storm drain system doesn't reach all the way up 212st
Yes in the basement 220 and lougheed area comes up in the sani main no Stromboli's in area people are pumping into sani main and sani main is 55 + old and it is AC pipe it has happen 3 times in 20 years
yes, flooding in neighbourhood twice per year, most years, usually spring and fall, about 4 times/yearin N. Alouette river area.
I have seen it in the neighbourhood on 132 Av at or near 224 St. It occurs with heavy rainfall. Two or three times a year commonly with spring runoff but more volatile now with Climate Change.
no
The intersection/bridge at 224th & 132nd. It has happened several times per year during the last few years. It never used to occur so frequently.
No, i have not experienced flooding in my neighbourhood.
Yes we have experienced it, and so have the majority of our neighbours on the north side of 136th immediately at the back of our properties. 22579 136th ave, Maple Ridge. Almost anytime it rains as majority of our perimeter drainage goes to the back of the property where there's a ditch, but the ditch is completely clogged in in desperate need of cleaning. Over the past year the ditch has started to now flood our property almost every time it rains.
Yes. Occurs along the North Alouette River. The nature of the flooding has changed dramatically over time. In the 70-80s spring freshet caused the Fraser floodwaters to back up and 224 north of 132 flooded almost every year. This was predictable and occurred slowly enough that residents for the most part could take precautions. After the development of Silver Valley, unquestioned deposition of fill, construction of the cranberry dykes, and raising of 224, the type of flooding changed. Now spring freshet rarely causes a problem(and there doesn't seem to be enough snow on the local mountains to have much effect). Almost every year there is flooding corresponds to weather events. These are usually severe, rapid onset and unpredictable.

Question 3: Are You Aware of How Natural Features Are Important for Drainage?
Yes.
Yes
Yes
Yes. The odd urban tree makes no difference, which is why the tree bylaw is so ridiculous - forest and parks where there is a a decent amount of vegetation on the other hand do make an impact. I would like to see an increase in planting and parks around any new development - paid for by the developer. Case in point - the sports filed at Arthur Peake has plenty of room around the edges to plant trees that would also assist the residents in screening from the light and noise at night from the field. Instead we have a poorly planted grass verge with terrible drainage in winter.
Yes.
Yes. Stream side buffers are important to reduce the amount of flooding after minor rain events.
Yes. Silly question
YES!! We need more of them!! Nature has spent millennia perfecting the earth's water storage (eg. glaciers) and drainage system and we are destroying it and having to deal with the consequences. Keep the green we have and let it do its job. Add more green. It improves mental health as well as helping with the water cycle.
yes
Absolutely. They are also important for human physical and mental health, supporting biodiversity, and moderating climate change effects.
yes, very aware. That is why we need to preserve them!
Yes
Somewhat
Absolutely
Yes
Yes
yes, Very aware
Yes
no
Yes
Yes. I am extremely aware of the importance of the natural features such as urban trees, forests, stream and wetlands and their importance on drainage and watershed health.
No ,
Yes, as a resident of Alouette Valley, I see this first hand.
Yes and very concerned about the way development is occurring in the area. Trees taken down and properties clear cut with out proper consideration to how this affects run off to lower areas.

Vegetarian disturbed taking away the opportunity for natural draining, fill brought in to raise development areas, and hard surfaces put in that give no natural drainage. The rivers are being polluted and salmon are being put at risk. Environmental engineers hired by developers ignoring problems to save money.

Question 4: Your Impression of Watershed Health (Rural Areas)

No comment.

They are excellent.

Fairly healthy except were development has been allowed in the upstream areas.

Generally OK, though building on the flood plain of any significant river/stream ought to be automatically prohibited, not only for the health of the watershed but also because when the river floods (which it will) taxpayers are indirectly on the hook for some of the bailout costs. We could just avoid it altogether and not allow any further construction on flood plains.

The green spaces and waterways in maple ridge are a jewel, but continued further development appears to be greatly encroaching on them, with negative impacts, like increased and extreme waterflows, more debris, less shading, etc. even the required 15-30 m buffer from major waterways for new development appears very loosely enforced, and developments above watersheds tend to raise the water table below them from additional runoff.

Excessive stream side development is degrading the natural flood control.

NA

Forested areas = good, most rural areas = not bad, depending on how much concrete/pavement/building there is.

They have been fine up to this point.

The forested areas appear to be doing well. I have concerns about the rural areas. I'm not sure that enough is being done to protect these natural features from the effects of urbanization and contamination from farming and other rural land uses.

Nature takes care of the water when it comes. I have lived here a long time and never seen a problem. If there is standing water, all it takes is a little patience and it will be absorbed by the earth and trees, which need it.

We need to do better to protect our watershed

None

I am very concerned. The development of housing in the East has been peeling away the protective layer of the forests and I don't see it slowing down. I'd like to know that the rural areas are going to be protected from development.

They are getting over tax need to do more to slow water down and clean water before it goes into the streams

very poor drainage "improvement" at corner of 232 St and 132 Ave.....all the runoff from silver valley hill and it's silt directed to N. Alouette (salmon bearing river). Too much development and can't handle it.

I cannot say, other than that the city is more and more encroaching upon them, and that isn't good for drainage and watershed health.

seems fine to me

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River.

We need to retain more forests and riparian areas along rivers and creeks to encourage more natural drainage. Keeping streamside setbacks of 30 metres is a very good start but should be increased to 50m. Use more bioswales and other natural remediation measures in new developments.

I don't have an opinion as I'm unsure what this is referring to.

Can only speak to the neighbourhood I know. I believe that the overall watershed may be in good health due to its remoteness and size. The lower reaches however seem to be suffering.

The way the area is being developed puts severe pressure on the natural environment and is destroying the forests and watersheds.

Generally poor considering the amount of flooding of streets in the last year. Examples are: Seniors Centre on 224th.and the 225th. & Haney Bypass intersection.

Good

Fair but could be greatly improved. Would require the city or developers to invest in monitoring flows to determine what actually runoff from storms are and what is the water quality of this runoff.

I think they are probably OK, though again I remain concerned about building close to streams. The construction that has happened around Cotttonwood, and now continuing close by with development at the end of 232 St seems likely to put more pressure on feeder streams to Kanaka Creek. I am also concerned that these natural watersheds/drainage are also wildlife corridors, or rather were. We should be encouraging developers to enhance some of the existing natural features and ensure separation for wildlife. Sadly we have already encroached too far within the urban and suburban areas, but we can at least, if the will is there, prevent future destruction and erosion in the name of "growth" (which everyone but me seems to think is a good and necessary thing!)

Getting worse with more development, see my comment above to #3.

Excessive stream side development is degrading the natural flood control. Many stream banks can no longer retain enough water to prevent significant siltation and downstream flooding.

NA

Not so good - many of the ditches and waterways are covered over and are damaged during construction of roads & new development. NEW developments will be better equipped to deal with drainage and work with/around existing watershed elements, but older developments destroyed everything. We need to do restoration in these areas.

"I am not sure exactly where you are describing. More accurate descriptions would help.

As a long time resident we know that the soil along the Fraser has a high amount of clay which has and will continue to create a slippage. There is poor drainage to the west of the Town Center. Water floods the basement of some homes and there are no storm drains."

There are many examples of streams that are paved over (at best with culverts) and non-existant set-backs. Very poor practice. By contrast, an area that was recently developed fairly close to me retained and protected the natural stream and streamside vegetation. It is a joy to walk through and I'm sure the developer(s) still received ample return on their investment.

It seems to be very good.

I feel that it is a bit better due to a more natural setting which is better equipped to handle water

Seems fine

Even worse in the East/Albion areas. I'm a (home) insurance broker and the incidence of basements flooding has increased disproportionately in recent years in these areas. The more pavement, the less absorption. Very basic common sense.

Not good they are not getting cleaned or inspected

see above

Not improving because of the increased housing and pavement uphill from the lower lands especially floodplains in this area. Near where I live, the North Allouette needs dredging because of increased gravel deposits.

128 near 224th seems fine

"Answer same as above (not sure which area is considered rural vs. suburban)

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."

Again, the more trees kept, grassed areas and less asphalt, the better. We need to think about using new technologies of pervious pavements and move away from using so much impervious surfaces to channel and move stormwater out of our systems.

I don't have an opinion as I'm unsure what this is referring to.

Doc#

Question 6: Your Impression of Watershed Health (Urban Areas)

Very poor.See 4. above.

They seem fine.

Poor. Old infrastructure that does not address runoff rates or water quality. Recent downtown improvements could have integrated modern runoff facilities and did not. Not seeing the green infrastructure that should be required with new developments- a rooftop patio with a tree does not cut it.

OK - it rains a lot, we get wet. We need to halt the rate of urbanization and say "enough is enough". Maple Ridge is no longer open for developers other than on existing Brownfield sites.

Much worse, as it's more developed, with little green space to absorb rainfall, etc. With increasing effects of climate change, we need to be able to handle storms dropping an inordinate amount of rainfall in a short period of time.

Our storm water is directed into the streams and rivers, instead of treatment. Too many people are unaware, or just oblivious, to the consequences of dumping into the storm system. (The Hoy Creek fish kill is a tragic example of this ignorance.)

In Hammond, it's not very complete

Terrible - look at all the damage done when there was a flash flood. Too much concrete & pavement. Not enough green spaces and permeable surfaces.

This area seems to function pretty well.

Much much more needs to be done to restore the watershed health within the Town Centre and along major traffic corridors. This is absolutely essential in order to grow sustainably and mitigate the effects of climate change. At the same time, the community as a whole will enjoy the many interrelated benefits offered by this approach, from better air quality to more options for active transportation ("green" corridors supporting safe pedestrian and cycling modes of transportation).

It is perfect. And since you do not provide adequate space on this form for comments, I want to say that we should not be trying to have "ongoing urbanization" - that is the main problem here. There is too much development and not enough natural spaces left that would offset any water issues. It's time Maple Ridge put a cap on development, or we will end up with an ugly city that is simply urban sprawl (like Langley) and not the beautiful green city we are on the verge of losing.

Needs improvement

None

The existing drains may be at capacity already as evidenced by the street flooding earlier this year. Although some of it was caused by blocked drains, there were still several blocks 'underwater' as the systems couldn't remove the volume of water. I'd like to know that the systems are going to be upgraded or maintained to prevent collapse.

I live 2 blocks from the hospital and half the houses on our end the street do not have storm drains or connections

They are under sized and old not getting cleaned or inspected

big flood at Sr. Ctr., so obvious that there are problems

l cannot say.

good

"Answer same as above (not sure which area is considered rural vs. suburban)

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."

As above.

I don't have an opinion as I'm unsure what this is referring to.

Do not know



M.

ATTACHMENT C

External Stakeholder Feedback Summary

Stakeholder	Response
Agricultural Land Commission	Provided feedback in a letter dated June 17, 2021 (refer to Attachment D)
Alouette River Management Society	Met with Urban Systems and City staff and provided feedback in a document dated June 2, 2021 (refer to Attachment E)
Alouette Valley Association	Provided feedback in an email dated June 7, 2021 (refer to Attachment F)
BC Conservation Foundation – WildsafeBC	Met with Urban Systems and City staff and provided feedback in a letter dated November 30, 2020 (refer to Attachment G)
BC Ministry of Agriculture, Food and Fisheries	Met with Urban Systems and City staff and provided information on how the Ministry encourages sustainable farming
BC Ministry of Environment & Climate Change Strategy	Met with Urban Systems and City staff and provided feedback in a document dated May 7, 2021 (refer to Attachment H)
BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development	Met with Urban Systems and City staff and provided feedback in a document dated May 28, 2021 (refer to Attachment I)
BC Hydro	Met with Urban Systems and City staff and provided information on their operations at the Alouette Lake Reservoir
BC Parks	Met with Urban Systems and City staff and provided information on the management of Golden Ears Park and their ongoing efforts to increase understanding of the park area's natural assets through partnerships and studies
City of Pitt Meadows	Responded to the City's invitation for review but did not have any specific comments on the ISMP

Stakeholder	Response
DK Bowins & Associates Inc.	DK Bowins & Associates is a local engineering consulting firm specializing in land developing. DK Bowins staff met with Urban Systems and City staf provided insight into certain rainwater managemen design challenges, provided information on design criteria used by other jurisdictions, supported the Engineering department's approach of raising rainwater management as a priority very early in th development review process and supported the IS recommendation for more area-specific design targ (related to variability in soil conditions)
Fisheries and Oceans Canada	Met with Urban Systems and City staff and express interest in leveraging information in the ISMP to support their work promoting improved habitat and habitat connectivity, especially as related to overcoming obstacles to fish passage in local watercourses; noted significant opportunities for environmental improvements in the Agricultural La Reserve, recognizing in particular the need for ripa buffer zones
Kanaka Education & Environmental Partnership Society	Met with Urban Systems and City staff and provide written feedback (refer to Attachment J)
Katzie First Nation	Katzie First Nation did not respond to the invitation provide feedback on the ISMP.
Kwantlen First Nation	Kwantlen First Nation did not respond to the invita to provide feedback on the ISMP.
Local Real Estate Developers	Two local real estate developers responded to the invitation, but declined the opportunity to provide feedback on the ISMP.
Metro Vancouver Regional Parks	Met with Urban Systems and City staff and indicate support for the ISMP recommendations; noted the need for ongoing flow monitoring; supported improvements to the implementation of Tier A (rainwater infiltration) as part of development work seeing increased erosion along Kanaka Creek; described Metro Vancouver's management of inva plant species; highlighted concern related to poter for increased flow in Kanaka Creek due to upstrea development; inventory of natural assets should b considered a high priority
Thornhill Aquifer Protection Society	Provided feedback in an email dated May 28, 202

Stakeholder	Response
UBC Malcolm Knapp Research Forest	Provided feedback in an email dated May 3, 2021 (refer to Attachment L)

ATTACHMENT D



Agricultural Land Commission 201 – 4940 Canada Way Burnaby, British Columbia V5G 4K6 Tel: 604 660-7000 | Fax: 604 660-7033 www.alc.gov.bc.ca

June 17, 2021

Reply to the attention of Shannon Lambie ALC Issue: 52068

Joe Dingwall Manager of Utility Engineering, City of Maple Ridge jdingwall@mapleridge.ca

Delivered Electronically

Re: Integrated Stormwater Management Plan for South Alouette and Kanaka Creek

Thank you for forwarding a draft copy of the *Integrated Stormwater Management Plan for the South Alouette and Kanaka Creek* (the "second ISMP") for review and comment by the Agricultural Land Commission (ALC). In January of 2021, ALC staff provided comments for the City of Maple Ridge's (the "City") first ISMP that covered the Blaney Creek Watershed, the North Alouette River Watershed, and the Fraser River Watershed. These comments can be read in ALC Correspondence 52068m1. The following comments are provided to help ensure that the ISMP is consistent with the purposes of the *ALC Act* (ALC Act), the Agricultural Land Reserve (ALR) General Regulation, (the "ALR General Regulation"), the ALR Use Regulation (the "ALR Use Regulation"), and any decisions of the ALC.

The regional objective of integrated stormwater management planning is to "strive to maintain existing watershed health and achieve no-net-loss on a watershed basis". To achieve this, the second ISMP process examines the relationships between land use planning and development, drainage servicing, and environmental protection. The second ISMP covers approximately 310 km² of the South Alouette and Kanaka Creek watersheds, of which 160 km² lie within the City's boundary.

The second ISMP is a policy-level document, which provides a vision for future planning; therefore, specific details regarding how this may affect the ALR have not yet been delineated. ALC staff thus request that City staff refer any future bylaws or other legal tools, along with any proposed parks or conservation areas that may affect lands within or adjacent to the ALR, to ALC staff in advance of their adoption for review and feedback. If addition, ALC staff request that the City provide details confirming the ALR areas affected by the second ISMP for internal mapping purposes. ALC staff would like to thank City staff for the opportunity to be involved in the development of the ISMP and hope to continue to expand dialog concerning regional planning issues that affect stormwater management and drainage issues across watersheds.

If you have any questions about the above comments, please contact the undersigned at 236-468-2026 or by e-mail (shannon.lambie@gov.bc.ca).

Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

Szampia

Shannon Lambie, Regional Planner 52068m2



24959 ALOUETTE ROAD, MAPLE RIDGE, BC V4R 1R8 Tel: 604.467.6401 Fax: 604.467.6478 arms@alouetteriver.org www.alouetteriver.org

June 2, 2021

Joe Dingwall Manager of Utility Engineering City of Maple Ridge 11995 Haney Place, Maple Ridge, BC V2X 6A9

CC: Mayor and Council

Dear Mr. Dingwall:

RE: South Alouette, Kanaka Creek Draft Integrated Stormwater Management Plan File No: 11-5255-20-061

Please find attached the report containing comments pertaining to the subject draft Integrated Stormwater Management Plan in response to the invitation by the City of Maple Ridge (CMR) for the Alouette River Management Society (ARMS) to provide comment on the draft plan.

Should you have any questions or concerns regarding the contents of this letter, please do not hesitate to reach out to the Greta Borick-Cunningham, Executive Director of ARMS.

ARMS would like to take this opportunity to thank City of Maple Ridge for the invitation to provide comment on a draft plan of this level of importance. ARMS will happily contribute to other future planning and policy documents related to the Alouette River watershed should the City request it.

Sincerely,

Ken Stewart, On behalf of ARMS

Alouette River Management Society Review of the Blaney, North Alouette and Fraser River Integrated Stormwater Management Plan

Daniel King¹, Josh Baker², Greta Borick-Cunningham³, Cheryl Ashlie¹, John Kelly¹

¹Alouette River Management Society Director ² Alouette River Management Member, Professional Environmental Chemist

³ Alouette River Management Society Staff

Executive Summary

As in our submission for the North Alouette Integrated Stormwater Management Plan ARMS response to the South Alouette Integrated Stormwater Management Plan is positive, as we found that the plan provides a comprehensive watershed analysis to better inform city planning, development and restoration works. ARMS notes that both plans advocate for all the watersheds' natural areas and environmental services, which we believe provides a good foundation for future work to improve the health of each of the watersheds involved.

However, we question the decision to do two separate plans. And while the logistics of such was shared by city staff, ARMS considers having separate plans as a misstep that moves us away from our goal of a wholistic approach to watershed management.

Key points that ARMS raises in the following submission provide recommendations in current practices that are presently providing positive environmental changes within the North American development landscape. The plan itself, while containing promising recommendations and methodology on how to protect the involved watersheds' health from negative outcomes of stormwater, due to development, appears to be void of substantive means of enacting innovative methods and important ideas, such as green infrastructure. Like the NAISMP, much of our feedback focuses on moving aspirational comments in the plan to that of actions that will protect the watershed.

To this end, key recommendations are provided in the areas of working relationships with stakeholders to ensure the plan fulfills the intent of protecting the watersheds involved. ARMS believes that a sub-committee involving stakeholders, which ARMS would like to be part of, could be a useful mechanism to implement both plans and would request that this be an immediate action by council.

ARMS once again provides feedback in Monitoring and Adaptive Management Framework (MAMF), as we believe that there are gaps in focus areas that will result in deficiencies within the data that will be required to accurately assess development impact on the watershed. We believe that including our recommendations in this area will provide a robust methodology to match that of the vision of the document. As well, ARMS has restated some of our previous recommendations in Stormwater Infrastructure and Management from the NAISMP, where we have proposed the use of more green infrastructure mechanisms, coupled with the removal of building materials and products that are known to cause contamination within watersheds, as we feel that these are imperative steps for a return to a healthy watershed system.

ARMS has also highlighted in the question/concerns section the repeated pattern within this ISMP that we saw in the NAISMP, whereby clear strategies to address infill opportunities through green

infrastructure and a lack of performance targets for all developments that have led to poor results within the City's stormwater management activities.

ARMS also provides within this section our concern relating to the interpretation of "no net loss." It is the view of ARMS that while there is concerted effort on the City's part to gain conservation land in areas of conservation, the focus on such is so narrow and misses an opportunity to ensure there is a net gain throughout the City's boundaries.

Overall, the Integrated Stormwater Management Plan is an excellent beginning, and the plan provides a good beginning for actions to protect the watershed from degradation. In that spirit, we hope the following observations and recommendations can form a continuance of the collaboration that enabled the draft plan for council's consideration, and we look forward to furthering discussions with the city on the opportunities within the plan for a robust set of policies that will ensure the protection and enhancement of the watersheds for which we are all striving to protect.

Introduction

The Alouette River Management Society (ARMS) would like to thank the representatives of the City of Maple Ridge (CMR) involved in finalizing the Draft Integrated Stormwater Management Plan (ISMP) for the invitation to provide input and feedback on the ISMP. It is the hope of ARMS that the recommendations herein will be thoughtfully considered and applied to the ISMP, as well as future development, ecological restoration, environmental monitoring, fisheries monitoring and restoration, decisions surrounding protected areas, parks, and green space; and all activities related to the preservation and enhancement of the Alouette River Watershed. In addition to directly addressing recommendations within the ISMP, ARMS also took the opportunity to provide specific recommendations for stormwater monitoring, mitigation and management based on the most current and robust evidence available.

ARMS greatly anticipates further work and collaboration with CMR on enhancement and monitoring efforts within the watershed using the framework outlined the proposed ISMP; updated with ARMS recommended changes.

Partnership Opportunities Between ARMS and CMR

ARMS found that the recommendations for habitat restoration, environmental monitoring, stormwater mitigation, fisheries monitoring and all other related recommendations within the ISMP were aligned with the vision and goals ARMS has for the Alouette River watershed. Due to this alignment ARMS foresees the implementation of this ISMP and the recommendations therein as a perfect opportunity for collaboration with the CMR on the protection and enhancement of the Alouette River watershed. Some specific recommendations for work in partnership between ARMS and CMR are outlined in this section and throughout this report.

• ARMS re-states our proposal included in our feedback to the NAISMP for the formation of a Stormwater Management and Aquatic Habitat Restoration Technical Working Group with representatives from rightsholder Katzie First Nation and each key stakeholder group (e.g. CMR,

ARMS etc.) immediately following the implementation of the new ISMP. We recommend that the key mandates of this group include:

- Creation of an implementation plan for the ISMP that would outline specific requirements, approaches, and best practice for stormwater management to provide actionable guidance for the framework outlined in the ISMP.
- Create a priority capital and habitat infrastructure list along with a proposed schedule for upgrading of said capital infrastructure and habitat restoration.
- Review and advise Mayor and Council on stormwater management plans for planned and future developments.
- Establishing baseline measures to track performance.

The management plan is full of exciting recommendations and methodology on how to protect watershed health from negative outcomes of stormwater. However, many of the more innovative methods and important ideas are not directly included in either the current policies and/or in the future suggested actions of the management plan (*e.g.*, green infrastructure is described in some detail but is absent from most of the suggested infrastructure upgrades). The disconnect between what is described and what is proposed makes the plan just a placeholder for ideas but not actionable items to truly protect the watershed.

Key Recommendations from the ISMP

Within this section ARMS will outline in sufficient detail specific subjects identified within the ISMP and our recommended changes or considerations to address those issues. When items are not directly within the ISMP, ARMS requests that they be considered for inclusion, or, noted for inclusion in a future implementation plan.

Habitat Protection and Restoration

It is unclear if the guiding principle of no-net-loss is met based on data and derived conclusions. The ISMP concludes the following:

"Based on stream data collected and provided by the City, assessment of sample catchments suggests that if successfully achieved, the City's current stormwater management criteria should, at minimum, abate the impact development may have on stream erosion and watershed health, satisfying the baseline ISMP goal of "no-net-loss".

This conclusion presumably stems from minimal deviation from the relationship between predicted biological condition scores (B-IBI based on riparian and impervious percentages) and observed condition scores (B-IBI from sampling efforts) at the monitored sites. This ignores the background process of development; development reduces riparian coverage while increasing impervious percentages and therefore would lead to a lower predicted condition score. Thus, ensuring that the ISMP does not allow for a deviation in the predicted versus observed scores only facilitates that the ISMP protects against no additional loss over and beyond development. Upon review, this appears to not represent no-net-loss but appears to represent no-additional-loss. Furthermore, the data presented would suggest a net-loss even if we were to use this method of deviation from predicted-observed B-IBI condition scores as a tool

to assess the data for no-net-loss. Millionaire Creek provides an example of this type of net-loss as its B-IBI condition score is lower than its predictive score which is based on development alone (i.e., loss in percent riparian and impervious).

- 1. The ISMP needs to be clear on its primary goal of "no-net-loss" and be willing to identify examples of net loss.
- 2. The City needs to consider its current "net gain" scheme to assess its efficacy and how it can be expanded to all areas inclusive of infill areas of the city.

Conclusions for biological condition of streams based on limited data are problematic. The ISMP uses B-IBI scores observed versus predicted scores (based on riparian and impervious areas) as tools to make broad conclusions regarding stormwater management and water quality. While the report outlines that the data should not be taken as conclusive on their own, due to the variety of factors that can lead to differing measures of biological condition (site selection, habitat, etc) and the drawbacks of a single sampling event, it nevertheless provides summary statements. For example, the ISMP postulates that the data are indicative of effective stormwater practices; the report concludes this as a "good-newsstory". The data are not sufficient to make these conclusions and the poor biological condition of the sites, and the seemingly connected exceedances of water quality parameters, are difficult to personally interpret, and to receive as someone else's interpretation, as good news.

3. The ISMP recommends that conducting B-IBI monitoring every 2-5 years and yearly water quality sampling will improve conclusions. This monitoring, done at an increased frequency, is necessary to derive robust baseline data which would allow for appropriate conclusions on the health of watershed data, and the subsequent required adaptive management.

Existing Stormwater Design Criteria

As stated by the consultant on page 167 of the document, "... based on stream data collected and provided by the City, sample catchments suggest that the City's current stormwater criteria should, at minimum, abate the impact development may have on stream erosion and watershed health. Under current climate conditions, current practices, and assuming current climatic conditions are expected to generally maintain, or minorly reduce, the risk of erosion in areas that had been previously developed without the application of controls. However, this is with a caveat that developers are not consistently achieving Tier A/B controls. Where they are not achieved, development impacts are expected."

To this end, we restate our position presented within the NASIMP related to the guidelines released by Metro Vancouver in 2017 for specific minimum guidelines for stormwater management for single-family lots. These guidelines represent a minimum level of mitigation expected on single-family lots across the region. The City's Tier A criteria, if implemented, exceed the minimum requirements of the Metro Vancouver Baseline, however, the baseline criteria could form a fall-back for cases where Tier A criteria is unable to be met on single-family lots."

1. ARMS recommends that the city strengthen the policy direction to ensure that the city's guidelines are the predominant outcome, and that Metro Vancouver Baseline is only permitted when there has been no capacity to meet the city's guidelines.

Data appears to indicate that time for adaptive management is now. Under the MAMF, it is stated:

"If watercourse erosion and environmental health do not stabilize, or preferably improve, the City may need to accelerate the implementation of communal management infrastructure through its capital program; either with high flow diversions or stormwater detention ponds. Within mature development areas land acquisition and building demolition may be required."

Data within the report reveals poor biological condition at multiple sites, possibly due to stormwater inputs, and therefore could justify the above actions.

2. The list of monitoring parameters which could show improvement (page 213) should be the targets for CMR. Further, increasing in monitoring will define the current situation and can help clarify path forward.

Water Quality Monitoring

There were several areas identified within the ISMP with insufficient or absent details regarding water quality monitoring. The following are our suggested additions:

 ARMS strongly supports all efforts that will ensure non-point sources of pollution pertaining to water quality are addressed. For consistency in the ISMPs, ARMS requests that Tier A wording in the NAISMP be inclusive of water quality, to ensure that runoff volume addresses pollutants from any vehicle accessible surfaces.

Stormwater runoff has been shown to be acutely toxic to Coho salmon at all life stages, including to spawning adults before they are able to spawn (e.g.>90% egg retention in females) (McIntyre et al. 2020). ARMS has included additional points in the *Stormwater Mitigation* section.

The exceedance of water quality parameters and the resultant poor conditions of streams in the South Alouette watershed is a possible indication that city is failing to adequately treat stormwater. Exceedances of water quality thresholds at the monitoring sites have been suggested in the ISMP to be the cause of deteriorated condition. Total trace metals, turbidity, bacteriology and conductivity were demonstrated to exceed targets proposed in the MAMF. The condition of Millionaire Creek is reported to be below the expected biological condition which is hypothesized to be due to the negative influence of water quality. CMR regulations and policies must ensure that poor water quality in stormwater is not deteriorating watershed health.

2. Investigations suggested in the report, including addressing sources of E.coli and fecal coliforms, metals and increased conductivity, throughout the watershed should be undertaken. These

investigations will allow for a better understanding of source and source control, the ultimate mechanism to improve stormwater management.

Consideration to why the assessment of water quality thresholds for metals are included. The guidelines (good, satisfactory, needs attention) under the MAMF are set for copper and zinc assuming a hardness of 100 mg/L (Appendix A). The North and South Alouette Rivers have extremely low hardness conditions (<10 mg/L). As the toxicity of copper and zinc to aquatic organisms are hardness-dependent conducting the assessments at a higher hardness has the potential to underestimate the risk of metals on the watershed. The hardness-dependent nature of copper and zinc has been incorporated into the reported BC Water Quality Guidelines.

- 3. It is suggested that the BC WQGs be used for the assessment of risk and for the requirement for attention for metals, or, update the MAMF guidelines to be appropriate to the site condition.
- 4. The MAMF monitoring should be done on a three year not five-year cycle. This is standard practice for other monitoring programs such as the Metal and Diamond Mining Effluent and Pulp and Paper Effluent Regulations (ECCC, 2010; 2014).

Though mining and pulp and paper effluent seem far more environmentally damaging than stormwater runoff, this is not necessarily the case. Urban stormwater effluent, depending on the contents, can be extremely damaging to various receptors within an aquatic ecosystem; the main difference is stormwater is not monitored and regulated to the level of industries such as mining. To properly implement the "adaptive" portion of the Monitoring and Adaptive Management Framework (MAMF), ARMS feels that monitoring programs every three years are necessary.

5. ARMS recommends that in addition to the water quality parameters outlined in the ISMP, two other common and relatively inexpensive parameters be added: Dissolved organic carbon (DOC) and water hardness.

To determine if a copper or zinc concentration is safe for aquatic life the bioavailability to aquatic life is dependent upon dissolved organic carbon and water hardness (zinc) and only water hardness is required for copper. This allows the derivation of a site-specific concentration protective of aquatic life (including DOC and hardness) for these contaminants. In fact, if metal water quality monitoring is provincially or federally required to prove concentrations that are protective of aquatic life, the determination of site-specific copper and zinc concentrations is required (MOE, 1999; MOECCS, 2019; CCME, 1999; CCME 2018).

6. As in the NAISMP, ARMS strongly recommends the assessment of stormwater water quality, flow rate and volume.

An assessment of stormwater could include and would achieve:

- Monitoring during a storm event assesses stormwater in-situ;
- Monitoring after a dry period assesses the "first flush scenario" (ECCC, 2014);
- Analyze water chemistry (metals, nutrients, pH, conductivity, petrogenic PAHs) identifies and quantifies possible pollutants/toxicants;
- Analyze turbidity characterizes possible siltation/sedimentation dynamics which are important for spawning substrate;
- Flow/volume allows for quantification of the amount of stormwater in comparison to the creek and modeling the environmental fate, rate and concentration of toxicants identified in the water chemistry measurements.

This type of stormwater assessment has been conducted by other municipalities (MOE, 2007). This assessment would aid in identifying key issues, such as contaminants of potential concern and/or sources of sediment/silt. The assessment could prioritize locations which need attention (*e.g.*, a specific outfall/culvert) and would identify situations where source control programs may be warranted (*e.g.*, a community education program to reduce zinc loading from metal roofing materials). The primary goal of this study would be to identify sites with high-volume inputs into low-volume river sites overlap with high loads of pollutants. Subsequently, an engineered solution would be identified (*e.g.*, diverting a culvert to a bioswale to increase bioretention).

 ARMS continues to advocate for public disclosure of the environmental impact assessments for pre- and post-water quality monitoring and ARMS would like to actively participate in these impact assessments.

Stormwater Infrastructure and Management

1. Conclusions of effective stormwater practices are based on data which suggests the opposite. For instance, the ISMP suggests that current stormwater management practices are effective, yet the report provides evidence to the contrary as shown in the following.

The differences in condition at T2 and Millionaire are provided in the ISMP as a comparative example to demonstrate the effectiveness of the stormwater practices. The older development and practices in T2 Creek are presented as insufficient and the cause of the lowered biological condition at this site. T2 is contrasted with Millionaire Creek whose newer development and improved stormwater practices is postulated to have led to its higher biological condition. In contrast to these theories, Millionaire Creek is reported as in a condition which is below the predictive condition, which in the opinion of ARMS is indicating current stormwater practices are actually not sufficient.

2. ARMS requests clear and descriptive language on which parties are responsible for monitoring and enforcement related to stormwater and sediment runoff, after construction activities have concluded with a qualified environmental professional monitoring these parameters. Policies and plans which are enforced by CMR would serve the watersheds more beneficially. The descriptions of policies which apply to stormwater are numerous but vague on their application and enforcement. A particular example is an application on the north end of 240th Street, which intended to increase density from RS-3 to an urban standard. The proximity to the river and abutment to a slope that will rely on slope sediment being directed into a developer created streamside channel is counter-productive to the intent of the stream installation as a compensation component of the development. Once a developer has moved on, but issues arise post-construction, who is the responsible party? Who will enforce and monitor in situations like this?

- 3. ARMS requests that CMR continues to use SPR for development standards relating to streamside setbacks.
- 4. ARMS requests to be notified of any stormwater or capital infrastructure, and streamside restoration work in-or-about streams within the Alouette River and Kanaka Creek watersheds. This would include work completed by the CMR, subcontractors of the CMR and landowners/developers. ARMS would also like to be included in the planning, monitoring and construction activities.
- 5. ARMS recommends green infrastructure be made a priority for the City, due to the reliance of such strategies within the SAISMP. Increased funds and stronger policy positions, specifically in the area of infill is required within all of the ISMPs.
- 6. As in the NAISMP, ARMS recognized that an all-out ban on the use of roofing materials proven to release levels may be challenging, therefore we request, at minimum, the city develop a program to mitigate the release of toxic materials from roofing products and/or a program to educate the community about their use. Please consider the following rationale based on McIntyre et al (2019). McIntyre et al (2019) measured the concentrations of three metals known to be toxic to aquatic life arsenic, copper and zinc leaching into runoff from experimental panels of 14 roofing materials over 4.5 years of weathering. Ten roofing materials leached metals. Several leached >10 ppb. Metal concentration increased with roofing panel age as well as precipitation amount. Authors extrapolated loading of metals from each roofing material 10 years following installation. The roofing materials found to be most toxic were:
 - Wood shakes manufactured with copper chromated arsenic; leach the most arsenic
 - Treated wood shakes; leach copper
 - Copper granule-containing asphalt shingles; leach copper
 - Commercial roofs made of Zincalume and painted metal roofs that leach high levels of zinc

- 7. As in the NAISMP, ARMS recommends the use of a specified blend of bioretention media for stormwater treatment areas, identified in a study commissioned by King County, Washington, US (Herrera, 2020). Common practice for bioretention media has been 60% sand and 40% compost in Washington State. However, this bioretention treatment still allows leaching of phosphorous, nitrate and nitrite and total and dissolved copper and other contaminants after storm events. One media blend from the study met the Washington State Ecology Department Technology and Assessment Protocol-Ecology for bioretention media. This blend consisted of:
 - A primary layer with 70% volcanic sand, 20% coco coir/10% high carbon wood ash
 - A polishing layer placed under the primary layer 90% state sand/7% coarse activated alumina/3% iron aggregate
 - A 2-inch compost layer to promote plant growth

This media mixture removed total suspended solids, dissolved organic carbon, total phosphorous, ortho-phosphorous, nitrate+nitrite, total copper, dissolved copper, total zinc, dissolved zinc, total lead, dissolved lead, aluminum, total petroleum hydrocarbons from motor oil, diesel oil, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene and fecal coliforms; all to acceptable concentrations. The application of this blend as well as the cost per m³ can be seen in the below table taken from the study.

Table 53. Components and Application of New Washington Bioretention Media.								
	Basic Treatment	Enhanced Treatment	Phosphorus Treatment	Expanded Plant Palette and Robust Plant Growth				
Primary layer	Х	Х						
Primary plus polishing layer	Х	Х	Х					
Primary plus polishing layer plus compost mulch ^a	х	х	x	Х				

^a Do not use the primary media alone with compost mulch. The primary media and compost mulch without the polishing layer will export phosphorus and nitrogen.

Table	2.	Cost	per	m³	of	the	components	of	bioretention	media	identified	to	be	most	effective	at
contai	min	ant re	emov	val f	ron	1 sto	rmwater.									

Media	Cost per m ³ (CAD)
primary media	175
polishing layer	474
compost mulch	25
Total	673
60/40	100

Whenever possible at the minimum the primary layer should be used, with preference for the primary, polishing and compost layer for effluent draining directly into local streams or sensitive ecological areas. In the event that the components of this bioretention media are unavailable ARMS recommends a biorention soil media mixture of attainable materials that was less rigorously studied for all runoff components when compared to the study by Herrera (2020), but was shown to be protective of juvenile Coho salmon and their prey (mayfly spp.) after treatment of stormwater runoff that was toxic when untreated (McIntyre et al 2015). That mixture is 60% sand, 15% compost, 15% shredded bark, 10% drinking water treatment residuals all overlying a gravel aggregate drainage layer.

Though the water quality parameters used in the MAMF are a good starting point for stormwater management, many other contaminants are present within stormwater including metals, petroleum-based contaminants and even a host of unknown chemicals from tire rubber leachates which have been shown to be toxic to Coho salmon. Instead of adding a whole host of expensive water quality testing parameters to the monitoring framework, only to find stormwater mitigation underperforming, thus requiring adaptive mitigation; ARMS recommends a "do it once and do it right" approach by using these tried-and-true soil bioretention media in areas used to treat and manage stormwater runoff.

ARMS recommends this not just for the city managed-spaces and stormwater infrastructure but as a requirement on all small scale development used in rain gardens for each individual lot. To support "retrofitting" of stormwater mitigation measures on existing lots the city could run a program of providing this bioretention media mixture to residents.

- 8. As in the NAISMP, ARMS recommends a detailed plan be included within the ISMP to properly fund the maintenance of stormwater management infrastructure. Maintenance is required over the long term for absorbent landscapes to continue to provide stormwater benefits. These might include:
 - Replacing soils that have eroded or that are missing key components for contaminant removal
 - Landscape maintenance including removal of invasive and dead vegetation and planting of suitable native vegetation effective at flow mitigation and contaminant removal.

To implement maintenance of stormwater infrastructure and functioning some new source of funding to provide this service. Funding might come from:

- A stormwater "utility" charged as part of municipal taxes (e.g. Los Angeles County, City of Victoria)
- A tax that charges developments to either pay for or provide the service for the long-term management of stormwater infrastructure
- Local Area Service (LAS) Tax (based on CMR Local Area Service Policy)
- Infrastructure Planning Grants from Provincial government
- Local Government Infrastructure Grants from Provincial government
This is an area ARMS believes has been repeatedly neglected with no party left to take responsibility for the maintenance of dated stormwater infrastructure, even that with a modern and progressive design. ARMS requests the CMR take responsibility for this service and outlines a plan within the ISMP to cover the costs of this service using a variety of financing options available. Funding maintenance of stormwater infrastructure is becoming common practice and to support the significant investment in this ISMP and ensure its success, CMR should also use this approach.

Assessment of SW infrastructure function for adaptive management

Planning and execution of a long-term stormwater monitoring plan is the type of endeavor where ARMS would seek to partner with the CMR and rightsholders, key stakeholders and other interested parties (e.g. First Nations, academia, community volunteers etc.). Programs such as this are labour and cost-intensive to implement and partnerships and shared effort among stakeholders will be key to their success. Once again ARMS would recommend the use of stakeholder engagement table to guide the work and discussions. Points raised within the NAISMP that we would like to restate for consideration are as follows:

- 1. ARMS recommends benthic invertebrate monitoring should be conducted at all sites along with water quality; and that both be conducted every 3 years, not every 5 years. The only way to ensure a proper weight of evidence approach is to get all the lines of evidence. If you remove a key line of evidence, like benthic richness, the other lines of evidence (water quality, etc.) become less useful.
- 2. ARMS recommends the implementation of the MAMF supplemental performance monitoring indicators.
 - Salmon surveys, spawning adults and juvenile (YOY) would be helpful monitoring indicators. ARMS has an existing spawner assessment program and would like to expand it to benefit the needs of all watersheds. Additionally, ARMS would seek additional funding in partnership with CMR and other key stakeholders for juvenile (YOY) assessments.
- ARMS recommends that sediment size characteristics (grain size, % embedded) be used as a monitoring tool - using the Guidelines for Monitoring Fine Sediment Deposition in Streams (B.C. 2002)
- 4. ARMS would like to work in partnership with CMR, interested provincial and federal ministries, the Katzie First Nation, academia, other key stakeholders and interest groups to include a student and volunteer-based monitoring program of water quality and toxicity testing for benthic invertebrates (e.g. *Ceriodaphnia dubia*) and salmonids. This would allow for key funding opportunities, an accurate indication of the performance of stormwater management infrastructure at frequent intervals, allow for additional financial support for a novel program

through a multi-stakeholder partnership, and for community outreach through education and volunteerism.

5. ARMS strongly recommends that the raingarden and bioretention assessment protocol developed by Washington State University (and partners) be incorporated into the ISMP and required to be applied every three years along with other monitoring requirements (e.g. water quality, benthics). This would allow for the comparison of indirect metrics of potential stormwater impacts to direct assessments of stormwater infrastructure functioning (SAM, 2020). The protocol was developed to allow ease of implementation, repeatability across large geographic scales and multiple implementers, and provide data of scientific and adaptive management value.

This is another area ARMS would seek to partner with CMR to employ as a tool for education, volunteerism and community outreach; while serving to protect the Alouette watershed. Potential areas this protocol could be applied is as a requirement for developments or, used to support residential bioretention and rain garden infrastructure for individual residences in the form of a grant or tax-credit.

Agricultural Effluent Impacts

Agricultural effluent into adjacent waterways is a difficult problem to address when compared to residential and urban stormwater management. However, management of this effluent is no less important for preservation of the ecological integrity of the watershed and measures should be taken to mitigate effects of agriculture whenever feasible.

Agriculture provides jobs, food security, economic benefits and even flood control infrastructure. With these benefits comes potential risk of environmental impacts, especially with the storm events seen in the Lower Mainland. Agricultural runoff can include nitrogen, phosphorous, fecal coliforms, organic carbon and the associated nutrient enrichment effects such as eutrophication. Additionally, in accordance with integrated pest management, pesticide application is almost always necessary to maintain crop yields. There is a whole host of different pesticides within several classes including fungicides, insecticides, herbicides, rodenticides etc., each with their own physicochemical characteristics, behaviour within the environment and toxicity to the receptors within the environment. In addition to the fate and toxicity of the known chemicals, many pesticides come in proprietary mixtures with unknown chemical components (e.g. surfactants) with unknown behaviour within the receiving environment.

Although proper soil management is encouraged, and pesticide technology has made leaps and bounds in terms of environmental effects from the arsenic and lead-based pesticides of the early 1900's, it is still difficult to completely mitigate the effects and even more so, difficult to monitor and regulate their proper uses. There is little-to-no monitoring and enforcement and very little economic incentive for farmers to employ best-practice pesticide use and application (local farmer pers.comms.).

In the face of this difficult environmental problem associated with a necessary sector and service in agriculture, innovative approaches with efforts from multiple stakeholders are required. ARMS recommendations are aligned with those previously outlined by KWL in the NAISMP and restated for the purposes of the SAISMP:

- 1. ARMS recommends agricultural withdrawal and flow monitoring to ensure no impact to outmigrating salmonids.
- 2. ARMS recommends water quality and benthic monitoring sites in agricultural reaches of the North Alouette River and Blaney Creek be included in the ISMP.
- 3. ARMS proposes a partnership between CMR, ARMS, Provincial and Federal ministries, academia, First Nations, and conservation groups to financially and logistically support and guide farmers on achieving Salmon-Safe certification for their agricultural products. Salmon-Safe is one of the leading ecolabels in the Pacific Northwest that through peer-reviewed certification and accreditation program, implement farming practices and developments that protect water quality, maintain watershed health, and restore habitat.

Questions, Concerns, Errors and Omissions to be Addressed

There is community desire to improve watershed health. The survey conducted as part of the ISMP indicated that 80% of respondents would support moderate to significant investment in watersheds. Conveying community desire to city council will be important to ensure that environmental policy, monitoring programs and capital investments are appropriate to the scale of the task at hand. However, the number of responses was extremely low.

It is the view of ARMS that a more robust feedback/awareness program be undertaken to ensure council understands there is significant support for progressive policy and financial commitment from council.

Stakeholder engagement. The ISMP suggests a stakeholder table, but it does not provide funding for it within the budget proposals and relies on existing internal staffing support.

Review existing successful stakeholder tables such as the Coquitlam River Watershed Roundtable and adequately fund staffing support.

Developing ISMPs for two watersheds jointly with one consultant, while developing ISMPs for three other watersheds with another consultant leads to unnecessary overlap at the same time as clear differences. The city has stated it is jointly developing ISMPs for these watersheds (South Alouette and Kanaka Creek) because of the overlapping objectives and benefits the process provides to the City. Do not all watersheds within the city have overlapping objectives? The work by Urban Systems on the South Alouette uses different terminology, methods and recommendations than the work conducted by KWL on the North Alouette. Further, there are recommendations made by KWL in Appendix A of the Urban Systems report.

This concern is mainly logistical in nature, in that CMR, and the interested stakeholders, will need to draw out the primary conclusions and objectives from each work.

Data used to formulate content of the plan was outdated.

The plan recommends gathering immediate data over a three-year period, however, many of the conclusions within the proposed plan were based on outdated data.

Address data gaps, establish baseline data and ensure monitoring program is done on a regular interval and tied to measurable outcomes.

Recommendations, investigations, and follow-up actions are numerous and complex – what is achievable? The ISMP states that lack of funding, lack of knowledge transfer and lack of synchronized programs can lead to deficiencies. It also states that one of the greatest liabilities for a municipality is to have regulations – policies, bylaws, criteria, etc. – that are not enforced or achieved. These will be key points of interest for the environment moving forward.

How will CMR ensure that all this information is properly digested and put into action. What are CMRs plans for moving forward and how can ARMS help?

Progressive policy shifts are not supported through the proposed budget.

Although infrastructure replacement and upgrade projects are identified within the plan, policy shifts that would enable gains through infill opportunities, although mentioned, are not backed up with significant funding and steps to ensure this outcome. Further, concerns around infill development and an on-site and off-site compensation regime is loosely addressed but not identified with actionable steps and performance targets to ensure adherence City wide.

Adopting policies shifts such as the use of green infrastructure and promotion of a "net gain" environment that is applied across the City's boundaries, as opposed to settling for a "no net loss" outcome that is referenced in the ISMP would benefit a more natural means of reaching the City's targets. Essentially, fund and promote restorative practices.

Monitoring development outcomes relating to Tier A criteria, with specific performance targets so the reliance on minimal standards set out by Metro Vancouver is not the de facto practice.

Ensuring the 3-tier performance metrics for impervious/pervious surfaces on new developments/upgrades from single family homes to triplexes etc. within the urban centre are applied.

Mapping net habitat gains and green infrastructure projects to monitor targets and track success.

Set and measure specific performance targets that guarantee a net gain from all development applications.

Maps and information were not in alignment.

It was noted by long-time residents who are members of ARMS and are familiar with the watersheds that the maps included in the report did not align with the written content of the report relating to fish bearing streams.

Ensure most up to date maps and data regarding fish bearing streams are included in the final report. ARMS would be happy to support the city with this task.

Approach stormwater management from a lens of "every stream is a fish bearing stream" if provided with the correct environment and the ISMP will work to ensure fish are provided with the habitat to succeed.

We wish to thank the City of Maple Ridge for the opportunity to provide our input to this draft Integrated Stormwater Management.

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Email from Alouette Valley Association - June 7, 2021

INTEGRATED STORMWATER MANAGEMENT PLAN

SOUTH ALOUETTE & KANAKA CREEK

Comments and Suggestions

5 EXISTING DRAINAGE SYSTEM PERFORMANCE

At one time the city did make an effort to develop green infrastructure in Silver Ridge. The reports notes that this is effective and working as designed. Unfortunately, with a lack of maintenance on the swales and detention ponds the new infrastructure cannot be expected to work.

Cost of maintenance should be built into the tax structure for newly developed areas.

8 LAND USE PARAMETERS

Too much pervious land is being covered by blacktop, concrete and roofs. Developers and homeowners need to be restricted as to how much blacktop, concrete etc. is used in their driveways and pathways. A percentage of each lot should be mandated as permeable. Permeable green-roofs should be encouraged and incentivized. The city should also use permeable materials when building new roads, sidewalks and pathways.

Permeable materials need to be mandated such as:

Unit Pavers

These consist of interlocking concrete paving blocks separated by narrow gaps (pores) which are filled with sand and/or gravel, as specified by the manufacturer. These gaps allow stormwater to drain into a stone filled reservoir base below the surface, and then into the underlying soils. If the native soil below the paved area has poor permeability, the reservoir can be designed to store rainwater. Typically, overflow from extremely large storms is conveyed to municipal drainage systems off-site. Permeable pavers are most often seen in use for private driveways, walkways, parking areas at the edge of roadways and parking lots. They are not considered appropriate for heavy volume roads and highways.

Grass Pavers

Grass pavers consist of concrete cells or a strong plastic grid system with large pore spaces filled with a growing medium planted with grass or a low growing herb. This type of product is often used in low-traffic vehicle movement areas such as fire access lanes, long term parking slots and private driveways. Areas often include reservoir bases and underdrain systems similar to unit pavers.

Gravel Pavers

These are similar to grass pavers except that the growing medium is replaced with gravel and no plant materials are used. The look is similar to a simple gravel parking lot but the grid system helps keep gravel pieces in place over time, preventing ruts and worn spots.

Permeable Asphalt

This pavement consists of an open-graded coarse aggregate, bonded together by asphalt cement, with sufficient interconnected open spaces to make it highly permeable to water.

Permeable Concrete

This concrete has a much larger than usual void space, with little or no "fines" material in the mix. This allows water and air to move quickly through the material to the soils or the base layer below. It typically consists of specially formulated mixtures of Portland cement, uniform, open-graded coarse aggregate, and water. Porous concrete has been used on highways to reduce hydroplaning.

https://www.crd.bc.ca/education/stormwater-wastewaterseptic/green-stormwater-infrastructure/permeable-paving

10 EFFECTS ON WATERSHED HEALTH

Figure 10.1 - Effects of Land Use on Hydrology and Watercourse Erosion



The figure is a good graphic showing the effects of development on our streams.

We have seen this effect up and down the North Alouette and South Alouette Rivers. Much erosion occurs during high rainfall events. As the banks are eroded trees fall into the rivers and create blockage points. Huge gravel deposits made up of large river rocks have also moved downstream choking off tradition spawning areas. A lot the river rock is ending up plugging bridges increasing flood risk at high river flow. Currently there is no policy for dealing with trees that fall into and block the river. The city needs to allocate funds to monitor and deal with this problem. Removal of a few trees a year would not be very expensive with neighborhood cooperation. Residents and AVA are almost always happy to cooperate with the city to remove dangerous blockages. Much of the flooding experience over the few years has been as a direct result of river blockages. In the past politicians have blamed residents for "living on a floodplain" but clearly development has played a major role in the damage to the river systems that results in flooding and spawn bed damage.

The executive summary suggests:

"Conduct erosion and bank stability monitoring. Budget will depend on the extent of the watercourses monitored. Recommend that monitoring occur in fall and winter before vegetation growth to improve visibility."

We believe this is a good idea and can be easily accomplished with the help of residents who live on the rivers and drones for the more isolated areas.

The report does make this a low priority but given the amount of flooding that occurs every year we feel it should be a high priority and money much better spent than yet another consultant report on flooding after the inevitable next event.

Bruce Hobbs AVA Letter from BC Conservation Foundation - Wildsafe BC - November 30, 2020

Dear Mr. Dingwell,

Thank you very much for giving WildsafeBC the opportunity to give input on the ISMP. I found the document beneficial in understanding all the factors that goes into city planning. My comments below address the benefits of a proper wildlife corridor.

Maple Ridge is in the final stages of completing all the elements to achieve Bear Smart status. One of the requirements is for the city to have a comprehensive plan for the safe movement of wildlife within its city's limits. Properly planned wildlife corridors are essential for the safe movement of wildlife. The suggested minimum distance for a wildlife corridor based on the topography of Maple Ridge is 50 to 100 meters (see attached buffer ranges). In older established neighborhoods this distance was not always achieved. Hopefully, when new developments are created this standard will be seriously considered.

My other suggestion is when replacing culverts to make them large enough for safe passage of bears. In 2019 we had 5 bears hit by cars. If there's a safe passage for them, then this number could be reduced and thereby increasing public safety.

I understand that every organization has a wish list which creates a challenge in creating an effective ISMP that benefits all stakeholders. According to Paul Beier, Dan Majka, Shawn Newell, Emily Garding, Northern Arizona University January 2008 Best Management Practices for Wildlife Corridors there are 16 steps to consider when establishing a wildlife corridor.

Mitigation for Urban Barriers 1) Integrate the Linkage Design into local land use plans. Specifically, use zoning and other tools to retain open space and natural habitat and discourage urbanization of natural areas in the Linkage Design. 2) Where development is permitted within the linkage design, encourage small building footprints on large (> 40 acre) parcels with a minimal road network. 3) Integrate this Linkage Design into county general plans, and conservation plans of governments and nongovernmental organizations. 4) Encourage conservation easements or acquisition of conservation land from willing land owners in the Linkage Design. Recognizing that there may never be enough money to buy easements or land for the entire Linkage Design, encourage innovative cooperative agreements with landowners that may be less expensive (Main et al. 1999, Wilcove and Lee 2004). 5) Combine habitat conservation with compatible public goals such as recreation and protection of water quality. 6) Each strand of the linkage design must be broad (typically 1-2 km for most of its length) to allow a designated trail system without compromising the usefulness of the linkage for wildlife. Because of the high potential for human access, the trail system should be carefully planned to minimize resource damage and disturbance of wildlife. People should be encouraged to stay on trails, keep dogs on leashes, and discouraged from collecting reptiles and harassing wildlife. Traveling in groups should be encourage in areas frequented by mountain lions or bears. 7) Where human residences or other low-density urban development occurs within the linkage design or immediately adjacent to it, encourage landowners to be proud stewards of the linkage. Specifically, encourage them to landscape with natural vegetation, minimize water runoff into streams, manage fire risk with minimal alteration of natural vegetation, keep pets indoors or in enclosures (especially at night), accept depredation on domestic animals as part of the price of a rural lifestyle, maximize personal safety with respect to large carnivores by appropriate behaviors, use pesticides and rodenticides carefully or not at all, and direct outdoor lighting toward houses and walkways and away from the linkage area. 8) When permitting new urban development in the linkage

area, stipulate as many of the above conditions as possible as part of the code of covenants and restrictions for individual landowners whose lots abut or are surrounded by natural linkage land. Even if some clauses are not rigorously enforced, such stipulations can promote awareness of how to live in harmony with wildlife movement. 9) Develop a public education campaign to inform those living and working within the linkage area about living with wildlife, and the importance of maintaining ecological connectivity. 10) Discourage residents and visitors from feeding or providing water for wild mammals, or otherwise allowing wildlife to lose their fear of people. 11) Install wildlife-proof trash and recycling receptacles, and encourage people to store their garbage securely. 12) Do not install artificial night lighting on rural roads that pass through the linkage design. Reduce vehicle traffic speeds in sensitive locations by speed bumps, curves, artificial constrictions, and other traffic calming devices. 13) Encourage the use of wildlife-friendly fencing on property and pasture boundaries, and wildlife-proof fencing around gardens and other potential wildlife attractants. 14) Discourage the killing of 'threat' species such as rattlesnakes. 15) Reduce or restrict the use of pesticides, insecticides, herbicides, and rodenticides, and educate the public about the effects these chemicals have throughout the ecosystem. 16) Pursue specific management protections for threatened, endangered, and sensitive species and their habitats.

Properly planned wildlife corridors of 50 to 100 meters are also beneficial to the water quality of streams and rivers.

There has also been some consideration of, but very limited research on, changes related to the evolution of the buffer itself over time. Murcia (1995) hypothesizes that buffers to wooded or forested systems may play an important role for a newly created edge, but less of a role over time as that edge "hardens". In cases where a newly planted buffer is being installed around a watercourse or wetland, time can be beneficial insofar as the establishment and growth of herbaceous and woody vegetation can help improve water quality. For example, Vellidis et al. (2003) documented significant improvements in wetland water quality from a 38 m buffer over a nine year period, while Yamada et al. (2008) documented improvements in groundwater quality within three years of planting a 25 m buffer along a stream in an agricultural setting. A thesis (Orzetti 2005, as cited in Okay 2007) reported that restored forested riparian buffers in the northwestern U.S. begin to show effectiveness after about five years and are hypothesized to increase in effectiveness for 30 to 40 years or longer as the trees mature. Clearly monitoring programs designed over a few years are not going to detect these kinds of changes.

Beacon Environmental Ecological Buffer Guideline Review (December 2012)

Thank you again for including WildsafeBC as part of your input into the ISMP. I have attached two researched documents into buffer ranges and biophysical factors.

Best,

Daniel Mikolay WildsafeBC coordinator Maple Ridge



Table 7. Ranges for buffer widths to natural heritage features based on the current science.

Natural	Buffer Function Category												F	_	
Heritage			_	Е	ε	Ε	Ε	Ε	ε	ε	ε	E	10 1	20 n	
Feature		F	10 n	20	30	40	20	60	70	80	06	10	- -	1	8
Category		< 51	, D	1	21 -		 	51 -	5	7 -	2	5	101	11	9
		-		-											<u> </u>
WATERCO	A Water Quantity		1		4-1-1-		 	J I							<u> </u>
	R. Water Quality	data	Indica	te that	this is	not m	ltigated	i by sh	e spec	anc du	ner				
	C. Screening of Human Dicturbance /	_													
	Changes in Land Use													_	
	D. Hazard Mitigation Zone	shou	ld be l	based	on cor	sidera	tion of	hazar	ds, but	may c	verlap	with b	uffers		_
	E. Core Habitat Protection			_											
WETLAND	S		*												1
	A. Water Quantity	data	indica	te that	this is	not m	itigated	d by sit	e spec	ific bu	ffer				_
	B. Water Quality									_		1			
	C. Screening of Human Disturbance /		1												
	Changes in Land Use														
	D. Hazard Mitigation Zone	shou	ld be l	based	on cor	sidera	tion of	hazar	ds, but	may c	verlap	with b	uffers		
	E. Core Habitat Protection		-				_			_			_	-	
UPLAND W	OODLANDS and FORESTS														
	A. Water Quantity	insufficient data													
	B. Water Quality	insu	fficier	t data			-								
	C. Screening of Human Disturbance /														
	Changes in Land Use												L		<u> </u>
l	D. Hazard Mitigation Zone	shou	ld be i	based	on cor	sidera	tion of	hazar	ds, but	may c	verlap	with b	ouffers	1	
	E. Core Habitat Protection	-						-			-				
MEADOWS															
	A. Water Quantity	insu	fficier	it data	1										
	B. Water Quality	insu	fficier	it data	I										
	C. Screening of Human Disturbance /	insu	fficier	it data	1										
	D Llagerd Mitigation Zana		6 (1.1.)	4 -1 - 1		_									
	D. Hazard Willigation Zone	Insu	πicier	nt data		-									-
	E. Core Habitat Protection					Luci	Land	1	-						2

*data available for area-sensitive grassland birds only

<u>Note 1:</u> In all cases the buffer is to be applied from the Critical Function Zone limit, not strictly the feature boundary.

Note 2: Supporting literature is identified in Appendix A.

Key: Risk of Not Achieving the Desired Buffer Function HIGH MODERATE LOW



Ecological Buffer Guideline Review (December 2012)

Table 9. Supporting literature for key biophysical factors to consider in buffer width determination.

Biophysical Factor*	Increases to buffer widths <i>may not</i> need to be considered	Increases to buffer widths could be considered	Supporting Literature	Comments		
HYDROLOGIC DYNAMICS	Catchment area size small relative to protected feature size (e.g., 100:1)	Catchment area size large relative to protected feature size (e.g., 1000:1 or more)	Adamus 2007; Leavitt 1998	Buffers in and of themselves only have a limited ability to moderate catchment-scale water quantity dynamics; this ability is directly		
	Entry runoff velocity low to moderate	Entry runoff velocity high	Lee et al. 2003; Woodard and Rock 1995	related to the pattern and intensity of flows (Dillaha et al. 1986a, Leavitt 1998, Lee et al.		
	Sheet flow over buffer	Channel flow or buffer bypassed by drainage	Castelle and Johnson 2000; Adamus 2007	2003, Woodard and Rock 1995).		
	Subsurface flow (seeps, high water table)	Flow path to deep or regional groundwater	Angier et al. 2005	Groundwater that manifests itself near the surface can contribute to denitrification.		
SLOPES	Slopes of 0% to 12% towards protected feature***	Slopes of 13% to 15% or more towards protected feature	Wenger 1999; Woodard and Rock 1995; Schueler 1987; Norman 1998; Castelle and Johnson 2000; Adamus 2007	The literature indicates that slopes of more than 12% to 15% tend to result in reduced buffer effectiveness related to water quality functions. Soil type and vegetative cover also factor in to buffer effectiveness on slopes.		
VEGETATIVE COMPOSITION OF BUFFER	A relatively dense herbaceous layer	Sparse herbaceous cover	Hook 2003; Castelle et al. 1992; Wilson and Imhof 1998	Herbaceous cover is generally more effective at attenuation of contaminants in surface runoff (while woody vegetation is generally		
	Presence of trees and shrubs with herbaceous understory	Sparse presence of trees and shrubs with herbaceous understory	Lee et al. 2003	more effective at attenuation of contaminants in sub-surface runoff). Treed buffers also provide a better screen for light, wind, noise as		
	Presence of coniferous trees and shrubs	Presence of deciduous trees and shrubs	Brown <i>et al.</i> 1990; Lowrance and Sheridan 2005; Knight et al. 2010	well as better erosion control. Coniferous buffers provide these functions all year round.		
	Presence of woody debris	Absence of woody debris	Sheldon et al. 2005	Relates to water quantity and quality control by slowing flow pathways.		
SOILS	Larger textured soils (e,g, sand, loams)	Finer textured soils (e.g., clays)	Brown <i>et al.</i> 1990; Wilson 1967; Sullivan <i>et al.</i> 2007;	Relates to water quantity and quality control by influencing local permeability and infiltration		
	Soils permeable but not highly sandy	Compacted soils and/or soils with low permeability	Polyakov et al. 2005	rates. Organic matter also contributes to denitrification.		
	Soil with organic matter, humus or mulch layer	Soil without organic matter, humus or mulch layer	Mayer <i>et al</i> . 2006; Gift <i>et al.</i> 2010; Bradley <i>et al</i> . 2011			

* Biophysical factors have the potential to interact with and influence each other, and therefore should not be considered independently

— Page 101

Email from the Ministry of Environment – May 7, 2021

These comments focus exclusively on groundwater related aspects of the report.

Section 2.3 – Provincial Legislation: Could include the Groundwater Protection Regulation, which is separate from the WSA and accompany regulations.

Section 2.3 – Provincial Guidelines: Could include the 2014 guidance document on underground infiltration https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=50288

The aquifer vulnerability ratings in Tables 4.7 and 4.9 are inconsistent with ratings in the provincial aquifer database for several aquifers. This should be reconciled, or explanation should be added indicating the vulnerability ratings are based on independent analysis and differ from the provincial database.

- Table 4.7: Aquifer 38 is listed with a moderate vulnerability in the provincial aquifer fact sheet. <u>https://apps.nrs.gov.bc.ca/gwells/aquifers/38</u>. | do agree that a high vulnerability rating may be more appropriate for an unconfined S&G aquifer.
- Table 4.9: Aquifer 19 is listed with a moderate vulnerability in the provincial aquifer fact sheet. https://apps.nrs.gov.bc.ca/gwells/aquifers/19
- Table 4.9: Aquifer 154 is listed with a moderate vulnerability in the provincial aquifer fact sheet. https://apps.nrs.gov.bc.ca/gwells/aquifers/154
- Table 4.9: Aquifer 883 is listed a retired in the aquifer database. This aquifer should be removed from Table 4.9. <u>https://apps.nrs.gov.bc.ca/gwells/aquifers/883</u>
- Table 4.9: Aquifer 26 is listed with a moderate vulnerability in the provincial aquifer fact sheet. https://apps.nrs.gov.bc.ca/gwells/aquifers/154

Section 5.1. This section notes known issues in summer base flows. You could consider adding discussion to the report (in an appropriate section) on the role of groundwater in sustaining summer base flow and the importance of groundwater discharge in supporting aquatic habitats, including providing thermal refuge for spawning and rearing salmon, e.g. see following links. https://www.watershed-watch.org/publications/files/Groundwater+Salmon++hi+res+print.pdf https://watershedwatch.ca/wp-content/uploads/2011/02/Groundwater-WWSS-Nov2009.pdf This discussion could be linked to the potential impacts from urban development on reduction of infiltration and groundwater recharge and the importance of infiltration BMPs. You could also consider identifying important groundwater recharge areas or groundwater dependent ecosystems (perhaps with the aid of your calibrated model?). You may have done this indirectly with your soil group designations, but it could be more explicit in terms of identifying important GW protection areas. If this were possible, such areas could receive special consideration or emphasis on the protection of groundwater quality and recharge and the use of infiltration BMPs. The two comments below were prepared before reaching discussion on pg 192. Glad to see you incorporated information from the provincial guidance on underground infiltration.

Section 13.1.3, Siting requirement No 5 states: "Infiltrators must be a minimum of 30m from a source of water (well)." Note, the 2014 Provincial guidance on underground infiltration recommends a setback distance of 60m from water wells for underground infiltration systems, which is consistent with the Municipal Wastewater Regulation. A protective setback largely depends on sight specific conditions and a minimum setback requirement may or may not be protective. You could consider adding flexibility to require greater setbacks at the City's discretion to address high risk situations.

The provincial document also provides guidance on land use exclusions, water table separation distance, pre-treatment, and other setbacks. This guidance is provided from the perspective of protecting groundwater quality and may exceed the city's design requirements. You could review and consider the applicability of this guidance for local use.

Section 13.1.4, Groundwater Protection – states: "Infiltration should be separated from drinking water wells, against both surface water intrusion and ground water pollution. Currently, Provincial regulation requires a minimum of 30.5m of horizontal separation." Please reference the provincial regulation.

Pg. 188, second paragraph. Good description of risks to GW. Other risk factors you could include are the depth to groundwater, land use practices, and solubility of contaminants.

Email from BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development – May 28, 2021

South Alouette/Kanaka ISMP

	Description	Comment/Question
Section		· · ·
P. 21	Pesticide Use Control Bylaw	Consider amending bylaw to include uses of detergent to treat anything – per Clayburn Creek mis-hap (https://bc.ctvnews.ca/powdered-detergent- responsible-for-kilometres-long-trail-of-foam-in-abbotsford-creek- 1.5410133)
194	Valid hardship	Is there a definition or clarification of what is acceptable or "valid hardship"?
199	Enforcement of ESC Bylaw	How effective is enforcement of ESC Bylaw? (ensuring ESC Plan is intact, functional, being followed, etc?)
200	Cash in lieu	Agree that cash in lieu should be avoided at all costs and original habitat be protected, (ie canopy in riparian areas; stream health is dependent on this and planting/restoring habitat elsewhere does not always result in functional habitat
202	Watershed networks	Agree, this is highly important for watershed integrity and health
214	Inspecting 20% of watershed	Good idea – how to plan and implement this to ensure it is achieved? What will the inspections look like? Will fines be involved if non-compliant with original plan or not in compliance with bylaw?
216	Tree canopy inspection	This is proposed to be completed using GIS – will recent aerial imagery be obtained and compared over the years (compared to baseline)?
P. 214	"Flow monitoring should be conducted for a one-year period, every five years, at the aforementioned locations, in accordance with the MAMF."	I think this should be done continuously. Build a rating curve, then once that has been established and is considered stable, can verify with spot measurements that the rating curve is still valid. Otherwise will miss variability from year to year and harder to determine if objectives have been met.
220	Promote EFP (Agriculture)	Good idea, but limited funding available through this program. How to expand/promote good environmental farm practices otherwise?
224	Water Level Data	"It is recommended that the City implement a semi-permanent water level (not flow) gauge in low lying agricultural flood plains of Kanaka Creek and the South Alouette River." - What is the goal for using this data?
226	Performance Measures	Good idea to have measurable targets; agree that this is a high priority and should be determined ahead of time.
237	Regulation and Enforcement	Review of watercourse bylaw protections to include agricultural properties and appropriate setbacks with respect to crop location or any land alterations and should include retaining of native vegetation not just a "setback"

238	Asset Management	Information sharing agreement for Hydrometric network, or ability for Province to take over monitoring and maintenance of station
239	Environmental Monitoring	Would be good to consider including upstream (headwaters) and downstream (confluence with next major source) samples to determine if there is an observable trend, also would be good to consider collecting a sample within undeveloped upstream fish bearing reaches of say Kanaka, North and South Alouette as a background to compare values during each sample period.

Executive summary document p37 talks about community response to new developments not considering existing natural drainage

With reference to the general trend of new development eliminating/relocating watercourses in favor of engineered swales, it is noted that the constructed water features don't confer the same habitat and infiltration functions as those they replace. In relation to the overall work on understanding infiltration capacity in the catchment (Section 13.1.2 of the main document), off site compensation in another part of the watershed is the least reliable method of controlling development related flows. Retaining on site tree cover, wetted features (whether ditches, wetlands or otherwise) is the most cost effective and reliable way to control runoff. Many of these features may not be subject to either the RAPR or the WSA and as such, the city may want to consider conferring their own protection standards for "minor" watercourses related to stormwater goals.

Main document p239 and other references throughout section

NS.

In regard to Erosion monitoring as an indicator of implementation effectiveness, the extent to which this can be attributed to increased development stormwater run off as opposed to other hydromorphological controls in the catchment is unclear. The dam on the Alouette catchment could be a significant factor in depriving the downstream watercourses of sediment which would manifest in increased bed and bank erosion. I would think the effects of this would be evident in a longer baseline dataset as the watercourses may have adapted their form to this lack of sediment over time. It is worth bearing in mind when designing a monitoring protocol whether this influence can be separated out.

In addition on the same issue, bed erosion is typically more difficult to monitor than bank erosion which is not only more visible but often easier to link to specific point source inputs – e.g. widespread bank erosion directly below large capacity outfall. Changes in the channel cross section are often more obvious in the longer term (10+ year cycles) and not as easy to attribute to specific factors in the catchment. If there is a good baseline dataset for bed profiles as such may not yield useful data to evaluate the effectiveness.

ATTACHMENT J



Joe Dingwall Manager of Utility Engineering City of Maple Ridge 11995 Haney Place Maple Ridge, B.C. V2X-6A9

May 31, 2021

Dear Joe:

We have reviewed the Draft Report for the South Alouette and Kanaka Integrated Stormwater Management Plan, by Urban Systems. We find this document to be exhaustive and very comprehensive, and we are pleased with it. We support this document, and consequently ask that the City of Maple Ridge formerly adopt the principles that are in this document.

Sincerely

ROSS DAVIES

<u>www.keeps.org</u> Facebook: https://www.facebook.com/KanakaEducationAndEnvironmentalPartnershipSociety/

Email from Thornhill Aquifer Protection Society (TAPS) - May 28, 2021

Hi Joe,

I would like to share some observations regarding your invitation and request for TAPS to become involved in the ISMP reports from the membership and then I will forward some thoughts regarding TAPS' involvement.

1. Spencer Creek- is already in poor condition, stringent measures need to be taken.

- the City is not doing enough

2. Combining watersheds does a disservice to the individual watershed as well different consultants were hired for each project.

3. Exceedances of water are frequent with no direct measures for source control

4. The current Stormwater practices do not appear to be sufficient even though it is subject to improved Stormwater practices.

5. The ISMP needs to be clear on its primary goal of "no-net-loss" and be willing to identify examples of net loss.

6. Conveying the community desire to Council will be important to ensure that environmental policy, monitoring programs and capital investments are appropriate to the scale of the task at hand.

7. TAPS' focus is on the Grant Hill Aquifer and Watershed, so it is important to see how the Engineering department is managing the Kanaka and Alouette watersheds through the ISMP and consultants' report. If the results of the report includes suggestions and follow up and the City is not acting on those suggestions, then there appears to be a failure to follow through.

8. TAPS is very concerned regarding Council's direction to put Light Industrial onto our vulnerable aquifer. ISMP will be critical to ensure that the well dependent residents' water source is not contaminated by this development and that the water quantity is not adversely affected.

9. The Engineering Department is directed by Council, so TAPS' concern lies with how effective the Engineering Department will be in providing the necessary information to Council to avoid these impacts and how TAPS can influence Council's direction.

The comments we have received from the membership indicate that an active involvement at this time is not the direction they would like to pursue. The City can be assured that we are all watching and evaluating the results and recommendations regarding the other two watersheds.

However, when you start looking at the Grant Hill aquifer and watershed, we would appreciate notice and how we can be of assistance and become more closely involved.

I did ask TAPS how they felt about sharing the reports we have received and they were reticent in sharing them at this time. Note that the planning department will have received many of those reports during the OCP public hearings in 2005/2006.

We also have reports that TAPS has paid for, which we will not be sharing at this time.

Please keep us informed as to the decisions that may affect our watershed. In the interest of time, which we all seem to have less of, many find the commitment required is more than can be given at this time. We appreciate your thoughts of including us and we will always be open to discussions in the future.

Sincerely, Betty & Klaus von Hardenberg On behalf of TAPS

Email from UBC Malcolm Knapp Research Forest – May 3, 2021

Hi Joe,

Rob and I have both reviewed your draft, and found it to be a very good document and very informative for us.

We appreciate the opportunity to be involved in the review process and we would be happy to review any future plans or implementations that may affect us.

All the best,

Paul

Paul Lawson Director, University Research Forests Faculty of Forestry The University of British Columbia | Malcolm Knapp Research Forest | ģíćəý Traditional Territory 14500 Silver Valley Rd. | Maple Ridge BC | V4R 2R3 Canada Phone 604 463 8148 press 1 - 102 | Cell 604 341 2168 | Fax 604 463 2712 Paul.lawson@ubc.ca mkrf.forestry.ubc.ca | afrf.forestry.ubc.ca | loonlake.ubc.ca | gallant.forestry.ubc.ca | wildlearnings.ca



THE UNIVERSITY OF BRITISH COLUMBIA

ATTACHMENT M





FINAL REPORT Blaney, North Alouette, and Fraser River Integrated Stormwater Management Plan

Our File 173.188 October 2021

Submitted by:



KERR WOOD LEIDAL



Executive Summary

This report presents an Integrated Stormwater Management Plan (ISMP) for the Blaney Creek, North Alouette River, and Fraser River watersheds in the City of Maple Ridge.

The Blaney Creek watershed is approximately 2,574 ha; it drains several smaller lakes and runs approximately 8.8 km from its headwaters before it joins the North Alouette River. The watershed is largely forested and includes important ecosystems such as the UBC Malcolm Knapp Research Forest, Blaney Bog Regional Park Reserve and much of the Codd Island Wetland Ecological Conservancy Area. The south portion of the watershed consists of large agricultural lots and development areas within the Urban Containment Boundary (UCB); impervious land makes up only 5% of the watershed.

The North Alouette River watershed is approximately 3,983 ha. The river has several tributaries along its upper 8 km and flows through a densely wooded canyon, before forming a meandering channel across the uplands plain, finally turning into 5 km of a slough-like stream that has been dredged and diked, prior to converging with the South Alouette River. The watershed is mostly forested, and includes portions of the Malcolm Knapp Research Forest and Golden Ears Park in the upper watershed. The North Alouette Regional Greenway and a portion of the Codd Island Wetland Ecological Conservancy Area are located in the lower watershed, which includes suburban residential areas and land that is part of the Agricultural Land Reserve (ALR). The North Alouette River is prone to flooding downstream from 232 Street.

The Fraser River watershed is the smallest of the three watersheds at 342 ha and is fully developed and entirely within the UCB; 57% of the land cover is impervious. There are approximately 4 small tributaries to the Fraser River within the catchment in addition to piped drainage. The watershed includes an area southwest of the Haney Bypass that is within Kanaka Creek Regional Park. To manage geotechnical risks on the Fraser River Escarpment, the City has an existing policy that sets out controls for water discharge for a portion of this watershed that borders the Fraser River.

The ISMP Objectives and Process

The purpose of this ISMP is to provide guidance and information on how to proceed with future land development and re-development while protecting and enhancing the overall health and natural resources of the study creeks and watersheds.

The ISMP process has been consistent with the Metro Vancouver Integrated Stormwater Management Plan Terms of Reference Template (2005), meeting at least the minimum level of effort clauses outlined in the template, and has included stakeholder consultation to inform, engage, and consult the public, external stakeholders, City staff, and Council.

Initial Stakeholder Consultation

Stakeholder consultation meetings were incorporated to present information and findings and to obtain input and feedback. Initial meetings were held with representatives from several City departments as well as members of the Alouette River Management Society, and members of the Alouette Valley Association. Watershed knowledge and input on key issues and potential solutions and alternatives were solicited, and both written and verbal feedback was received, documented and addressed to the extent possible given the limitations of the ISMP study process.

Public outreach for the ISMP was accomplished via an online survey open to all City residents and announced via several platforms.

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Stakeholder Outreach on the Draft Report

Outreach at the draft report stage included the following groups:

Groups Invited to Comment

- Agricultural Land Commission (ALC)
- Alouette River Management Society (ARMS)
- Alouette Valley Association (AVA)
- BC Conservation Foundation (Wildsafe BC Program)
- City of Maple Ridge Environmental Advisory Committee
- City of Maple Ridge Staff from multiple departments
- City of Pitt Meadows
- Department of Fisheries and Oceans Canada (DFO)

- Katzie First Nation
- Kwantlen First Nation
- Metro Vancouver Regional Parks
- Ministry of Agriculture, Food and Fisheries
- Ministry of Forests, Lands, Natural Resource Operations and Rural Development
- Morningstar Homes
- UBC Malcolm Knapp Research Forest
- Wayne Stephen Bissky Architecture Urban
 Design Incorporated

All groups were provided with a link to the Draft Report and invited to have a meeting including a short overview presentation of the ISMP, an opportunity to ask questions and provide verbal or written comments. 13 stakeholder groups provided feedback. That feedback improved and enriched the Final version of the ISMP Report.

Background Review

A review of existing conditions and data included an initial summary of the watersheds' characteristics and a review of existing bylaws and criteria to manage stormwater and drainage, including municipal, provincial, and federal guidelines and regulations. Key drainage issues and environmental concerns were obtained from background documents and initial stakeholder input. These pertained to ongoing river flooding, erosion, undersized drainage infrastructure, impacts of recent and future development and the need for protection of fisheries and other environmental values. These issues were reviewed and considered during the work on the ISMP. Additional issues and concerns were raised during the stakeholder review of the Draft report and were considered and addressed as well, to the extent possible in this project, through recommendations for actions, additional work, and collaboration with others.

Field Drainage Inventory

The desktop review of existing data and documents was followed by a field drainage inventory of drainage features and infrastructure. The inventory was limited to areas of importance based on community observations and previously submitted reports outlining areas of concern including for example flooding, erosion, deposition and obstruction sites, as well as areas where field data could be collected to be used for modelling purposes.

Severe erosion was observed at three sites with potentially high risk hazard and related high consequences. However, the rate of erosion throughout the watershed seems normal and the consequences of the erosion sites appear to be minimal. Also, no anthropogenic obstructions were observed in the field.

KWL also undertook survey of culverts and manholes in the watersheds to fill in gaps in available data provided by the City. In particular, the survey targeted culverts and storm manholes where missing information would make modelling of these pieces of infrastructure difficult or the results unreliable.

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Environmental Assessment

KWL completed a desktop review, field inventory, and assessment of environmental values in the study watersheds including aquatic species and habitats, riparian and watershed forest cover, terrestrial species and habitat, and water quality. The purposes of the assessments were to assess status and trends in watershed health; identify priority environmental issues to be addressed; and identify environmental enhancement opportunities. The Blaney Creek and North Alouette Watersheds contain diverse and regionally unique terrestrial and wetland habitats. For example, Blaney Bog and Codd Island Wetlands provide high quality habitat for many rare and endangered flora and fauna. North Alouette River and Blaney Creek watersheds provide excellent spawning habitat and extensive areas of rearing habitat for salmon and trout. Coho and chum salmon, coastal cutthroat trout, rainbow trout/steelhead, and well as other fish species have been recorded in these watersheds. The Fraser River catchment provides little spawning and rearing habitat and only coho salmon and threespine stickleback have been recorded in this catchment. Water quality in North Alouette tributaries is generally good, but Cattell Brook has had several water quality issues and the Fraser River tributary had poor water quality.

Based on the review of background information, field habitat assessment, and stakeholder engagement, several priority concerns and recommendations for protecting fish and aquatic habitat within the watersheds were identified.

Watershed Health Tracking

The health of a watershed is estimated based on the Watershed Health Tracking System (WHTS), outlined in the ISMP Template. The WHTS is a tool for assessing watershed health based on measuring three characteristics – the total impervious area (TIA, %), riparian forest integrity (RFI, %), and the diversity and abundance of creek bed taxa expressed as the Benthic Index of Biological Integrity (B-IBI, measured and predicted) – of any given watershed. The higher the RFI and the lower the TIA, the higher B-IBI scores should be, and the better the watershed health. Anderson Creek had a mean B-IBI score of 34.7 and 44 taxa of invertebrates. The North Alouette had a mean B-IBI score of 24.0 and 32 taxa. Biological conditions were 'fair' in Anderson Creek and 'poor' in the North Alouette River, based on the biological condition rankings found in the MAMF that correspond to these B-IBI scores. The B-IBI scores for both Anderson Creek and North Alouette River indicate relatively healthy watersheds. Higher than predicted B-IBI score for Anderson Creek may suggest that stormwater source controls used in the Silver Valley developments in this watershed have been effective at offsetting at least some of the impacts of that development. If future increases in impervious area are not mitigated, the watershed health would be expected to decrease. The measured score for North Alouette River is lower than predicted, indicating the watershed health is not as robust as would be expected given the large forested areas of the upper watershed.

Existing and Future Conditions Drainage Assessment

To assess the capacity of the drainage system, PCSWMM was used to simulate the watershed hydrology and upland hydraulics for pipes that are 400 mm in diameter and larger. The existing conditions model was calibrated and validated using flow monitoring data collected at five flow monitoring locations in the watersheds. As per the City's Design Criteria Manual, design storms were used to assess pipe capacity and real storm events were used to assess the detention facility performance.

In the minor system, modelled flows exceeded the design criteria for the 10-year existing land use instantaneous peak flows in 7.9% of the total pipe length (corresponding to 27 out of 329 pipes). In the major system, flows exceeded the design criteria for the 100-year existing land use in 2.6% of the total pipe length (corresponding to 9 out of 38 pipes). Culverts were assessed for the 10-year conveyance capacity for driveway culverts, 100-year conveyance capacity for creek culverts and 200-year conveyance for culverts under arterial roads; 34% of the culverts (16) were identified as undersized under the existing conditions. Nine existing detention ponds were assessed. One of these has inadequate volume for existing conditions and five ponds will likely require adjustments to meet capacity criteria under future development and climate change conditions.

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The future land use was developed by using OCP GIS data and any neighbourhood/community planning land uses. Land expected to develop/re-develop under the OCP and within the time horizon were considered and special attention was given to parcels designated as 'Eco-Cluster', where green spaces are set aside to a high degree. The future impervious areas of the Fraser River, North Alouette River and Blaney Creek watersheds were estimated at 62, 10, and 12%, respectively.

The major and minor conveyance system was evaluated for future land use conditions using the same criteria as for the existing conditions. The future conditions assessment without climate change resulted in 1 additional pipe exceeding the minor system design criteria 10-year peak flow and 1 additional pipe exceeding the design criteria for the major 100-year peak flow. Future conditions were also assessed taking climate change into account, by increasing the rainfall amounts by 10% and 20%, representing predicted climate change effects in years 2050 and 2080, respectively. The future conditions assessment under the effect of climate change in 2050 resulted in peak flows exceeding the minor system design criteria in 10.2% of the total pipe length, and the major system design criteria in 3.9% of the pipes (including existing deficiencies). For the 2080 scenario (+20% rainfall), minor system design criteria were exceeded in 12.2% of the total pipe length, and in 3.9% of the pipes in the major system. Under unmitigated future conditions with climate change there are 2 additional culverts that do not meet the assessment criteria in the 2050 scenario and 2 more that do not meet the assessment criteria in the 2050 scenario and 2 more that do not meet the assessment criteria under 2080 conditions. The increased rainfall also results in poorer performance of the detention ponds; under 2080 climate change conditions all of the 9 ponds have inadequate volumes.

Detention Facility Assessment

Detention facility simulations were completed to estimate the effectiveness of the flow control facilities and to understand which facilities may need to be upgraded under the existing, future land use, and future land use plus climate change scenarios. At four facilities, water levels would exceed their banks under 100-year design storm simulation. These facilities most likely do not require large modifications; a detailed study of safe overland flow routes due to flooding at a facility would be an option for those facilities. The Silver Valley Walkway facility may require modifications such as removing a flow control plate or reducing overflow levels to prevent flooding during smaller design storms. It is not clear that changes to the existing detention facilities are required, only that they may be warranted based on the high-level assessment in this ISMP.

Vision for the ISMP

Part of the ISMP process involves setting the overall goal for the health of the watershed as a vision statement. The Vision for the longer-term health of the Blaney, North Alouette and Fraser River watersheds was developed by considering existing goals and opportunities within City documents, incorporating the intent and purpose of the ISMP process, and input from City staff from multiple departments.

The ISMP incorporates the five priorities of the City's Strategic Plan 2019-2022:

- 1. Community Safety
- 2. Intergovernmental Relations
- 3. Growth
- 4. Community Pride & Spirit
- 5. Natural Environment

¹ Climate change predictions will vary over time as the global climate models underlying the rainfall predictions are updated and climate conditions continue to evolve. These values are benchmarks for the given planning horizons at the time of the study.



The following ISMP Vision Statement was developed.

In a City inspired by nature, we aspire to:

- Preserve and improve the health of the watersheds where we live, work, and play while we allow for development as planned in our Official Community Plan.
- Prepare for changes in climate and weather patterns and work to ensure the safety of our communities within our watersheds.

Recommendations

In order to address the challenges and concerns for mitigating impacts of development and protecting and enhancing watershed health for the future, a suite of recommendations was developed. After extensive stakeholder consultation on the Draft Report, further recommendations and clarifications were added to address stakeholder concerns. The resulting recommendations form the 'plan' for the ISMP and are summarized as follows.

Capital Upgrade Program for Drainage Infrastructure

Potential infrastructure upgrades are proposed for undersized infrastructure in the minor or major drainage system under both existing and future conditions. The potential projects in this capital upgrade program provide planning-level budgets that cover preliminary and detailed designs and construction in current day costs. Potential upgrades to storm sewer infrastructure have been prioritized by considering whether a pipe is part of the major or minor system, the severity of surcharging at the inlet of a pipe, and the relative magnitude of upgrades required. Highest priority is given to recommended upgrades in the existing major drainage system where adequate conveyance or detention volume is not provided for the existing land use 100-year event or 200-year event for culverts under arterial and collector roads. It is recommended that infrastructure condition be assessed and infrastructure in poor condition be integrated into this priority. Priority 2 upgrades are minor system infrastructure where adequate conveyance is not provided for the 10-year event under existing land use. Priority 3 upgrades are minor or major system infrastructure that adequately convey flow under existing land use conditions but cannot convey flow under future land use with or without climate change. A Class 'C' Cost Estimate was completed for the pipes and culverts that were identified as having insufficient capacity for their required storm events. Storm sewer and culvert upgrade cost estimates are summarized as follows:

Priority 1 – Short Term Plan	
Fraser Watershed Storm Sewer (5 conduits)	\$3,623,000
Blaney Watershed Storm Sewer (4 conduits)	\$1,161,000
Fraser Watershed Culverts (1)	\$1,412,000
Blaney Watershed Culverts (2)	\$719,000
North Alouette Watershed Culverts (1)	\$214,000
Priority 1 Total	\$7,129,000
Priority 2 – Medium Term Plan	
Fraser Watershed Storm Sewer (27 conduits)	\$7,915,000
Fraser Watershed Culverts (1)	\$200,000
North Alouette Watershed Culverts (1)	\$117,000
Priority 2 Total	\$8,232,000



Priority 3 – Long Term Plan	
Fraser Watershed Storm Sewer (12 conduits)	\$2,572,000
Blaney Watershed Storm Sewer (4 conduits)	\$745,000
North Alouette Watershed Storm Sewer (4 conduits)	\$996,000
Fraser Watershed Culvert (1)	\$536,000
North Alouette Watershed Culvert (2)	\$633,000
Priority 3 Total	\$5,482,000
Watershed Summary	
Fraser Watershed Total Cost	\$16,258,000
Blaney Watershed Total Cost	\$2,625,000
North Alouette Watershed Total Cost	\$1,960,000
Total Cost	\$20,843,000

The City is recommended to consult with Wildsafe BC on priority locations for potential sizing of culverts to accommodate safe bear passage.

The modelling of the drainage system completed for this ISMP has limitations in the level of detail incorporated due to the watershed-scale size of the models as well as use of a single modeling scenario for Tier A/B attainment. The City is recommended to develop sub-watershed (200 - 300 ha) Master Drainage Plans (MDPs) to further examine the issues, emerging trends and upgrades needed in each catchment.

The City has identified that there is only limited information on overland flood paths for the 100-year event in existing urban areas. It is recommended that the City consider a future project to assess and review major overland flood paths using a risk assessment framework.

It is recommended that the City continue with implementing the flood protection plans as recommended in the North Alouette and South Alouette Rivers Additional Floodplain Analysis report completed by NHC in 2016.

For areas where there is no existing drainage servicing, it is recommended the City undertake drainage plans for these areas in accordance with the discussion in Section 12.4.

Bylaw and Policy Recommendations to Mitigate Impacts

The City should continue to use and implement the three-tiered approach to mitigation of flows from development and should continue to work with developers and consultants to apply the existing criteria, particularly emphasizing the benefits of multi-return period detention design.

Proper management of stormwater can lead to avoided costs for flooding, reduced needs for infrastructure upgrades, and increased property value. Healthy watersheds can also provide other benefits, so-called ecosystem services, that are necessary for community well-being but that are difficult to monetize, such as water filtration and storage, nutrient cycling, and recreation. By protecting natural areas from development and mitigating stormwater in developed areas using the three-tiered approach, valuable ecosystem services provided by healthy watersheds are also protected. The following enhancements to existing criteria and policies are recommended to support the protection and enhancement of watershed health:

- 1. Implement Tier A and Tier B criteria to mitigate the effects of development. This involves addressing and overcoming the barriers that cause Tier A and Tier B requirements to often fall short of performance targets.
- 2. Update the City's Stormwater Design Criteria Tier A wording and criteria to include elements for improving runoff water quality from vehicle-accessible surfaces.

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- 3. Work with developers to close the gap between the intent of the Tier A and B criteria, and the design of stormwater management practices to achieve the criteria.
- 4. Add other means than infiltration and exfiltration for managing Tier A and B events in the Fraser River Escarpment Area. To meet the performance targets described for Tier C, storm sewers in this area may need to be designed to provide sufficient capacity to convey runoff from 10- and up to 100-year events.
- 5. Apply 2017 Metro Vancouver Baseline guidelines for stormwater management on single-family lots to encourage and support on-lot stormwater management while assisting the design community by providing robust stormwater management design options. These guidelines represent a minimum level of mitigation expected on single-family lots across the region.

It is increasingly recognized that natural systems provide a wide variety of services to society that have significant value. The City of Maple Ridge has a wealth of natural areas that provide benefits and services to the public. It is recommended that the City build up documentation of its many natural assets, linking the assets with the services they provide. An understanding and accounting for natural assets the City relies on can provide support for protection and maintenance of these natural assets similar to how traditional infrastructure is valued, inventoried, maintained and budgeted for.

In addition to the stormwater design criteria improvements recommended above, other recommended enhancements to existing programs and policies for the City's consideration include:

- 1. Continue to utilize the existing policies and bylaws already in place that support and protect watershed health.
- 2. Incorporate climate change in planning and sizing for stormwater infrastructure including sewers, culverts, and detention ponds.
- 3. Promote Green Infrastructure to mitigate impacts of development.
- 4. Develop a pilot program for water quality treatment of road runoff focusing on reducing existing stormwater pollution impacts on sensitive aquatic environments.
- 5. Allow for off-site stormwater management in cases where full on-site stormwater management compliance is not possible.
- 6. Enhance protection of sensitive ecosystems from development and other impacts.
- 7. Protect well capture zones and aquifers from contamination from stormwater infiltration facilities.
- Seek options for implementing bio-engineering methods over rip-rap at interfaces between watercourses and drainage outfall channels.
- Review and revise the City's approach on construction site erosion and sediment control (ESC) to require designers to have ESC-specific training, education and certification and to plan ESC measures based on a quantitative approach such as the Revised Universal Soil Loss Equation (RUSLE).
- 10. Promote regional development planning to better consider regional issues, values, and solutions, by instituting regional planning processes for areas where development is or is expected to be widespread.
- 11. Increase communication and awareness of the City's efforts and programs that support watershed health to improve public confidence in the City's efforts, and improve coordination between the City and stakeholder groups that have close ties to watershed health.



Proposed Environmental Protection and Enhancement Measures

Maintaining and enhancing the health and integrity of the Blaney, North Alouette, and Fraser watersheds will require an overarching strategy, political will, enforcement, participation of all levels of government, and collaboration with stakeholders and people active in the community. A strategy for maintaining and enhancing these watersheds prioritizes avoiding or minimizing impacts to existing natural ecosystems and natural assets.

Based on the assessments completed for this ISMP, there are 26 projects proposed to maintain and enhance watershed health (see Figures 16-1 through 16-3). Seven projects will promote and protect watershed health, and hence are the highest priority. These include protection of:

- 1. Rare and sensitive habitat types located in Blaney Bog and Anderson Creek from future development;
- 2. High quality fish habitat located in Blaney Creek and its tributaries, including Spring Creek and Donegani Creek;
- 3. High quality water within Balsam Creek from potential impacts of future development;
- 4. High quality fish habitat within the Upper North Alouette River from potential impacts of future development;
- 5. High quality water within Birch Creek from potential impacts of future development;
- 6. Rare old growth riparian habitat along Roslyn Creek;
- 7. High quality riparian habitat along North Alouette River and Connector A Creek.

Remaining recommended projects will improve stream or watershed health over and above the existing condition. These projects cover riparian enhancement, stream restoration, erosion repair, fish passage, research, stormwater management, and public engagement efforts.

Monitoring and Adaptive Management

To fulfill provincial requirements to monitor stormwater to assess and report on the effectiveness of ISMP implementation, Metro Vancouver and its member municipalities have developed a *Monitoring and Adaptive Management Framework for Stormwater* (MAMF). Through repeated sampling, watershed health trends and the effectiveness of specific watershed protection measures and management actions can be tracked over time. Using a monitoring and adaptive management approach for ISMP implementation allows for regular feedback on the efficacy of measures recommended in the ISMP and adaptive course-corrections over time.

KWL has proposed a monitoring program for the Blaney, North Alouette, and Fraser River ISMP, including chemical, physical and biological monitoring components that goes beyond the minimum requirements of the MAMF; it includes methods, sites, monitoring frequency, and recommended implementation approach. The primary focus for the first five years after completion of the ISMP will be to implement the proposed monitoring program, further investigate issues identified in 2016 monitoring and baseline analysis, and assess whether results indicate watershed health trends in the right direction or whether enhanced mitigation or management approaches are needed.

Additional water quality monitoring beyond the MAMF requirements includes agricultural runoff testing and inpipe or end-of-pipe monitoring to better understand the pollutant loading that runoff is contributing to receiving streams.

Funding Options

The cost of recommended capital projects has been indicated. Recommended programs have not been costed at this time as they will incur internal costs that will require assessment of internal resources and needs as the programs are developed in detail. Various existing and potential funding sources could be considered for implementing the recommendations of this ISMP. Section 17.3 outlines options for consideration.

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Questions

- 1. Have you experienced flooding in your neighbourhood?
- 2. Are you aware of how natural features are important for drainage?
- 3. Your impression of watershed health (rural areas)
- 4. Your impression of watershed health (suburban areas)
- 5. Your impression of watershed health (urban areas)
- 6. How important is health of watersheds to you?
- 7. What level of investment in drainage improvements would you support?
- 8. Postal Code

Results by Respondent

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
1	Yes. On October 28/19 approx. during a heavy downpour the storm water drain at 10596 245 St. backed up causing considerable damage to my basement suite with eight inches of water. Cause was the outlet pipe for the catch basin located at the end of the SRT Field was clogged by overgrowth due to lack of maintenance.	Yes.	No comment.	Generally poor considering the amount of flooding of streets in the last year. Examples are: Seniors Centre on 224th.and the 225th. & Haney Bypass intersection.	Very poor.See 4, above.	Significant importance	Significant investment	V2W 0A2
2	No	Yes	They are excellent.	Good	They seem fine.	Minor importance	Minor investment	V2W 1C2
3	No	Yes	Fairly healthy except were development has been allowed in the upstream areas.	Fair but could be greatly improved. Would require the city or developers to invest in monitoring flows to determine what actually runoff from storms are and what is the water quality of this runoff.	Poor. Old infrastructure that does not address runoff rates or water quality. Recent downtown improvements could have integrated modern runoff facilities and did not. Not seeing the green infrastructure that should be required with new developments- a rooftop patio with a tree does not cut it.	Significant importance	Moderate investment	V2W 2C2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
4	No	Yes. The odd urban tree makes no difference, which is why the tree bylaw is so ridiculous - forest and parks where there is a a decent amount of vegetation on the other hand do make an impact. I would like to see an increase in planting and parks around any new development - paid for by the developer. Case in point - the sports filed at Arthur Peake has plenty of room around the edges to plant trees that would also assist the residents in screening from the light and noise at night from the field. Instead we have a poorly planted grass verge with terrible drainage in winter.	Generally OK, though building on the flood plain of any significant river/stream ought to be automatically prohibited, not only for the health of the watershed but also because when the river floods (which it will) taxpayers are indirectly on the hook for some of the bailout costs. We could just avoid it altogether and not allow any further construction on flood plains.	I think they are probably OK, though again I remain concerned about building close to streams. The construction that has happened around Cotttonwood, and now continuing close by with development at the end of 232 St seems likely to put more pressure on feeder streams to Kanaka Creek. I am also concerned that these natural watersheds/drainage are also wildlife corridors, or rather were. We should be encouraging developers to enhance some of the existing natural features and ensure separation for wildlife. Sadly we have already encroached too far within the urban and suburban areas, but we can at least, if the will is there, prevent future destruction and erosion in the name of "growth" (which everyone but me seems to think is a good and necessary thing!)	OK - it rains a lot, we get wet. We need to halt the rate of urbanization and say "enough is enough". Maple Ridge is no longer open for developers other than on existing Brownfield sites.	Significant importance	Minor investment	V2X 0G8
5	Yes, during a major rainfall last August/September, our road (228th north of Abernathy) turned into a waterway, with water shooting *out* of the storm drains as they were overwhelmed.	Yes.	The green spaces and waterways in maple ridge are a jewel, but continued further development appears to be greatly encroaching on them, with negative impacts, like increased and extreme waterflows, more debris, less shading, etc. even the required 15-30 m buffer from major waterways for new development appears very loosely enforced, and developments above watersheds tend to raise the water table below them from additional runoff.	Getting worse with more development, see my comment above to #3.	Much worse, as it's more developed, with little green space to absorb rainfall, etc. With increasing effects of climate change, we need to be able to handle storms dropping an inordinate amount of rainfall in a short period of time.	Significant importance	Significant investment	V2X 0N3
6	No	Yes. Stream side buffers are important to reduce the amount of flooding after minor rain events.	Excessive stream side development is degrading the natural flood control.	Excessive stream side development is degrading the natural flood control. Many stream banks can no longer retain enough water to prevent significant siltation and downstream flooding.	Our storm water is directed into the streams and rivers, instead of treatment. Too many people are unaware, or just oblivious, to the consequences of dumping into the storm system. (The Hoy Creek fish kill is a tragic example of this ignorance.)	Significant importance	Moderate investment	V2X 0T2

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	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
7	"My backyard is wet most of every winter. The back boundary has a footing for the fence, which					Significant importance	Significant investment	V2X 1S3
8	prevents drainage. Muddy"	Yes. Silly question	NA	NA	In Hammond, it's not very complete	Significant importance	Significant investment	V2X 1S4
9	Not personally, but it's always a concern for nearby Lower Hammond. We were also horrified to learn the Katzie First Nation Reserve is located on the WRONG side of the dikes, that due to the politics of the day, the dikes go AROUND the outside edge of the reserve and leave their whole reserve extremely vulnerable to flooding. This needs to be rectified ASAP.	YES!! We need more of them!! Nature has spent millennia perfecting the earth's water storage (eg. glaciers) and drainage system and we are destroying it and having to deal with the consequences. Keep the green we have and let it do its job. Add more green. It improves mental health as well as helping with the water cycle.	Forested areas = good, most rural areas = not bad, depending on how much concrete/pavement/building there is.	Not so good - many of the ditches and waterways are covered over and are damaged during construction of roads & new development. NEW developments will be better equipped to deal with drainage and work with/around existing watershed elements, but older developments destroyed everything. We need to do restoration in these areas.	Terrible - look at all the damage done when there was a flash flood. Too much concrete & pavement. Not enough green spaces and permeable surfaces.	Need more information before commenting	Need more information before commenting	V2X 2L2
10	Yes.After heavy rains. 3 to 4 times a year	yes	They have been fine up to this point.	"I am not sure exactly where you are describing. More accurate descriptions would help.		Significant importance	Significant investment	V2X 4A4
11	As a long time resident we know that the soil along the Fraser has a high amount of clay which has and will continue to create a slippage. There is poor drainage to the west of the Town Center. Water floods the basement of some homes and there are no storm drains."	This area seems to function pretty well.				Need more information before commenting	Minor investment	V2X 4J4
12	During heavy rains we regularly get water pooling in our large yard (next to ALR). We are north of 123 Avenue on 208 St.	Absolutely. They are also important for human physical and mental health, supporting biodiversity, and moderating climate change effects.	The forested areas appear to be doing well. I have concerns about the rural areas. I'm not sure that enough is being done to protect these natural features from the effects of urbanization and contamination from farming and other rural land uses.	There are many examples of streams that are paved over (at best with culverts) and non-existant set-backs. Very poor practice. By contrast, an area that was recently developed fairly close to me retained and protected the natural stream and streamside vegetation. It is a joy to walk through and I'm sure the developer(s) still received ample return on their investment.	Much much more needs to be done to restore the watershed health within the Town Centre and along major traffic corridors. This is absolutely essential in order to grow sustainably and mitigate the effects of climate change. At the same time, the community as a whole will enjoy the many interrelated benefits offered by this approach, from better air quality to more options for active transportation ("green" corridors supporting safe pedestrian and cycling modes of transportation).	Significant importance	Need more information before commenting	V2X 4K2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
13	No	yes, very aware. That is why we need to preserve them!	Nature takes care of the water when it comes. I have lived here a long time and never seen a problem. If there is standing water, all it takes is a little patience and it will be absorbed by the earth and trees, which need it.	It seems to be very good.	It is perfect. And since you do not provide adequate space on this form for comments, I want to say that we should not be trying to have "ongoing urbanization" - that is the main problem here. There is too much development and not enough natural spaces left that would offset any water issues. It's time Maple Ridge put a cap on development, or we will end up with an ugly city that is simply urban sprawl (like Langley) and not the beautiful green city we are on the verge of losing.	Significant importance	Significant investment	V2X 4P3
14	Yes, mainly on the street. 124th and 227thst	Yes	We need to do better to protect our watershed	I feel that it is a bit better due to a more natural setting which is better equipped to handle water	Needs improvement	Significant importance	Moderate investment	V2X 4X4
15	No	Somewhat	None	Seems fine	None	Significant importance	Significant investment	V2X 4Z6
16	No flooding/pooling of water during heavy rains	Absolutely	I am very concerned. The development of housing in the East has been peeling away the protective layer of the forests and I don't see it slowing down. I'd like to know that the rural areas are going to be protected from development.	Even worse in the East/Albion areas. I'm a (home) insurance broker and the incidence of basements flooding has increased disproportionatey in recent years in these areas. The more pavement, the less absorption. Very basic common sense.	The existing drains may be at capacity already as evidenced by the street flooding earlier this year. Although some of it was caused by blocked drains, there were still several blocks 'underwater' as the systems couldn't remove the volume of water. I'd like to know that the systems are going to be upgraded or maintained to prevent collapse.	Minor importance	Significant investment	V2X 5P9
17	The house I live in has flooded 4 times over the years because the city storm drain system doesn't reach all the way up 212st	Yes			I live 2 blocks from the hospital and half the houses on our end the street do not have storm drains or connections.	Significant importance	Significant investment	V2X 7N3
18	Yes in the basement 220 and lougheed area comes up in the sani main no Stromboli's in area people are pumping into sani main and sani main is 55 + old and it is AC pipe it has happen 3 times in 20 years	Yes	They are getting over tax need to do more to slow water down and clean water before it goes into the streams	Not good they are not getting cleaned or inspected	They are under sized and old not getting cleaned or inspected	Significant importance	Moderate investment	V4R OA
19						Significant importance	Significant investment	V4R 0A8
	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
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20	yes, flooding in neighbourhood twice per year, most years, usually spring and fall, about 4 times/yearin N. Alouette river area.	yes, very aware	very poor drainage "improvement" at corner of 232 St and 1.32 Aveall the runoff from silver valley hill and it's silt directed to N. Alouette (salmon bearing river). Too much development and can't handle it.	see above	big flood at Sr. Ctr., so obvious that there are problems	Minor importance	Moderate investment	V4R 0A9
21	I have seen it in the neighbourhood on 1.32 Av at or near 224 St. It occurs with heavy rainfall. Two or three times a year commonly with spring runoff but more volatile now with Climate Change.	Yes	I cannot say, other than that the city is more and more encroaching upon them, and that isn't good for drainage and watershed health.	Not improving because of the increased housing and pavement uphill from the lower lands especially floodplains in this area. Near where I live, the North Allouette needs dredging because of increased gravel deposits.	l cannot say.	Moderate importance	Moderate investment	V4R 0G1
22	no	no	seems fine to me	128 near 224th seems fine	good	Significant importance	Significant investment	V4R 1R8
23	The intersection/bridge at 224th & 132nd. It has happened several times per year during the last few years. It never used to occur so frequently.	Yes	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River.	"Answer same as above (not sure which area is considered rural vs. suburban)		Need more information before commenting	Need more information before commenting	V4R 2P7
24	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."	"Answer same as above (not sure which area is considered rural vs. suburban)				Significant importance	Significant investment	V4R 2R2

	Flooding in Neighbourhood	Awareness of Natural Features and Drainage	Impression of Watershed Health (Rural)	Impression of Watershed Health (Suburban)	Impression of Watershed Health (Urban)	Importance of Watersheds	Support for Investment in Drainage	Postal Code
25	I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."					Significant importance	Significant investment	V4R 2R2

Results by Question

Question 1: Postal Code



Question 2: Have You Experienced Flooding in Your Neighbourhood?
Yes. On October 28/19 approx. during a heavy downpour the storm water drain at 10596 245 St. backed up causing considerable damage to my basement suite with eight inches of water. Cause was the outlet pipe for the catch basin located at the end of the SRT Field was clogged by overgrowth due to lack of maintenance.
No
No
No
Yes, during a major rainfall last August/September, our road (228th north of Abernathy) turned into a waterway, with water shooting *out* of the storm drains as they were overwhelmed.
No
"My backyard is wet most of every winter. The back boundary has a footing for the fence, which
prevents drainage. Muddy"
Not personally, but it's always a concern for nearby Lower Hammond. We were also horrified to learn the Katzie First Nation Reserve is located on the WRONG side of the dikes, that due to the politics of the day, the dikes go AROUND the outside edge of the reserve and leave their whole reserve extremely vulnerable to flooding. This needs to be rectified ASAP.
Yes.After heavy rains. 3 to 4 times a year
During heavy rains we regularly get water pooling in our large yard (next to ALR). We are north of 123 Avenue on 208 St.
No
Yes, mainly on the street. 124th and 227thst
No
No flooding/pooling of water during heavy rains
The house I live in has flooded 4 times over the years because the city storm drain system doesn't reach all the way up 212st
Yes in the basement 220 and lougheed area comes up in the sani main no Stromboli's in area people are pumping into sani main and sani main is 55 + old and it is AC pipe it has happen 3 times in 20 years
yes, flooding in neighbourhood twice per year, most years, usually spring and fall, about 4 times/yearin N. Alouette river area.
I have seen it in the neighbourhood on 132 Av at or near 224 St. It occurs with heavy rainfall. Two or three times a year commonly with spring runoff but more volatile now with Climate Change.

no

The intersection/bridge at 224th & 132nd. It has happened several times per year during the last few years. It never used to occur so frequently.

No, i have not experienced flooding in my neighbourhood.

Yes we have experienced it, and so have the majority of our neighbours on the north side of 136th immediately at the back of our properties. 22579 136th ave, Maple Ridge. Almost anytime it rains as majority of our perimeter drainage goes to the back of the property where there's a ditch, but the ditch is completely clogged in in desperate need of cleaning. Over the past year the ditch has started to now flood our property almost every time it rains.

Yes. Occurs along the North Alouette River. The nature of the flooding has changed dramatically over time. In the 70-80s spring freshet caused the Fraser floodwaters to back up and 224 north of 132 flooded almost every year. This was predictable and occurred slowly enough that residents for the most part could take precautions. After the development of Silver Valley, unquestioned deposition of fill, construction of the cranberry dykes, and raising of 224, the type of flooding changed. Now spring freshet rarely causes a problem(and there doesn't seem to be enough snow on the local mountains to have much effect). Almost every year there is flooding corresponds to weather events. These are usually severe, rapid onset and unpredictable.

Question 3: Are You Aware of How Natural Features Are Important for Drainage?
Yes.
Yes
Yes
Yes. The odd urban tree makes no difference, which is why the tree bylaw is so ridiculous - forest and parks where there is a a decent amount of vegetation on the other hand do make an impact. I would like to see an increase in planting and parks around any new development - paid for by the developer. Case in point - the sports filed at Arthur Peake has plenty of room around the edges to plant trees that would also assist the residents in screening from the light and noise at night from the field. Instead we have a poorly planted grass verge with terrible drainage in winter.
Yes.
Yes. Stream side buffers are important to reduce the amount of flooding after minor rain events.
Yes. Silly question
YES!! We need more of them!! Nature has spent millennia perfecting the earth's water storage (eg. glaciers) and drainage system and we are destroying it and having to deal with the consequences. Keep the green we have and let it do its job. Add more green. It improves mental health as well as helping with the water cycle.
yes
Absolutely. They are also important for human physical and mental health, supporting biodiversity, and moderating climate change effects.
yes, very aware. That is why we need to preserve them!
Yes
Somewhat
Absolutely
Yes
Yes
yes, very aware
Yes
no
Yes
Yes. I am extremely aware of the importance of the natural features such as urban trees, forests, stream and wetlands and their importance on drainage and watershed health.
No
Yes, as a resident of Alouette Valley, I see this first hand.
Yes and very concerned about the way development is occurring in the area. Trees taken down and properties clear cut with out proper consideration to how this affects run off to lower areas.

Vegetarian disturbed taking away the opportunity for natural draining, fill brought in to raise development areas, and hard surfaces put in that give no natural drainage. The rivers are being polluted and salmon are being put at risk. Environmental engineers hired by developers ignoring problems to save money.

No comment.

They are excellent.

Fairly healthy except were development has been allowed in the upstream areas.

Generally OK, though building on the flood plain of any significant river/stream ought to be automatically prohibited, not only for the health of the watershed but also because when the river floods (which it will) taxpayers are indirectly on the hook for some of the bailout costs. We could just avoid it altogether and not allow any further construction on flood plains.

The green spaces and waterways in maple ridge are a jewel, but continued further development appears to be greatly encroaching on them, with negative impacts, like increased and extreme waterflows, more debris, less shading, etc. even the required 15-30 m buffer from major waterways for new development appears very loosely enforced, and developments above watersheds tend to raise the water table below them from additional runoff.

Excessive stream side development is degrading the natural flood control.

NA

Forested areas = good, most rural areas = not bad, depending on how much concrete/pavement/building there is.

They have been fine up to this point.

The forested areas appear to be doing well. I have concerns about the rural areas. I'm not sure that enough is being done to protect these natural features from the effects of urbanization and contamination from farming and other rural land uses.

Nature takes care of the water when it comes. I have lived here a long time and never seen a problem. If there is standing water, all it takes is a little patience and it will be absorbed by the earth and trees, which need it.

We need to do better to protect our watershed

None

I am very concerned. The development of housing in the East has been peeling away the protective layer of the forests and I don't see it slowing down. I'd like to know that the rural areas are going to be protected from development.

They are getting over tax need to do more to slow water down and clean water before it goes into the streams

very poor drainage "improvement" at corner of 232 St and 132 Ave.....all the runoff from silver valley hill and it's silt directed to N. Alouette (salmon bearing river). Too much development and can't handle it.

I cannot say, other than that the city is more and more encroaching upon them, and that isn't good for drainage and watershed health.

seems fine to me

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River.

We need to retain more forests and riparian areas along rivers and creeks to encourage more natural drainage. Keeping streamside setbacks of 30 metres is a very good start but should be increased to 50m. Use more bioswales and other natural remediation measures in new developments.

I don't have an opinion as I'm unsure what this is referring to.

Can only speak to the neighbourhood I know. I believe that the overall watershed may be in good health due to its remoteness and size. The lower reaches however seem to be suffering.

The way the area is being developed puts severe pressure on the natural environment and is destroying the forests and watersheds.

Generally poor considering the amount of flooding of streets in the last year. Examples are: Seniors Centre on 224th.and the 225th. & Haney Bypass intersection.

Good

Fair but could be greatly improved. Would require the city or developers to invest in monitoring flows to determine what actually runoff from storms are and what is the water quality of this runoff.

I think they are probably OK, though again I remain concerned about building close to streams. The construction that has happened around Cotttonwood, and now continuing close by with development at the end of 232 St seems likely to put more pressure on feeder streams to Kanaka Creek. I am also concerned that these natural watersheds/drainage are also wildlife corridors, or rather were. We should be encouraging developers to enhance some of the existing natural features and ensure separation for wildlife. Sadly we have already encroached too far within the urban and suburban areas, but we can at least, if the will is there, prevent future destruction and erosion in the name of "growth" (which everyone but me seems to think is a good and necessary thing!)

Getting worse with more development, see my comment above to #3.

Excessive stream side development is degrading the natural flood control. Many stream banks can no longer retain enough water to prevent significant siltation and downstream flooding.

NA

Not so good - many of the ditches and waterways are covered over and are damaged during construction of roads & new development. NEW developments will be better equipped to deal with drainage and work with/around existing watershed elements, but older developments destroyed everything. We need to do restoration in these areas.

"I am not sure exactly where you are describing. More accurate descriptions would help.

As a long time resident we know that the soil along the Fraser has a high amount of clay which has and will continue to create a slippage. There is poor drainage to the west of the Town Center. Water floods the basement of some homes and there are no storm drains."

There are many examples of streams that are paved over (at best with culverts) and non-existant set-backs. Very poor practice. By contrast, an area that was recently developed fairly close to me retained and protected the natural stream and streamside vegetation. It is a joy to walk through and I'm sure the developer(s) still received ample return on their investment.

It seems to be very good.

I feel that it is a bit better due to a more natural setting which is better equipped to handle water

Seems fine

Even worse in the East/Albion areas. I'm a (home) insurance broker and the incidence of basements flooding has increased disproportionately in recent years in these areas. The more pavement, the less absorption. Very basic common sense.

Not good they are not getting cleaned or inspected

see above

Not improving because of the increased housing and pavement uphill from the lower lands especially floodplains in this area. Near where I live, the North Allouette needs dredging because of increased gravel deposits.

128 near 224th seems fine

"Answer same as above (not sure which area is considered rural vs. suburban)

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."

Again, the more trees kept, grassed areas and less asphalt, the better. We need to think about using new technologies of pervious pavements and move away from using so much impervious surfaces to channel and move stormwater out of our systems.

I don't have an opinion as I'm unsure what this is referring to.

Very poor.See 4. above.

They seem fine.

Poor. Old infrastructure that does not address runoff rates or water quality. Recent downtown improvements could have integrated modern runoff facilities and did not. Not seeing the green infrastructure that should be required with new developments- a rooftop patio with a tree does not cut it.

OK - it rains a lot, we get wet. We need to halt the rate of urbanization and say "enough is enough". Maple Ridge is no longer open for developers other than on existing Brownfield sites.

Much worse, as it's more developed, with little green space to absorb rainfall, etc. With increasing effects of climate change, we need to be able to handle storms dropping an inordinate amount of rainfall in a short period of time.

Our storm water is directed into the streams and rivers, instead of treatment. Too many people are unaware, or just oblivious, to the consequences of dumping into the storm system. (The Hoy Creek fish kill is a tragic example of this ignorance.)

In Hammond, it's not very complete

Terrible - look at all the damage done when there was a flash flood. Too much concrete & pavement. Not enough green spaces and permeable surfaces.

This area seems to function pretty well.

Much much more needs to be done to restore the watershed health within the Town Centre and along major traffic corridors. This is absolutely essential in order to grow sustainably and mitigate the effects of climate change. At the same time, the community as a whole will enjoy the many interrelated benefits offered by this approach, from better air quality to more options for active transportation ("green" corridors supporting safe pedestrian and cycling modes of transportation).

It is perfect. And since you do not provide adequate space on this form for comments, I want to say that we should not be trying to have "ongoing urbanization" - that is the main problem here. There is too much development and not enough natural spaces left that would offset any water issues. It's time Maple Ridge put a cap on development, or we will end up with an ugly city that is simply urban sprawl (like Langley) and not the beautiful green city we are on the verge of losing.

Needs improvement

None

The existing drains may be at capacity already as evidenced by the street flooding earlier this year. Although some of it was caused by blocked drains, there were still several blocks 'underwater' as the systems couldn't remove the volume of water. I'd like to know that the systems are going to be upgraded or maintained to prevent collapse.

I live 2 blocks from the hospital and half the houses on our end the street do not have storm drains or connections

They are under sized and old not getting cleaned or inspected

big flood at Sr. Ctr., so obvious that there are problems

l cannot say.

good

"Answer same as above (not sure which area is considered rural vs. suburban)

I feel watershed health is not being taken into enough consideration. There has been a large amount of development in Silver Valley, particularly in the RockRidge area, where too many homes have been built too close together and not enough grass, tress, etc. has been maintained. Additionally, construction (including road construction on 232) has been causing more soil (and who knows what else) run-off into the North Alouette River."

As above.

I don't have an opinion as I'm unsure what this is referring to.

Do not know

Question 7: How Important Is Health of Watersheds to You?



Question 8: What Level of Investment in Drainage Improvements Would You Support?



External Stakeholder Feedback Summary

Stakeholder	Response
Agricultural Land Commission	Met with KWL and City staff and provided feedback in a letter dated Janurary 25, 2021 (refer to Attachment P)
Alouette River Management Society	Met with KWL and City staff and provided feedback in a document dated December 8, 2020 (refer to Attachment Q)
Alouette Valley Association	Met with KWL and City staff and provided feedback in an email dated December 3, 2020 (refer to Attachment R)
BC Conservation Foundation - WildsafeBC	Met with KWL and City staff and provided feedback in a letter dated November 30, 2020 (refer to Attachment S)
BC Ministry of Agriculture, Food and Fisheries	Met with KWL and City staff and provided information on how the Ministry encourages environmentally sustainable farming.
BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development	Met with KWL and City staff and provided feedback in a document dated February 18, 2021 (refer to Attachment T)
City of Pitt Meadows	Responded to the City's invitation for review, but did not have any specific comments on the ISMP
Fisheries and Oceans Canada	Met with KWL and City staff and expressed interest in removal of the historic agricultural dike within the Blaney Bog Regional Park Reserve; noted a perceived limitation on spawning areas and raised for consideration the possibility that new spawning areas should be prioritized over provision of additional rearing habitat, should it be shown that this was a limiting factor; indicated that removal of barriers to fish passage is a priority where quality upstream habitat exists; noted a lack of riparian vegetation/habitat complexity in the downstream agricultural flatlands west for out-migrating fry and asked if there were considerations for improve ments; expressed interest in opportunities to improve habitat on tributaries connected to the Fraser River; mentioned concern that efforts to increase habitat connectivity could result in invasive species such as carp accessing new areas; asked about ecosystem health monitoring – will this be long term and will results available to the public as well as Fisheries and Oceans?
Katzie First Nation	Katzie First Nation did not respond to the invitation to provide feedback on the ISMP.
Kwantlen First Nation	Kwantlen First Nation did not respond to the invitation to provide feedback on the ISMP.

Stakeholder	Response
Metro Vancouver Regional Parks	Met with KWL and City staff and described the recent expansion of the North Alouette Regional Greenway and Codd Wetlands Ecological Conservancy Area, related Metro Vancouver's goal of creating a "large and resilient park complex in the northeastern part of the region"; Metro Vancouver Regional Parks expressed interest in conducting a wetland impact study of potentially breaching the historic agricultural dike in the Blaney Bog Regional Park Reserve, would like to partner with Maple Ridge on this study; described frequent beaver dams along the channel leading from 224 Street to the wetlands causing backwatering and their ongoing need to manage these dams; recognized a knotweed (invasive plant species) challenge along the North Alouette Greenway and Maple Ridge's ongoing efforts to eradicate it; indicated that Metro Vancouver would find it useful if Maple Ridge made its stream monitoring information available online.
Morningstar Homes	Morningstar Homes met with KWL and City staff and provided feedback in a document dated January 12, 2021 (refer to Attachment U)
UBC Malcolm Knapp Research Forest	Provided GIS mapping data along with feedback in an email dated December 10 & 11, 2020 (refer to Attachment V)
Wayne Stephen Bissky Architecture Urban Design Incorporated	Wayne Bissky met with KWL and City staff and described how in his experience most developers support protection of the environment; indicated that since green infrastructure is natural, more dynamic and less predictable in performance, contractors tend to shy away from it – they prefer grey infrastructure as there is less chance they will need to fuss with it during construction and the maintenance period; outlined how architects are liable for the performance of green roofs and how there are potential quality control risks during installation – believes that if insurance liability associated with green roofs could be distributed more, there might be more uptake, also questions remain on the long-term performance of the membrane and other parts; more green on Town Centre frontages is nice, but plants are stolen from planters a couple of times a year; back lanes present an option for greening – the Advisory Design Panel often comments on planting and supports/requests it; the less pervious soils in Maple Ridge have a big impact on green infrastructure options – pushes people from natural to artificial solutions; a lot of people tend not to think about the importance of the quality of rainwater runoff for watercourse health.



Agricultural Land Commission 201 – 4940 Canada Way Burnaby, British Columbia V5G 4K6 Tel: 604 660-7000 | Fax: 604 660-7033 www.alc.gov.bc.ca

January 25, 2021

Reply to the attention of Shannon Lambie ALC Issue: 52068

Joe Dingwall,. Manager of Utility Engineering, City of Maple Ridge jdingwall@mapleridge.ca

Delivered Electronically

Re: <u>Blaney, North Alouette, and Fraser River Integrated Stormwater Management</u> Plan

Thank you for forwarding a draft copy of the *Blaney, North Alouette, and Fraser River Integrated Stormwater Management Plan* (the "ISMP") for review and comment by the Agricultural Land Commission (ALC). The following comments are provided to help ensure that the ISMP is consistent with the purposes of the *ALC Act* (ALC Act), the Agricultural Land Reserve (ALR) General Regulation, (the "ALR General Regulation"), the ALR Use Regulation (the "ALR Use Regulation"), and any decisions of the ALC.

The purpose of the ISMP is to provide the City of Maple Ridge (the "City") with guidance and information on how to proceed with future land development and re-development, while protecting and enhancing the overall health of the study creeks and watersheds located within the municipality. The ISMP covers the Blaney Creek Watershed, the North Alouette River Watershed, and the Fraser River Watershed.

ALC staff would like to thank City staff for the opportunity to be involved in the development of the ISMP and hope to continue to expand dialog concerning regional planning issues that affect stormwater management and drainage issues across watersheds. In particular, ALC staff note that the ISMP identifies several "future environmental measures for maintaining and enhancing watershed health" on page 111. ALC staff request that City staff refer any future bylaws or other legal tools, along with any proposed parks or conservation areas that may affect lands within or adjacent to the ALR, to ALC staff in advance of their adoption for review and feedback.

Finally, in the presentation provided by City staff on January 14, 2021, it was mentioned that approximately 4000 ha of land within the North Alouette River Watershed area of the ISMP are also located within the ALR. ALC staff ask that City staff confirm the ALR areas affected by the ISMP for internal mapping purposes.

If you have any questions about the above comments, please contact the undersigned at 236-468-2026 or by e-mail (shannon.lambie@gov.bc.ca). Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

S. Lambie

Shannon Lambie, Regional Planner 52068m1



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December 8, 2020

Joe Dingwall Manager of Utility Engineering City of Maple Ridge 11995 Haney Place, Maple Ridge, BC V2X 6A9

CC: Mayor and Council

Dear Mr. Dingwall:

RE: Blaney, North Alouette and Fraser River Draft Integrated Stormwater Management Plan File No: 11-5255-20-061

Please find attached the report containing comments pertaining to the subject draft Integrated Stormwater Management Plan in response to the invitation by the City of Maple Ridge (CMR) for the Alouette River Management Society (ARMS) to provide comment on the draft plan.

Should you have any questions or concerns regarding the contents of this letter, please do not hesitate to reach out to the Greta Borick-Cunningham, Executive Director of ARMS.

ARMS would like to take this opportunity to thank City of Maple Ridge for the invitation to provide comment on a draft plan of this level of importance. ARMS will happily contribute to other future planning and policy documents related to the Alouette River watershed should the City request it.

Sincerely,

Ken Stewart, On behalf of ARMS

Alouette River Management Society Review of the Blaney, North Alouette and Fraser River Integrated Stormwater Management Plan

Daniel King¹, Josh Baker², Greta Borick-Cunningham³, Cheryl Ashlie¹, Cheryl Power⁴, Paul Lawson⁴, John Kelly¹

¹Alouette River Management Society Director ² Alouette River Management Member, Professional Environmental Chemist

³ Alouette River Management Society Staff

⁴UBC Malcolm Knapp Research Forest Staff

Executive Summary

The overall response from ARMS in regards to the Integrated Stormwater Management Plan is positive, as it provides a comprehensive watershed analysis to better inform city planning, development and restoration works. ARMS notes that the plan advocates for all of the watersheds' natural areas and environmental services, which we believe provides a good foundation for future work to improve the health of each of the watersheds involved.

Key points that ARMS raises in the following submission provide recommendations in the area of current practices that are presently providing positive environmental changes within the North American development landscape. The plan itself, while containing promising recommendations and methodology on how to protect the involved watersheds' health from negative outcomes of stormwater, due to development, appears to be void of the more innovative methods and important ideas, such as green infrastructure. Much of our feedback focuses on moving aspirational comments in the plan to that of actions that will protect the watershed.

To this end, key recommendations are provided in the areas of working relationships with stakeholders to ensure the plan fulfills the intent of protecting the watersheds involved. ARMS believes that a sub-committee involving stakeholders, which ARMS would like to be part of, could be a very useful mechanism to implement the plan and would request that this be an immediate action by council.

ARMS provides significant feedback in the area of Monitoring and Adaptive Management Framework (MAMF), as we believe that there are gaps in focus areas that will result in deficiencies within the data that will be required to properly assess development impact on the watershed. We believe that including our recommendations in this area will provide a robust methodology to match that of the vision of the document. As well, ARMS has listed a number of recommendations in the area of Stormwater Infrastructure and Management, where we have proposed the use of more green infrastructure mechanisms, coupled with the removal of building materials and products that are known to cause contamination within watersheds.

As well, ARMS has included opinions on existing recommendations by the consultant relating to restoration of degraded aquatic habitats outlined in the ISMP, such as Cattell Brook and the Blaney Creek bank erosion, which are areas that ARMS could provide considerable support for. And we concur with KWL's recommendations related to agriculture's impact on the watershed. We believe we can work closely with the city to support such advocacy and work.

Overall, the Integrated Stormwater Management Plan is an accomplishment for bringing as many details as it does regarding the watershed(s) into one place. The plan provides a good beginning and a roadmap

for future actions to protect the watershed from degradation. As stated by ARMS member and contributor to ARMS' document, Josh Baker, "KWL and CMR should be commended for this work." In that spirit, we hope the following observations and recommendations can form a continuance of the collaboration that enabled the draft plan for council's consideration and we look forward to further discussion with the city on the opportunities within the plan for a robust set of policies that will ensure the protection and enhancement of the watersheds for which we are all striving to protect.

Introduction

The Alouette River Management Society (ARMS) would like to thank the representatives of the City of Maple Ridge (CMR) involved in finalizing the Draft Integrated Stormwater Management Plan (ISMP) for the invitation to provide input and feedback on the ISMP. It is the hope of ARMS that the recommendations herein will be thoughtfully considered and applied to the ISMP, as well as future development, ecological restoration, environmental monitoring, fisheries monitoring and restoration, decisions surrounding protected areas, parks and green space; and all activities related to the preservation and enhancement of the Alouette River Watershed. In addition to directly addressing recommendations within the ISMP, ARMS also took the opportunity to provide specific recommendations for stormwater monitoring, mitigation and management based on the most current and robust evidence available.

ARMS greatly anticipates further work and collaboration with CMR on enhancement and monitoring efforts within the watershed using the framework outlined the proposed ISMP; updated with ARMS recommended changes.

Partnership Opportunities Between ARMS and CMR

ARMS found that the recommendations for habitat restoration, environmental monitoring, stormwater mitigation, fisheries monitoring and all other related recommendations within the ISMP were aligned with the vision and goals ARMS has for the Alouette River watershed. Due to this alignment ARMS foresees the implementation of this ISMP and the recommendations therein as a perfect opportunity for collaboration with the CMR on the protection and enhancement of the Alouette River watershed. Some specific recommendations for work in partnership between ARMS and CMR are outlined in this section and throughout this report.

- ARMS proposes the formation of a Stormwater Management and Aquatic Habitat Restoration Technical Working Group with representatives from each key stakeholder group (e.g. Katzie, CMR, ARMS etc.) immediately following the implementation of the new ISMP. We recommend that the key mandates of this group include:
 - Creation of an implementation plan for the ISMP that would outline specific requirements, approaches and best-practice for stormwater management to provide actionable guidance for the framework outlined in the ISMP
 - Create a priority capital and habitat infrastructure list along with a proposed schedule for upgrading of said capital infrastructure and habitat restoration
 - Review and advise Mayor and Council on stormwater management plans for planned and future developments

The management plan is full of exciting recommendations and methodology on how to protect watershed health from negative outcomes of stormwater. However, many of the more innovative methods and important ideas are not directly included in either the current policies and/or in the future suggested actions of the management plan (*e.g.*, green infrastructure is described in some detail but is absent from most of the suggested infrastructure upgrades). The disconnect between what is described and what is proposed makes the plan just a placeholder for ideas but not actionable items to truly protect the watershed.

Key Recommendations from the ISMP

Within this section ARMS will outline in sufficient detail specific subjects identified within the ISMP and our recommended changes or considerations to address those issues. When items are not directly within the ISMP, ARMS requests that they be considered for inclusion, or, noted for inclusion in a future implementation plan.

Habitat Protection and Restoration

ARMS agrees with the restoration of degraded aquatic habitats outlined in the ISMP (e.g. Cattell Brook, Blaney Creek bank erosion). ARMS looks forward to working with CMR and other stakeholder groups to achieve these restoration goals and improve the ecosystem functioning within the North Alouette River and Blaney Creek watersheds. Notable areas that ARMS identified as a priority for restoration and protection are:

- Permanent protection of two sections of high-quality fish habitat identified within the ISMP. These areas are the 800-metre section of Blaney Creek upstream of the 224th Street bridge and the North Alouette River upstream of the 232nd Street bridge, where 13% of the river area supports 63.8% of the fish biomass. Protection afforded to these key sections of aquatic habitat would maintain a refuge of high-quality aquatic habitat that will always support populations of species within each watershed, even in the event of habitat degradation. Note: Protection of these areas was also recommended by KWL in section 6.5 of the ISMP.
- 2. ARMS would like to actively participate in habitat restoration within Cattel Brook. Metal concentrations were above the guideline levels (though site-specific guideline concentrations were not developed). Habitat restoration in this area could provide high quality fish and wildlife habitat, assist in stormwater mitigation and filtration and even in flood mitigation.
- 3. Use of natural stabilization methods and vegetation/stabilization combinations over only using rip rap for bank stabilization and flow mitigation. For example, the rip rap-laden culvert outfall into the North Alouette River at the 232nd Street bridge. Proper installation of bioretention soil and plantings could have prevented the constant sediment release from this location and mitigated the other stormwater impacts as well.

Existing Stormwater Design Criteria

As stated by the consultant, "In addition, as of 2017, Metro Vancouver released specific minimum guidelines for stormwater management for single-family lots. These guidelines represent a minimum level

of mitigation expected on single-family lots across the region. The City's Tier A criteria, if implemented, exceed the minimum requirements of the Metro Vancouver Baseline, however, the baseline criteria could form a fall-back for cases where Tier A criteria is unable to be met on single-family lots."

1. ARMS recommends that the city strengthen the policy direction to ensure that the city's guidelines are the predominant outcome and that Metro Vancouver Baseline is only permitted when there has been no capacity to meet the city's guidelines.

Water Quality Monitoring

There were several areas identified within the ISMP with insufficient or absent details regarding water quality monitoring. The following are our suggested additions:

1. ARMS strongly supports the recommendation outlined in section 15.2 in the first paragraph that addresses non-point sources of pollution pertaining to water quality. ARMS supports the following recommendation and corresponding excerpt from the plan, "The Mitigation criteria (Tier A) wording should be revised to include water quality. "This runoff volume must be treated to remove pollutants from any vehicle accessible surfaces such as roads, parking areas, and driveways". The present method will not address non-point-sources of pollution which is the case for most stormwater runoff known to impact the health of even adult salmon.

Stormwater runoff has been shown to be acutely toxic to Coho salmon at all life stages, including to spawning adults before they are able to spawn (e.g.>90% egg retention in females) (McIntyre et al. 2020). Potential options recommended by ARMS of "suggested treatment methods and approaches" as outlined in section 15.2 of the ISMP can be found within this response in the *Stormwater Mitigation* section.

2. The MAMF monitoring should be done on a three year not five-year cycle. This is standard practice for other monitoring programs such as the Metal and Diamond Mining Effluent and Pulp and Paper Effluent Regulations (ECCC, 2010; 2014). As recommended on page 17-4 and Table 17-4.

Though mining and pulp and paper effluent seem far more environmentally damaging than stormwater runoff, this is not necessarily the case. Urban stormwater effluent, depending on the contents, can be extremely damaging to various receptors within an aquatic ecosystem; the main difference is stormwater is not monitored and regulated to the level of industries such as mining. In order to properly implement the "adaptive" portion of the Monitoring and Adaptive Management Framework (MAMF), ARMS feels that monitoring programs every three years are necessary.

- 3. ARMS recommends reporting dissolved copper and zinc, in addition total concentrations. Appendix D presents water quality data but only mentions a value of total copper and total zinc. This value is necessary for determining the portion of these metals within the aquatic environment that are bioavailable and potentially toxic to aquatic organisms.
- ARMS recommends that in addition to the water quality parameters outlined in the ISMP, two other common and relatively inexpensive parameters be added: Dissolved organic carbon (DOC) and water hardness.

To determine if a copper or zinc concentration is safe for aquatic life the bioavailability to aquatic life is dependent upon dissolved organic carbon and water hardness (zinc) and only water hardness is required for copper. This allows the derivation of a site-specific concentration protective of aquatic life (including DOC and hardness) for these contaminants found in, for example, stormwater runoff causing elevated Cu and Zn at Cattell Brook monitoring site. In fact, if metal water quality monitoring is provincially or federally required to prove concentrations that are protective of aquatic life, the determination of site-specific copper and zinc concentrations is required (MOE, 1999; MOECCS, 2019; CCME, 1999; CCME 2018).

This is especially important due to the uniquely low specific conductivity reported in the North Alouette River (5-40 μ S/cm). This would indicate an exceptionally low water hardness (<10 mg/L as CaCO₃; Ca and Mg) and low concentrations of other ionic constituents. The iono-regulatory condition of the spawning salmonid would be likely very unique as they move from the high-ion condition of saltwater to an essentially de-ionized condition of this freshwater river. The impairment by trace levels of divalent metals (Cu, Zn, Pb, Cd) would likely be strongly accentuated by this low ionic condition. As the salmonids would be fighting to iono-regulate the low Ca/Mg conditions they would likely be more susceptible to taking in these trace metals; they want all the divalent metal ion channels, unfortunately allowing for more uptake of the divalent trace metals Cu²⁺/Zn²⁺/Pb²⁺/Cd²⁺. The low ionic condition of the river necessitates that flushes of toxic trace metals from stormwater runoff are minimized.

5. ARMS strongly recommends the assessment of stormwater water quality, flow rate and volume. What appears to be missing in the ISMP is an assessment of stormwater – its water quality and flow/volume. The MAMF (Table 17-1) includes assessment of water quality of piped systems but this is not detailed in the report. Specifically, locations where culverts/outfalls send untreated stormwater in high volumes into smaller creek/rivers in the watershed need to be investigated. While some monitoring is active for five sites in the watershed, the monitoring is detached from the assessment of stormwater and therefore any connection between a determined deterioration at the site would not be traceable to stormwater. In addition, a five-year monitoring cycle in the rivers would be inadequate to allow for appropriately timed responses to alterations to watershed health.

An assessment of stormwater could include and would achieve:

- Monitoring during a storm event assesses stormwater *in-situ*;
- Monitoring after a dry period assesses the "first flush scenario" (ECCC, 2014);
- Analyze water chemistry (metals, nutrients, pH, conductivity, petrogenic PAHs) identifies and quantifies possible pollutants/toxicants;
- Analyze turbidity characterizes possible siltation/sedimentation dynamics which are important for spawning substrate;

• Flow/volume – allows for quantification of the amount of stormwater in comparison to the creek and modeling the environmental fate, rate and concentration of toxicants identified in the water chemistry measurements.

This type of stormwater assessment has been conducted by other municipalities (MOE, 2007). This assessment would aid in identifying key issues, such as contaminants of potential concern and/or sources of sediment/silt. The assessment could prioritize locations which need attention (*e.g.*, a specific outfall/culvert) and would identify situations where source control programs may be warranted (*e.g.*, a community education program to reduce zinc loading from metal roofing materials). The primary goal of this study would be to identify sites with high-volume inputs into low-volume river sites overlap with high loads of pollutants. Subsequently, an engineered solution would be identified (*e.g.*, diverting a culvert to a bioswale to increase bioretention).

6. ARMS would like the environmental impact assessments for pre- and post-water quality monitoring outlined in Table 16-1 Strategies 3 and 4, to be made publicly available and if possible, ARMS would like to actively participate in these impact assessments.

Stormwater Infrastructure and Management

 ARMS requests clear and descriptive language on which parties are responsible for monitoring and enforcement related to stormwater and sediment runoff, after construction activities have concluded with a qualified environmental professional monitoring these parameters. Policies and plans which are enforced by CMR are unclear in the ISMP. The descriptions of policies which apply to stormwater are numerous but vague on their application and enforcement.

For example, DFO, ARDSA, Provincial and CMR bylaws and regulations are all presented, but if all apply to the watershed and who is responsible for upholding them all in the watershed is not always evident. Is it the CMR's responsibility to uphold all of these? If so, additional information on the monitoring and enforcement of these bylaws/regulations should be provided. For example, a regulation at construction sites of suspended solids (TSS) levels of 25 mg/L is indicated (Page 4-3), which is a very important regulation to protect from watershed siltation, but it is unclear who or how this in upheld. Inclusion of the Fraser River escarpment in the plan also confuses the regulatory picture, as it has a unique set of regulations.

With the recent increase in development pressure sediment deposition into the local streams is a significant concern of ARMS, and according to a recent Zoom meeting with Joe Dingwall (CMR) and the Alouette Valley Association (AVA) about the ISMP; the AVA has also noticed a substantial increase in sedimentation within the North Alouette River and is concerned about this.

A particular example is the sediment deposition from the rip rap outfall on the northwest side of the new 232nd Street bridge over the North Alouette River. Following construction activities sediment was being deposited at an alarming rate from this outfall during storm events and from residual flow following storm events. Once a contractor has moved on but turbidity issues are

still evident post-construction who is the responsible party? Who will enforce and monitor in situations like this?

- 2. ARMS requests that CMR continues to use SPR for development standards relating to streamside setbacks.
- 3. ARMS concurs with the recommendation in the ISMP (15.2 Bylaw recommendations) for the use of a Local Area Services Approach to assist in the implementing stormwater treatment infrastructure and its required maintenance.
- 4. ARMS requests to be notified of any stormwater or capital infrastructure, and streamside restoration work in-or-about streams within the Alouette River and Blaney Creek watersheds. This would include work completed by the CMR, subcontractors of the CMR and landowners/developers. ARMS would also like to be included in the planning, monitoring and construction activities.
- 5. ARMS recommends green infrastructure under particular specifications to best handle flow and contaminants within stormwater, be included in the capital program section. Capital program section 12 all suggesting programs are increasing sizing of culverts and storm sewers. Other components (green infrastructure) are not included in the capital program suggestions.
- 6. ARMS recognized that an all-out ban on the use of roofing materials proven to release levels may be challenging, therefore we request, at minimum, the city develop a program to mitigate the release of toxic materials from roofing products and/or a program to educate the community about their use. Please consider the following rationale based on McIntyre et al (2019). McIntyre et al (2019) measured the concentrations of three metals known to be toxic to aquatic life arsenic, copper and zinc leaching into runoff from experimental panels of 14 roofing materials over 4.5 years of weathering. Ten roofing materials leached metals. Several leached >10 ppb. Metal concentration increased with roofing panel age as well as precipitation amount. Authors extrapolated loading of metals from each roofing material 10 years following installation. The roofing materials found to be most toxic were:
 - Wood shakes manufactured with copper chromated arsenic; leach the most arsenic
 - Treated wood shakes; leach copper
 - Copper granule-containing asphalt shingles; leach copper
 - Commercial roofs made of Zincalume and painted metal roofs that leach high levels of zinc
- 7. ARMS recommends the use of a specified blend of bioretention media for stormwater treatment areas, identified in a study commissioned by King County, Washington, US (Herrera, 2020).

Common practice for bioretention media has been 60% sand and 40% compost in Washington State. However, this bioretention treatment still allows leaching of phosphorous, nitrate and nitrite and total and dissolved copper and other contaminants after storm events.

One media blend from the study met the Washington State Ecology Department Technology and Assessment Protocol-Ecology for bioretention media. This blend consisted of:

- A primary layer with 70% volcanic sand, 20% coco coir/10% high carbon wood ash
- A polishing layer placed under the primary layer 90% state sand/7% coarse activated alumina/3% iron aggregate
- A 2-inch compost layer to promote plant growth

This media mixture removed total suspended solids, dissolved organic carbon, total phosphorous, ortho-phosphorous, nitrate+nitrite, total copper, dissolved copper, total zinc, dissolved zinc, total lead, dissolved lead, aluminum, total petroleum hydrocarbons from motor oil, diesel oil, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene and fecal coliforms; all to acceptable concentrations. The application of this blend as well as the cost per m³ can be seen in the below table taken from the study.

Table 53. Components and Application of New Washington Bioretention Media.				
	Basic Treatment	Enhanced Treatment	Phosphorus Treatment	Expanded Plant Palette and Robust Plant Growth
Primary layer	Х	Х		
Primary plus polishing layer	Х	Х	Х	
Primary plus polishing layer plus compost mulch ^a	x	х	х	Х

Do not use the primary media alone with compost mulch. The primary media and compost mulch without the polishing layer will export phosphorus and nitrogen.

Media	Cost per m ³ (CAD)	
primary media	175	
polishing layer	474	
compost mulch	25	
Total	673	
60/40	100	

Table 2. Cost per m³ of the components of bioretention media identified to be most effective at contaminant removal from stormwater.

Whenever possible at the minimum the primary layer should be used, with preference for the primary, polishing and compost layer for effluent draining directly into local streams or sensitive ecological areas. In the event that the components of this bioretention media are unavailable

ARMS recommends a biorention soil media mixture of attainable materials that was less rigorously studied for all runoff components when compared to the study by Herrera (2020), but was shown to be protective of juvenile Coho salmon and their prey (mayfly spp.) after treatment of stormwater runoff that was toxic when untreated (McIntyre et al 2015). That mixture is 60% sand, 15% compost, 15% shredded bark, 10% drinking water treatment residuals all overlying a gravel aggregate drainage layer.

Though the water quality parameters used in the MAMF are a good starting point for stormwater management, many other contaminants are present within stormwater including metals, petroleum-based contaminants and even a host of unknown chemicals from tire rubber leachates which have been shown to be toxic to Coho salmon. Instead of adding a whole host of expensive water quality testing parameters to the monitoring framework, only to find stormwater mitigation underperforming, thus requiring adaptive mitigation; ARMS recommends a "do it once and do it right" approach by using these tried-and-true soil bioretention media in areas used to treat and manage stormwater runoff.

ARMS recommends this not just for the city managed-spaces and stormwater infrastructure but as a requirement on all small scale development used in rain gardens for each individual lot. To support "retrofitting" of stormwater mitigation measures on existing lots the city could run a program of providing this bioretention media mixture to residents.

- 8. ARMS recommends a detailed plan be included within the ISMP to properly fund the maintenance of stormwater management infrastructure. Maintenance is required over the long term for absorbent landscapes to continue to provide stormwater benefits. These might include:
 - Replacing soils that have eroded or that are missing key components for contaminant removal
 - Landscape maintenance including removal of invasive and dead vegetation and planting of suitable native vegetation effective at flow mitigation and contaminant removal.

To implement maintenance of stormwater infrastructure and functioning some new source of funding to provide this service. Funding might come from:

- A stormwater "utility" charged as part of municipal taxes (e.g. Los Angeles County, City of Victoria)
- A tax that charges developments to either pay for or provide the service for the long-term management of stormwater infrastructure
- Local Area Service (LAS) Tax (based on CMR Local Area Service Policy)
- Infrastructure Planning Grants from Provincial government
- Local Government Infrastructure Grants from Provincial government

This is an area ARMS believes has been repeatedly neglected with no party left to take responsibility for the maintenance of dated stormwater infrastructure, even that with a modern and progressive design. ARMS requests the CMR take responsibility for this service and outlines

a plan within the ISMP to cover the costs of this service using a variety of financing options available. Funding maintenance of stormwater infrastructure is becoming common practice and in order to support the significant investment in this ISMP and ensure its success, CMR should also use this approach.

Assessment of SW infrastructure function for adaptive management

 ARMS requests specific and detailed requirements for a long-term stormwater monitoring plan in the ISMP. In Section 6.5 – Impacts it is stated "Long-term monitoring and maintenance of stormwater controls are needed to determine if the introduction of contaminants from large volumes of stormwater runoff from entering the aquatic environment". This does not provide a description of how CMR plans to implement the long-term monitoring.

Planning and execution of a long-term stormwater monitoring plan is the type of endeavor where ARMS would seek to partner with the CMR and other key stakeholders and interested parties (e.g. First Nations, academia, community volunteers etc.). Programs such as this are labour and cost-intensive to implement and partnerships and shared effort among stakeholders will be key to their success.

- ARMS recommends benthic invertebrate monitoring should be conducted at all sites along with water quality; and that both be conducted every 3 years, not every 5 years. The only way to ensure a proper weight of evidence approach is to get all the lines of evidence. If you remove a key line of evidence, like benthic richness, the other lines of evidence (water quality, etc) become less useful.
- 3. ARMS recommends the implementation of the MAMF supplemental performance monitoring indicators outlined in section 17.
 - Salmon surveys, spawning adults and juvenile (YOY) would be helpful monitoring indicators. ARMS would seek to assist the city through a working partnership by incorporating spawner assessments within the North Alouette and Blaney Creek into our current spawner survey program. Additionally, ARMS would seek additional funding in partnership with CMR and other key stakeholders for juvenile (YOY) assessments.
- ARMS recommends that sediment size characteristics (grain size, % embedded) be used as a monitoring tool - using the Guidelines for Monitoring Fine Sediment Deposition in Streams (B.C. 2002)
- 5. ARMS would like to work in partnership with CMR, interested provincial and federal ministries, the Katzie First Nation, academia, other key stakeholders and interest groups to include a student and volunteer-based monitoring program of water quality and toxicity testing for benthic invertebrates (e.g. *Ceriodaphnia dubia*) and salmonids. This would allow for key funding opportunities, an accurate indication of the performance of stormwater management

infrastructure at frequent intervals, allow for additional financial support for a novel program through a multi-stakeholder partnership; and for community outreach through education and volunteerism.

6. ARMS strongly recommends that the raingarden and bioretention assessment protocol developed by Washington State University (and partners) be incorporated into the ISMP and required to be applied every three years along with other monitoring requirements (e.g. water quality, benthics). This would allow for the comparison of indirect metrics of potential stormwater impacts to direct assessments of stormwater infrastructure functioning (SAM, 2020). The protocol was developed to allow ease of implementation, repeatability across large geographic scales and multiple implementers, and provide data of scientific and adaptive management value.

This is another area ARMS would seek to partner with CMR to employ as a tool for education, volunteerism and community outreach; while serving to protect the Alouette watershed. Potential areas this protocol could be applied is as a requirement for developments or, used to support residential bioretention and rain garden infrastructure for individual residences in the form of a grant or tax-credit.

Agricultural Effluent Impacts

Agricultural effluent into adjacent waterways is a difficult problem to address when compared to residential and urban stormwater management. However, management of this effluent is no less important for preservation of the ecological integrity of the watershed and measures should be taken to mitigate effects of agriculture whenever feasible.

Agriculture provides jobs, food security, economic benefits and even flood control infrastructure. With these benefits comes potential risk of environmental impacts, especially with the storm events seen in the Lower Mainland. Agricultural runoff can include nitrogen, phosphorous, fecal coliforms, organic carbon and the associated nutrient enrichment effects such as eutrophication. Additionally, in accordance with integrated pest management, pesticide application is almost always necessary to maintain crop yields. There is a whole host of different pesticides within several classes including fungicides, insecticides, herbicides, rodenticides etc., each with their own physicochemical characteristics, behaviour within the environment and toxicity to the receptors within the environment. In addition to the fate and toxicity of the known chemicals, many pesticides come in proprietary mixtures with unknown chemical components (e.g. surfactants) with unknown behaviour within the receiving environment.

Although proper soil management is encouraged, and pesticide technology has made leaps and bounds in terms of environmental effects from the arsenic and lead-based pesticides of the early 1900's, it is still difficult to completely mitigate the effects and even more so, difficult to monitor and regulate their proper uses. There is little-to-no monitoring and enforcement and very little economic incentive for farmers to employ best-practice pesticide use and application (local farmer pers.comms.).

In the face of this difficult environmental problem associated with a necessary sector and service in agriculture, innovative approaches with efforts from multiple stakeholders are required. ARMS recommendations are aligned with those outlined by KWL in the ISMP:

- 1. ARMS recommends agricultural withdrawal and flow monitoring to ensure no impact to outmigrating salmonids
- 2. ARMS recommends water quality and benthic monitoring sites in agricultural reaches of the North Alouette River and Blaney Creek be included in the ISMP.
- 3. ARMS proposes a partnership between CMR, ARMS, Provincial and Federal ministries, academia, First Nations, and conservation groups to financially and logistically support and guide farmers on achieving Salmon-Safe certification for their agricultural products. Salmon-Safe is one of the leading ecolabels in the Pacific Northwest that through peer-reviewed certification and accreditation program, implement farming practices and developments that protect water quality, maintain watershed health and restore habitat.

Pacific Salmon Escapement within Blaney Creek and the North Alouette River

The ISMP only describes Chum salmon escapement in Blaney Creek and the North Alouette River until 1997 and Coho salmon escapement until 2000 and 1996, respectively. The New Salmon Escapement Database System (NuSEDS) has escapement data available for Coho and Chum salmon in Blaney Creek until 2011 and 2018, respectively. For Coho and Chum salmon in the North Alouette River there is data available until 1994 and 2015, respectively. Of note, ARMS has been conducting salmon spawner surveys with volunteers since 2007 on a section of the North Alouette River near the bridge at 132nd Avenue bridge/232nd Street.

Coho and Chum salmon escapement within Blaney Creek and the North Alouette River are a critical metric for which to measure the performance of the ISMP and stormwater management infrastructure. Up-todate monitoring of escapement and comparison to historical escapement data is valuable tool for evaluating the health of a watershed. This is especially important in watersheds with increasing development pressures and impermeable surfaces (e.g. roofs, roads). Coho salmon escapement is particularly important to monitor when it comes to stormwater management as they remain an important vertebrate indicator species for degraded water quality in freshwater habitats under pressure from human population growth and urbanization (Young et al 2018).

- 1. ARMS requests that the most recent salmon escapement data be included in the final iteration of the ISMP.
- ARMS requests that the escapement is reviewed annually to be considered as a metric for stormwater and sediment control infrastructure performance. Annual monitoring of escapement will allow for adaptive management as outlined in the ISMP should a decline in escapement be observed and the decline is suspected to be linked to stormwater runoff.
- 3. ARMS would seek partnerships with CMR, the Pacific Streamkeepers Federation and the DFO for support and funding to incorporate Blaney Creek and to increase efforts on the North Alouette River for our current spawner assessment program which also includes various South Alouette River tributaries. Again, this partnership will provide an environmental and fisheries management

service, provide an educational opportunity for students and volunteers and opportunity for community outreach.

Inclusion of UBC Malcolm Knapp Research Forest as Key Stakeholder

The UBC Malcolm Knapp Research Forest (MKRF) is a large, relatively protected area within important headwater reaches of both the North Alouette River, Blaney Creek and key tributary streams of the South Alouette River. Staff of the MKRF have a long-standing intimate knowledge of the watershed within the MKRF that other stakeholders are unlikely to access to or knowledge about. ARMS greatly values this knowledge and has a history of working closely with MKRF staff.

The aforementioned streams and their tributaries are a key facet of the MKRF. To omit the knowledge gathered by MKRF staff as well as the work of hundreds of researchers who have studied these watersheds for 70+ years (over 1000 scientific projects to date) would be an error. They represent government (provincial and federal), SFU, other universities, consultants, and research institutes.

Failure to engage the MKRF knowledge of the watersheds and to include MKRF staff and their interests within the watershed as a key stakeholder demonstrates a shortcoming in due diligence and potential gaps in necessary knowledge necessary to adequately create a plan as important as the ISMP. Moving forward, in order to continue an ecosystem- and watershed-based approach to management of these key watersheds, ARMS requests that MKRF is included as a key stakeholder for all matters of policy, planning and decision making surrounding the North Alouette River, South Alouette River and Blaney Creek watersheds.

UBC Malcolm Knapp Research Forest Feedback

Though not directly asked to comment as a key stakeholder, the UBC MKRF has a close long-standing relationship with ARMS as we share and work within the same watershed. ARMS greatly values the knowledge and opinions of UBC MKRF staff, in this case Cheryl Power, Assistant Director and Paul Lawson, Director. For these reasons ARMS reached out for comments from MKRF staff to include within our formal response. Please see below for errors and omissions outlined by MKRF staff.

- The watershed area included in the maps within the ISMP is inaccurate, originating from faulty government base mapping. There is no stream or any flow whatsoever from Katherine Lake to Eunice Lake. This reduces the North Alouette Watershed by approximately 158 hectares. Katherine Lake flows into Pitt Lake.
- 2. In the ISMP it is stated that UBC MKRF covers 5,157 hectares of the upper Blaney/North Alouette watersheds. This is incorrect. UBC MKRF is 5,157 ha in total area but not entirely within those two watersheds. Approximately 1,330 ha of MKRF is in the Pitt Lake/River watershed and another 245 ha is in the South Alouette watershed. This equates to 1,575 ha (~30%) not within the Blaney or North Alouette watersheds.
- 3. Page 15-10 the paragraph refers specifically to Blaney and North Alouette watersheds, but there are no First Nations Woodland Licenses in them, nor are 3 of the 4 Provincial Woodlots in Maple

Ridge. Only a portion of Woodlot W0037 (which is licensed to UBC and managed as part of MKRF), is in the Blaney watershed.

- 4. Fig. C-1 Fish Distributions Map:
 - We have no evidence of anadromous fish in Donegani Creek this far upstream in the MKRF. Unless there is evidence we are missing, the upper section within our boundary should be removed or at least coloured 'unknown'.
 - Muir Creek (and another small tributary directly north of it) again no evidence of fish that far upstream, i.e. in the MKRF. From our side, the slopes appear to reach approximately 50% down the canyon to the North Alouette, presumably a fish barrier. (Report states they have LiDAR data which may help verify, if they (the consultant) have not field-measured). Upper sections should be removed or 'unknown'.
- 5. Fig. C-2 Salmonid Spawning and Rearing Habitat (map)
 - Same corrections based on the above.
 - Also North Alouette River coloured portion goes upstream too far, anadromous fish do not enter the MKRF here (barrier --canyon with high falls).

Fish species within each system

1. Section 1.1 and 1.2 state there are Coho, Chum, Pink and thirteen other fish species within the Blaney Creek and the North Alouette River. Section 6.1 states the Coho, Chum, Coastal Cutthroat, Rainbow and two other fish species have been recorded in Blaney Creek. This is 6 species, not the 16 mentioned in the introduction. For the North Alouette in the same section it states that there are Coho, Chum, Coastal Cutthroat, Rainbow and nine other fish species. This is 13 total species, not the 16-total mentioned in the introduction. Understanding species present within a watershed is important for assessing ecosystem functioning and health, and to allow adequate protection of these species from the ISMP. Please correct the fish species inventory within each watershed to a correct count that is consistent throughout the ISMP (i.e. intro, section 6.1, appendices).

Questions, Concerns, Errors and Omissions to be Addressed

- 1. ARMS is curious as to why the North Alouette, Blaney and Fraser escarpments were included in one ISMP, and the South Alouette was not included.
 - Why not use a whole-watershed approach to creating an ISMP including all areas within the Alouette watershed?
 - The inclusion of the Fraser escarpment, and its unique set of policies, muddies the picture for the Blaney/Alouette. We would have preferred it not be included in this plan but to have a separate one.

- 2. ARMS requests that CMR continues to use SPR for development standards relating to streamside setbacks.
- 3. ARMS is concerned about the vague nature of instream habitat related to sediment deposition in section 5.2 of the ISMP. The specific wording of concern is "Due to the physiological characteristic of the Blaney Creek and North Alouette River main channels, there were no areas of deposition identified that would likely cause any consequences in the future." This language is vague and not backed by any data. Is sediment characterization (the clay, silt, gravel, cobble breakdown) monitoring done at any sites? Statement implies no deposition of silt/sediment anywhere which seems unlikely in a developing city.
- 4. All suggested programs are increasing sizing of culverts and storm sewers. Why are other components (green infrastructure) not included in the capital program suggestions?
- 5. Section 16 It is stated that future development should have on-site water quality treatment. What is this treatment directed at? Removal of suspended solids? Removal of pollutants? As there is no description of stormwater characterization it is hard to understand the goal of water treatment.
- 6. Detention section 13 There is no description of possible sites of new detention facilities. Water detention is a key method to reduce velocity/flow why no new detention facilities? CMR uses Bti application to control mosquitoes. Is this done in the detention ponds? Are there any controls to ensure that negative outcomes of BTI on not-target organisms are not occurring in the watershed from this application?

We wish to thank the City of Maple Ridge for the opportunity to provide our input to this draft Integrated Stormwater Management.

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Reviewers

Cheryl Ashlie

Cheryl has contributed greatly to the City of Maple Ridge with many years of dedicated service to the community including a 15-year commitment to civic politics: 9 as a school trustee and 6 as a municipal councillor. Cheryl has also been a member and director of ARMS for many years and served two terms as President.

Daniel King, BSc (Hons) Biochemistry, MET Candidate, SFU

Daniel works as a fisheries biologist with experience in large infrastructure projects, mining and municipal infrastructure projects; and the associated effects on fish and fish habitat, and the mitigation measures required for these sectors. Additionally, Daniel has academic experience in domestic and international fisheries monitoring and management. Daniel has a BSc. (Honors) in Biochemistry, and will soon defend his Masters degree in Environmental Toxicology where he observed the effects of sea lice pesticides used in the Atlantic salmon farms on BC's coast on a flatfish species. Over the course of his post-secondary education Daniel developed a passion for conservation, with a focus on Pacific salmonids, and his education has given him to tools to employ a scientific approach to assessing impacts to salmonids from human activity, from the level of a whole population or ecosystem all the way down to the effects at a physiological and biochemical level.

Josh Baker, M.Sc., P.Chem.

Graduated from Acadia University with a B.Sc. degree in Chemistry in 2007. Commenced his research at Acadia with a study on the effect of river acidification and aluminum on fish. Moved on to study the toxicological relevance of environmental transformations of arsenic and chromium at Trent University, graduating with a M.Sc. degree in Environmental Chemistry. For the last decade he has researched the toxicity of industrial, municipal and stormwater effluents, at an aquatic toxicity testing laboratory in the Lower Mainland.

John Kelly

Recently retired from BC Hydro where he held several senior environmental management positions. These include leading the Water Licence Requirements Program to deliver on the over 300 projects and studies BC Hydro committed to in the Water Use Planning process. He also managed the Water Use Planning projects on the Peace, Campbell and Clowhom watersheds. John also managed the environmental portfolio for the Coastal, Vancouver Island and Bridge River generation fleet. He was the project manager for developing and implementing the Canadian Electricity Associations Environmental Commitment and Responsibility Program that established an industry-wide environmental monitoring and reporting program.

Cheryl Power, RPF

Cheryl Power, UBC Faculty of Forestry's Malcolm Knapp Research Forest Assistant Manager, received the Association of BC Forest Professionals' Distinguished Forest Professional Award for an RFP at the association's annual conference in Nanaimo in February. Cheryl was one of five recipients of the award, which is peer-nominated by other BC forestry professionals. It is the association's highest honour for a member in recognition for work that furthers the association's principles and significantly contributes to the betterment of forestry. Cheryl is a BC Registered Professional Forester and graduated with her Bachelor of Science in Forestry from the University of British Columbia's Faculty of Forestry (1984). For 30 years she has been a leader in the Faculty's field schools, involved in the training of thousands of new professional foresters.

Source: UBC Forestry, February 28, 2020

Paul Lawson, RPF

In 1999, Lawson took on the role of director of the Malcolm Knapp Research Forest and, for almost two decades, has been helping researchers, faculty and students explore, interpret and discover new knowledge in every square centimeter of the forest, from the Golden Ears mountains down to Pitt Lake and south to the edge of the city of Maple Ridge.

Source: UBC Forestry, <u>https://www.ubc.ca/about/what-are-you-working-on/paul-lawson.html</u>

Greta Borick-Cunningham, M.Ed., Dip. Tech. Sustainable Resource Management

Greta has been the Executive Director of the Alouette River Management Society since 2012 and has worked on a variety of salmonid habitat enhancement projects, watershed policy related to the Alouette system including BC Hydro water licenses, water use plan, and the restoration of sockeye salmon to its historical spawning area of the Alouette lake. Throughout Greta's work with ARMS she has partnered with Katzie First Nation, government agencies, BC Wildlife Federation, Green Teams Canada, the City of Maple Ridge, the City of Pitt Meadows, community groups, School District 42 and many others to protect and enhance the Alouette Watershed through education, advocacy and project implementation.

Correspondence from Alouette Valley Association - December 3, 2020

ISMP study

The ISMP is a very comprehensive and well put together document which offers many excellent suggestions for improving the studied watersheds.

We appreciated the opportunity to provide input to the document. Our comments will be confined to the North Alouette and Blaney creek watersheds.

Several members of the Alouette Valley Association were able to attend the online presentation of the document as organized by Joe Dingwall. All AVA attendees of the presentation are long time residents and all live on the North Alouette River. We have all experienced first hand the negative impact of development and traffic flows on the ecology of the watershed. We have also all experienced the increase in flooding of the area. We feel that poor development practices, agricultural practices and insufficient stormwater runoff management have had a major impact on the increased flooding in the area.

One of the most obvious impacts to the local environment is the tragic depletion of the salmon stock on the North Alouette. For many, the salmon are the canary in the coal mine and act as an indicator of how badly the local ecology is suffering. From my personal experience living just south of the 232 bridge on the North Alouette I personally have seen a huge decline in the number of salmon returning. The returns have been particularly bad in the last 5 years and were almost non existent last year. (The recommendation to look at improving access to Balsam Creek may help this in the future). Other indications include a massive decline in the frog populations, painted turtles and crickets. Much of this is not documented or quantified but the collective memories of our group do offer anecdotal evidence of this.

Because the document is so large and technical it is hard for any of us to make informed comment on it in totality so a few points that may be useful to the study.

Issues with development in progress.

 The practice of clearcutting prior to development is a major issue as it elevates the level of runoff to extremes and cause bank erosion. An example of the is the clear cut just north of 233 street. This clearcut has been sitting undeveloped for some time and drains directly into the North Alouette with no obvious runoff prevention.



No direct city environmental supervision of development.

We understand that the current practice is for the developer to hire their own environmental experts to monitor their development. This practice proved disastrous several times when a retention pond at a development on 232 street kept filling up resulting in silt overflows and ending up in the North Alouette River. This event likely would have killed many juvenile fish.



Development on 232st



Silt in the new 232 ditch - AKA Paradise Creek



Silt entering river by 232 bridge at prime salmon spawning pond
We would like to see much tighter supervisions of developers. If this requires hiring more environmental staff then the bill should be paid by the developer and not the taxpayer.

Using rivers as drainage ditches without mitigation.

We understand that the this is a widespread practice in most municipalities but it really makes no sense if we want maintain the health of our rivers.

- Example. The Paradise Creek and drainage pipe diversion on 232 street. There seems to be nothing to prevent toxic runoff and garbage from entering the North Alouette river. Given the drainage area of the pipe, the slope of the pipe and the amount of traffic now using 232s ave there is significant risk of pollution entering the river. In fact every thing possible has been done so as to not impede the flow of the runoff resulting in more stress on the river and exacerbating flooding risk. An an ARMS director observed an effluent plume entering the river. during a post dry season rain event. This was also observed by others but we have no photographic evidence.
- We would like to know how these perceived risks are being handled.

Additional comments from AVA

Just wondering about ongoing water testing throughout these processes.

Environment Canada had been doing testing for years, but lately I haven't seen anyone. I wonder if the previous reports on the testing been looked at during this process? It seems it is hit and miss in Maple Ridge. A few years ago I was told that there had not been previous records kept by the municipality on the health of the river. And, I know there was some testing done when the silt was pouring into the river during the changes on 232nd, but wonder if it is still done.

Pearson Ecological was here last year testing the water and trying to net salmon, working on behalf of the Katzie First Nation. I wonder if the Katzie have been included in this, but don't know if it pertains to this. But, I do know that they were left out on purpose out by the City, on the development proposed and passed on the South Alouette that ARMS has been fighting.

As you mentioned, we are losing our salmon population, but along with that we lose all that depend on the river and I have noticed, for instance, the absence of a lot of beneficial insects and invertebrates that live in a healthy river.

For me as well, there is also the concerns of how the invasive plants will be taken care of and why only in those specifically marked areas.

I'm glad to see they recognised most of the concerns we've been bringing up for years. They did not mention ditch cleaning or dredging and undersized culverts on private driveways. When these overflow and run down the road, as on 132 west of 224, and all along 224, they are dumping road contaminants directly into the smaller tributaries if not the river itself.

I got the impression that the city was not as informed as they should have been by other stakeholders about the regional park development. One way or another this will have an impact on both drainage issues and traffic patterns.

But overall, I think the report was very thorough and hopefully will do more than sit on a shelf.

My concern with reading the report is the * Barriers to Fish Passage Fig. 6-4

*Ponds

*Portion of Cattell Brook Appears to have been buried Fig. 6-9

*Table 6-1 Barriers to Fish Migration 6-12

We do have a high quality of wildlife habitat around Cattell Brook

* 6-14 Cattell Brook had several water quality issues with dissolved oxygen, conductivity E coli, fecal coliforms (wet season) all in Satisfactory or Needs Attention.

My point is: with the new development east end of 136th Ave and south , pipes will be connected for effluent from this subdivision. With the pump station behind 22909 132nd Ave, there is smell, (at times) . Is there fecal contaminants entering Cattell Brook at that end? What specific areas of Cattell Brook need attention? There is a beaver pond and 2 dams now on Cattell Brook along the Green Pond Trail, behind Nelson's property. Address 22947 132nd Ave has Cattell Brook running through back of the property, connecting to a cement culvert that handles water heading west (at high water) (possibly), along with another culvert west on the Green Pond Trail, again when water is high. For salmon to enter these 2 culverts to head upstream to spawn, it's highly impossible, the water flow needs way more water for salmon to reach higher grounds. Also, this property, have you seen the horse manure piled up on the back of the property lately? It's as high as the fence posts and many years accumulation and very, very close to the Cattell Brook.

We have had many years ago 2 salmon spawn on our portion of Cattell Brook. Unfortunately we did not take pictures.

Conclusion.

We commend the to do list in Table 16.1. Much of this is relatively inexpensive and could yield a good return. Where possible AVA would love to help with applicable projects.

Overall most of our group were very impressed with the document. It is hoped that it will become a living document and not just sit on a shelf gathering dust. It is hoped that the many good principles are followed and not ignored because of money and expediency. Many of the good people that spent huge amounts of time putting together the Silver Valley Area plan have given up in disgust that the core principles have not been followed. We hope this does not happen here. Maybe, now, the lessons learned from the pandemic will help us realize how important to our well being the environment is. The nature in the Valley and the dykes is the only real antidote to being locked up in our little boxes. Letter from BC Conservation Foundation - Wildsafe BC - November 30, 2020

Dear Mr. Dingwell,

Thank you very much for giving WildsafeBC the opportunity to give input on the ISMP. I found the document beneficial in understanding all the factors that goes into city planning. My comments below address the benefits of a proper wildlife corridor.

Maple Ridge is in the final stages of completing all the elements to achieve Bear Smart status. One of the requirements is for the city to have a comprehensive plan for the safe movement of wildlife within its city's limits. Properly planned wildlife corridors are essential for the safe movement of wildlife. The suggested minimum distance for a wildlife corridor based on the topography of Maple Ridge is 50 to 100 meters (see attached buffer ranges). In older established neighborhoods this distance was not always achieved. Hopefully, when new developments are created this standard will be seriously considered.

My other suggestion is when replacing culverts to make them large enough for safe passage of bears. In 2019 we had 5 bears hit by cars. If there's a safe passage for them, then this number could be reduced and thereby increasing public safety.

I understand that every organization has a wish list which creates a challenge in creating an effective ISMP that benefits all stakeholders. According to Paul Beier, Dan Majka, Shawn Newell, Emily Garding, Northern Arizona University January 2008 Best Management Practices for Wildlife Corridors there are 16 steps to consider when establishing a wildlife corridor.

Mitigation for Urban Barriers 1) Integrate the Linkage Design into local land use plans. Specifically, use zoning and other tools to retain open space and natural habitat and discourage urbanization of natural areas in the Linkage Design. 2) Where development is permitted within the linkage design, encourage small building footprints on large (> 40 acre) parcels with a minimal road network. 3) Integrate this Linkage Design into county general plans, and conservation plans of governments and nongovernmental organizations. 4) Encourage conservation easements or acquisition of conservation land from willing land owners in the Linkage Design. Recognizing that there may never be enough money to buy easements or land for the entire Linkage Design, encourage innovative cooperative agreements with landowners that may be less expensive (Main et al. 1999, Wilcove and Lee 2004). 5) Combine habitat conservation with compatible public goals such as recreation and protection of water quality. 6) Each strand of the linkage design must be broad (typically 1-2 km for most of its length) to allow a designated trail system without compromising the usefulness of the linkage for wildlife. Because of the high potential for human access, the trail system should be carefully planned to minimize resource damage and disturbance of wildlife. People should be encouraged to stay on trails, keep dogs on leashes, and discouraged from collecting reptiles and harassing wildlife. Traveling in groups should be encourage in areas frequented by mountain lions or bears. 7) Where human residences or other low-density urban development occurs within the linkage design or immediately adjacent to it, encourage landowners to be proud stewards of the linkage. Specifically, encourage them to landscape with natural vegetation, minimize water runoff into streams, manage fire risk with minimal alteration of natural vegetation, keep pets indoors or in enclosures (especially at night), accept depredation on domestic animals as part of the price of a rural lifestyle, maximize personal safety with respect to large carnivores by appropriate behaviors, use pesticides and rodenticides carefully or not at all, and direct outdoor lighting toward houses and walkways and away from the linkage area. 8) When permitting new urban development in the linkage

area, stipulate as many of the above conditions as possible as part of the code of covenants and restrictions for individual landowners whose lots abut or are surrounded by natural linkage land. Even if some clauses are not rigorously enforced, such stipulations can promote awareness of how to live in harmony with wildlife movement. 9) Develop a public education campaign to inform those living and working within the linkage area about living with wildlife, and the importance of maintaining ecological connectivity. 10) Discourage residents and visitors from feeding or providing water for wild mammals, or otherwise allowing wildlife to lose their fear of people. 11) Install wildlife-proof trash and recycling receptacles, and encourage people to store their garbage securely. 12) Do not install artificial night lighting on rural roads that pass through the linkage design. Reduce vehicle traffic speeds in sensitive locations by speed bumps, curves, artificial constrictions, and other traffic calming devices. 13) Encourage the use of wildlife-friendly fencing on property and pasture boundaries, and wildlife-proof fencing around gardens and other potential wildlife attractants. 14) Discourage the killing of 'threat' species such as rattlesnakes. 15) Reduce or restrict the use of pesticides, insecticides, herbicides, and rodenticides, and educate the public about the effects these chemicals have throughout the ecosystem. 16) Pursue specific management protections for threatened, endangered, and sensitive species and their habitats.

Properly planned wildlife corridors of 50 to 100 meters are also beneficial to the water quality of streams and rivers.

There has also been some consideration of, but very limited research on, changes related to the evolution of the buffer itself over time. Murcia (1995) hypothesizes that buffers to wooded or forested systems may play an important role for a newly created edge, but less of a role over time as that edge "hardens". In cases where a newly planted buffer is being installed around a watercourse or wetland, time can be beneficial insofar as the establishment and growth of herbaceous and woody vegetation can help improve water quality. For example, Vellidis et al. (2003) documented significant improvements in wetland water quality from a 38 m buffer over a nine year period, while Yamada et al. (2008) documented improvements in groundwater quality within three years of planting a 25 m buffer along a stream in an agricultural setting. A thesis (Orzetti 2005, as cited in Okay 2007) reported that restored forested riparian buffers in the northwestern U.S. begin to show effectiveness after about five years and are hypothesized to increase in effectiveness for 30 to 40 years or longer as the trees mature. Clearly monitoring programs designed over a few years are not going to detect these kinds of changes.

Beacon Environmental Ecological Buffer Guideline Review (December 2012)

Thank you again for including WildsafeBC as part of your input into the ISMP. I have attached two researched documents into buffer ranges and biophysical factors.

Best,

Daniel Mikolay WildsafeBC coordinator Maple Ridge



Ecological Buffer Guideline Review (December 2012)

Table 7. Ranges for buffer widths to natural heritage features based on the current science.

Natural	Buffer Function Category												٤	_	
Heritage		-	E	ε	Е	ε	ε	ε	ε	ε	ε	0 m	10 1	20 n	
Feature		ε	10 n	- 20	- 30	- 40	- 50	- 60	- 70	- 80	- 90	- 10	÷ I	4	20 L
Category		v V	5 -	1	21 -	31	41-	51 -	61 -	- 11	81 -	91 -	101	111	× 15
WATERCOURSES and WATER BODIES															
	A. Water Quantity	data	indica	te that	this is	not mi	itigated	t by sit	e spec	ific bu	ffer				
	B. Water Quality											1			
	C. Screening of Human Disturbance /	100								-					
	Changes in Land Use		j			-									
	D. Hazard Mitigation Zone	should be based on consideration of hazards, but may overlap with buffers													
	E. Core Habitat Protection		-									<u> </u>			
WETLANDS															
	A. Water Quantity	data	indica	te that	this is	not mi	itigated	d by sit	e spec	cific bu	ffer	<u> </u>			
	B. Water Quality										_	÷			
	C. Screening of Human Disturbance /														
	Changes in Land Use			2	and a	-									_
	D. Hazard Mitigation Zone	shou	ld be t	based	on con	sidera	tion of	hazar	ds, but	may c	overlap	with b	uffers	-	_
	E. Core Habitat Protection							2							
UPLAND WOODLANDS and FORESTS									-						
	A. Water Quantity		insufficient data												
	B. Water Quality	insu	fficien	t data	-	_									
	C. Screening of Human Disturbance /		2 -												
	Changes in Land Use		27	ليجيئ											
	D. Hazard Mitigation Zone	shou	ld be b	based	on con	sidera	tion of	hazar	ds, but	may c	overlap	with b	uffers		
E. Core Habitat Protection		-									<u> </u>				
MEADOWS															
	A. Water Quantity	insufficient data													
	B. Water Quality	insufficient data													
	C. Screening of Human Disturbance /	insufficient data													
	Changes in Land Use					_	_								
	D. Hazard Mitigation Zone	insu	fficier	t data			Charles and the lot	S- 8- 9- 1	1.5		-	-	-		-
	E. Core Habitat Protection*					-		6 mart	1. al			-	1	2-37	

*data available for area-sensitive grassland birds only

<u>Note 1:</u> In all cases the buffer is to be applied from the Critical Function Zone limit, not strictly the feature boundary.

Note 2: Supporting literature is identified in Appendix A.

Key: Risk of Not Achieving the Desired Buffer Function HIGH MODERATE LOW BEACON ENVIRONMENTAL

Ecological Buffer Guideline Review (December 2012)

Table 9. Supporting literature for key biophysical factors to consider in buffer width determination.

Biophysical Factor*	Increases to buffer widths <i>may not</i> need to be considered	Increases to buffer widths could be considered	Supporting Literature	Comments					
HYDROLOGIC DYNAMICS	YDROLOGIC Catchment area size small Catchment area YNAMICS relative to protected feature relative to prot size (e.g., 100:1) (e.g., 1000:1 o		Adamus 2007; Leavitt 1998	Buffers in and of themselves only have a limited ability to moderate catchment-scale water quantity dynamics; this ability is directly					
	Entry runoff velocity low to moderate	Entry runoff velocity high	Lee et al. 2003; Woodard and Rock 1995	related to the pattern and intensity of flows (Dillaha <i>et al.</i> 1986a, Leavitt 1998, Lee et al.					
	Sheet flow over buffer	Channel flow or buffer bypassed by drainage	Castelle and Johnson 2000; Adamus 2007	2003, Woodard and Rock 1995).					
	Subsurface flow (seeps, high water table)	Flow path to deep or regional groundwater	Angier <i>et al.</i> 2005	Groundwater that manifests itself near the surface can contribute to denitrification.					
SLOPES	Slopes of 0% to 12% towards protected feature***	Slopes of 13% to 15% or more towards protected feature	Wenger 1999; Woodard and Rock 1995; Schueler 1987; Norman 1998; Castelle and Johnson 2000; Adamus 2007	The literature indicates that slopes of more than 12% to 15% tend to result in reduced buffer effectiveness related to water quality functions. Soil type and vegetative cover also factor in to buffer effectiveness on slopes.					
VEGETATIVE COMPOSITION OF BUFFER	A relatively dense Sparse herbaceous cover herbaceous layer		Hook 2003; Castelle <i>et al.</i> 1992; Wilson and Imhof 1998	Herbaceous cover is generally more effective at attenuation of contaminants in surface runoff (while woody vegetation is generally					
	Presence of trees and shrubs with herbaceous understory	Sparse presence of trees and shrubs with herbaceous understory	Lee <i>et al.</i> 2003	more effective at attenuation of contaminants in sub-surface runoff). Treed buffers also provide a better screen for light, wind, noise as					
	Presence of coniferous trees and shrubs	Presence of deciduous trees and shrubs	Brown <i>et al.</i> 1990; Lowrance and Sheridan 2005; Knight et al. 2010	well as better erosion control. Coniferous buffers provide these functions all year round.					
	Presence of woody debris	Absence of woody debris	Sheldon et al. 2005	Relates to water quantity and quality control by slowing flow pathways.					
SOILS	Larger textured soils (e,g, sand, loams)	Finer textured soils (e.g., clays)	Brown <i>et al.</i> 1990; Wilson 1967; Sullivan <i>et al.</i> 2007;	Relates to water quantity and quality control by influencing local permeability and infiltration rates. Organic matter also contributes to denitrification.					
	Soils permeable but not highly sandy	Compacted soils and/or soils with low permeability	Polyakov e <i>t al.</i> 2005						
	Soil with organic matter, humus or mulch layer	Soil without organic matter, humus or mulch layer	Mayer et al. 2006; Gift et al. 2010; Bradley et al. 2011						

* Biophysical factors have the potential to interact with and influence each other, and therefore should not be considered independently

- Page 101

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Email from BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development -February 18, 2021

- Can the actual stream conditions at stormwater outfalls be assessed to confirm current SWM practices do not adversely affect the receiving stream, to supplement Table 14-1; similar to the Culvert Survey.
- Blaney Creek 144 Avenue Outfall erosion issue, Appendix A, Photo A-3, Section 14.4, , Appendix C, this is an indication that stormwater outfalls need to be designed appropriately, maintained, and repaired (or relocated) promptly when stream conditions change. Under the Water Sustainability Act, stormwater outfalls are done under Water Sustainability Regulation as a Notification, and there is little or no review done of a stormwater outfall designed (and submitted) by an engineering professional. It is recommended that approval of a stormwater system by a local government, includes a review of the stormwater outfalls by the local government environmental staff.
- Can Maple Ridge or KWL provide the basis of frost protection for cranberries may result in fry mortality, notes on Figure C-5?
- Delineate the shared boundary of the North Alouette River and the Alouette River along 132 Ave that is subject to flood flows, and that SWM along this shared boundary may not be possible due to the larger issue of trans boundary flood flows; input the results from the flood study.
- The end of January 2020 storm event is not mentioned in the October 2020 draft report, S.75 Existing Drainage System Assessment for storm events, listing September 1996, October 2003, September 2004 and March 2007 as Design Storms. Can the January 2020 storm event be reviewed as a future Design Storm?
- Stakeholders: Province (FLNRORD, MOE, MAg and associated leg RAR, WSA, EMA), Pitt Meadows?
- Table 4-2: Is there opportunity to update this to reflect other legislative requirements/recommendations and climate change considerations (for notification, 1:200 year?)? Consideration of climate change and how flows may change, and accommodation of those changes (what is the new 100-year or 200-year flow?)?
- Baseflows (summer low flows) and groundwater recharge: Is there opportunity to encourage recharge for baseflows? Or any studies relating to this for these particular watersheds?
 Development and land use changes have potential to lead to less infiltration of water to groundwater (recharge), which thereby can reduce baseflows during low flow periods.
- Downstream conditions in Pitt Meadows and upstream: have any referrals/discussion occurred with Pitt Meadows about impacts to these watersheds in each respective City, and how that impacts the other?
 - S. 4.3 on Impacts of future Development "residents also believe that changes to downstream conditions in Pitt Meadows (filling land, dikes, filling in ditches, channels) may affect the creeks and conditions upstream in the City of Maple Ridge"
 → can this be expanded on? → same could be said with regards to developments in upstream areas and stormflows that impact downstream conditions in Pitt Meadows
 - Policy Planning: ...the City of Pitt Meadows and the Agricultural Land Commission (ALC) have allowed the construction of a cranberry dike which has affected drainage in the Maple Ridge section of the valley. → Can you provide more info on this (when, where and why)? Am curious if this is part of licensed works, and if the FLNRORD Dikes team has been involved or is aware of it.

- Gravel removal from North Alouette still occurring? Is this valuable spawning habitat? Has the source of the sediment been addressed (always occurred, or occurring more recently? Can this be mitigated at the source rather than have consistent sediment removal?)
- "Together, Codd Island Wetlands and Blaney Bog form the largest area of off-channel salmonid rearing habitat within the Alouette watershed and provide some of the most important off channel wetland habitat for rearing salmon in the lower Fraser River (Gebauer 2001)" – this is directly adjacent to cranberry water licence applications. Thank you for making us aware of this valuable habitat.
- S. 6.5 I like the idea of working with Maple Ridge/DFO to ensure landowners are aware of the current regulations. Who would be best to engage with on this? How can we do this effectively?
 - A lot of the agriculture area is within Pitt Meadows. "Actions may include working with local farmers to help reduce their impact on the adjacent streams" – How to encourage/motivate farmers to do this if not explicitly in a bylaw or reg?
 - "The current state of these dikes and channels should be reviewed to determine if they are still required or if restoration of this sensitive habitat can be completed" Who would do this review and restoration? I like this idea, but unsure of how it can practically be achieved? (perhaps through funding options listed near end?)
 - "Mitigation measures such as increasing riparian cover, instream habitat complexity, and stream connectivity can be implemented to reduce predation pressures on outmigrating fry" – Same as above – who would do this, how is it covered in bylaws/regs/Pitt Meadows jurisdictional issues
- Does Maple Ridge want to be referred to for any streams within watersheds that are also within their boundary, even if stream/reach is not (e.g. Lower Blaney Creek and North Alouette that fall within Pitt Meadows)?
- S. 11.2
 - o 1. And promotion of GW recharge?
 - 2. Define stakeholders same as intro, or will it include provincial staff as well? (RAR, Water, Resource Management, SARA, MAg, etc)
 - Good stewardship of agricultural land Practically, how will this be done? Promoted? Regulated? Is there any legislation to enforce this, or purely encouragement? This could be challenging.
 - Anticipate and respond to impacts of climate change By building climate change buffers into current standards? (e.g. 100 year flood to 200 year flood and associated design)
 - Incorporate monitoring and re-evaluation/validation as an ISMP Principle and Approach? Good to set goals, but delivery and evaluation and associated adjustments are key to better potential success of protecting watershed health and associated public benefits to infrastructure and environment
- Table 16-1: Research #20: Investigate whether water withdrawals in the spring by cranberry farms for frost protecting is killing outmigrating salmon fry. → Expand: is this due to flows being too low to support migration of fish? Or due to entrainment? Or other? Unclear as to why.
- Figure 16-2: Project 10: restore off-channel habitat along lower Blaney Creek, North Alouette River, and Cattell Brook. → Would water current or future water withdrawals from this location

interfere with this? How to consider environmental impacts, on current scenario, or future scenario with off-channel habitat? Want to ensure new habitat is not dewatered.

- Table 17-4:
 - Hydrometric data any interest in adding to Provincial Hydrometric Data online through Aquarius (Data sharing agreement; this would be publicly available; goal is to have a centralized system for available hydrometric data)?
 - Any observation wells to relate this data to? To observe trends in GW that may be related to changes from land use/development?
- Section 1.4 I think this is key, especially with respect to our authorizations and how we require compensation on really poor quality watershed and ignore impacts on high quality watersheds... This should be considered like some form of a habitat bank, or instead of no-net-loss on site, we focus entirely on off-site compensation.
- Section 1.5 Bullet Point 6 focus on outlining where perched culverts are in the upland areas to focus on restoration... they need to consider adapting that culvert assessment that we watch from the US Forestry... I'll see if I can find the link and we should build that into our culvert stuff with the authorizations
- Section 15.3 Consider a tax break for agricultural areas that retain or increase vegetation buffers along stream banks.
- Table 4.2 Minor drainage system should be revised to 1:50
- Table 4.2 Major drainage system should be revised to 1:200
- Section 4.2 Provincial Streamside Protection Regulation: need to amend bylaws to include retaining riparian vegetation not just setting buildings back from banks of the stream, and should also include agricultural property
- Table 4.3 should include agriculture crop not just the buildings and should speak to retaining vegetation
- Undersized Culverts and Ditches should include agriculture crop not just the buildings and should speak to retaining vegetation
- Impacts of Future Development need to hold developers more accountable for longer term for the projects they are building
- Table 5.1 does this align with the EMBC ratings for consequences? Does it have to?
- Section 6.5
 - should incorporate green space flood plain into the development plans instead of building so many condos on a plot of land
 - o requirement for water metering is a must!
 - no "right to farm" permit should be issued without confirmation of adequate water availability and license
 - Re: North Alouette: there may be water users without licenses
 - Re: BC Ministry of Environment and Climate Change Strategy (BC MOE) how old is this report?
 - Re RipRap: Buy-in needed from the engineering department to increasingly turn toward natural landscaping in their design not cheap and easy riprap.
- Section 15.2 Application of Criteria -reduce land clearing of native vegetation, retain vegetation only on the lots being developed
- Section 15.4 the city should develop a list of sensitive streams based on their own criteria separate from the WSA so that the province could support them on efforts to improve these watersheds
- Section 15.4 Enhance Protection for Sensitive Areas include retention of riparian habitat and not just building setbacks

- Section 15.4 provide comments on registered vs unregistered
- Section 15.4 Public Education this is key to educate public in ALL things water.... most people don't even know these issues exist. it should be up to the municipality to get the message out to their tax payers (property tax mailout)
- Section 1.4 Project proponents should follow the BC Environmental Mitigation Policy in particular the mitigation hierarchy. Impacts should be avoided, minimized, and restored on-site wherever possible prior to considering offsets/compensation. <u>https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policiesstandards-guidance/environmental-guidance-and-policy/environmental-mitigation-policy
 </u>
- Section 1.5 Further engagement with FLNRORD on the North Alouette River flooding issues is
 encouraged if it is not already happening. It is preferred to let rivers/streams function naturally
 wherever possible. Where intervention is necessary to protect other interests, methods that
 minimize impact to habitat and natural stream function are preferred.
- Section 3.2 should include FLNRORD
- Section 15.3 In general supportive of protecting natural systems as natural assets. Would like
 to point out wetlands in particular. Municipalities often don't have an inventory of their
 wetlands (other than major ones) or have them on their web maps. Wetlands (especially
 headwater wetlands) are important for regulating flows. We get applications for Change
 Approvals where proponents are surprised by a wetland on their property. In other cases, they
 are aware of it, but have put significant time into a design that includes infilling the feature and
 creating compensation features. The compensation features generally don't perform as well as
 the natural features and we generally do not support this approach (while being aware that it
 may be necessary in certain cases). Having features mapped ahead of time and having them
 protected earlier in the process (i.e. at the municipal level) will prevent surprises/challenges
 later in the design process, making things easier for all stakeholders.
- 13.1/15.3 I would like to point out that we frequently see developers attempt to use construction of detention ponds with vegetation as compensation for losses of habitat. While having storm water management systems mimic natural hydrological processes as much as possible is preferred, they are generally not suitable replacements for natural systems and habitats. Those systems and habitats are location dependent. They develop in a particular location to perform particular functions. Constructed compensation systems and habitats generally do not perform as well and often result in a loss of valuable biodiversity.
- Stormwater Outfalls I would like to see the number of stormwater outfalls required kept to a
 minimum as they cumulatively present a potential for significant adverse impacts to streams via
 pollutants and erosion. Where they are required, we frequently see too much instream work
 (e.g. placement of rip rap) required for erosion protection. This indicates to us that not enough
 has been done to control the discharge rate and velocity above the outfall.
- How many mapped springs are there in the area? Are there actually significant users from springs?

- a. If there was a way for us to suggest that this was investigated further it would be great info for us
- Beyond culvert design, what are the other considerations for addressing climate change?
 - a. One consideration should be recharge
 - b. And if they are expecting more frequent storms, why are some culvert 1:100?
- Have any of the recommendations been given the go ahead or do they have a priority list of recommendations and any timelines?
- Maple Ridge plans on monitoring streams. This should include wetlands. I would also suggest some monitoring of the springs if they are indeed abundant.
- Section 6-2 Riparian Corridor Assessment reveals low RFI in Fraser Valley watershed which is not attributed to particular land uses. Clearer attribution of the reason for low RFI score to a particular land use/practice may be needed for clarity here. Distinguishing what is a result of ongoing agricultural land clearing vs what is grandparented development within riparian area can help distinguish whether this riparian cover can be reinstated or is lost to development.
- Section 6-5 Clearing of riparian vegetation on Cattell Brook as above is this related to bylaw contraventions i.e. unpermitted tree removals or historic clearance and grandparented development prior to adoption of Maple Ridge SPR bylaw? Or agricultural?
- Section 9-3 This section alludes further to what is the cause of low RFI total TIA in Fraser Valley being high suggesting historical development is the driver whereas Blaney/Cattel have low TIA suggesting agricultural driver. Driver for low RFI could be more explicitly laid out in order to understand potential for restoration vs to what extent watershed has been irrevocably altered. Making this distinction will help prioritize next steps should the focus be on retrofitting restoration to the watershed (channel & banks restoration) to compensate for losses already occurred? Alternatively, focusing on changing land use practices to reverse decline in watershed health may be more appropriate in places. Channel restoration in areas affected by poor land use practice will be ineffective and is more suited to areas where it is the only option historically developed catchments with no opportunity to recover riparian function.
- Section 16 This section is light on detail of how to tackle agricultural land use practices which
 seem to be a big driver of impacts to riparian cover and fish habitat. This aspect is one of the
 most difficult to resolve but has significant potential to contribute to the overall watershed
 health and Maple Ridge's ISMP goals. Understanding how feasible any changes to land use in
 agricultural areas may be critical in determining whether spending on other suggested projects –
 fish habitat/passage/erosion issues is worthwhile. Suggest partnering with Ministry of
 Agriculture to understand what options exist for improving practices/reversing decline or
 whether larger scale restoration projects may be possible.

Email from Morningstar – January 12, 2021

"Good morning Joe,

I apologize for the extended delay in getting these comments back to you. We thank you for the time you have provided us to review and discuss the DRAFT ISMP report dated October 2020. Please find our comments and questions below. We look forward to working on this further.

Page 64 Section 8-2 :

- Are there any suggested changes for applicable zones in the OCP regarding the pervious / impervious surface ratio on site? If so, we would like more information.

Page 101 Section 15-1:

- Introduction of water quality treatment for single family lots ... This could be very difficult to monitor/manage for single family homes.

- What measures are being considered?
- Will the City be requiring retrofitting for existing homes ?
- We have great interest in reviewing this item further.

Page 104 Section 15-4:

- Application of formal limits of allowable impervious surfaces should consider discretion in any design prescription based on site/soil conditions. For example, "Haney Clays" in the Albion region of Maple Ridge provide almost no infiltration within backyards, therefore a limit on impervious surfaces that constrict house size further than setback allowances would in our opinion be ineffectual.

- Further water quality on driveways/parking spaces for single family homes poses some concern – we would like to review further information on this if possible.

Page 107 Section 15-7:

- Strategies / incentives for funding (additional stormwater fees and/or area-specific development cost charges). We believe allocation for these items is already addressed under site-specific review of designs for rezoning, and carried under existing DCC / Budgets with each new application. Additional charges and fees add costs that are then passed onto the consumer / homeowners, further eroding housing affordability.

- We support the principle and option of offsite stormwater management opportunities as suggested, where full on-lot compliance may not be possible. This allows for greater flexibility and more tangible benefit.

Page 108 Section 15-8:

- We would like some clarification on a few of the statements in this section. After review with our QEP (Qualified Environmental Professional), it seems that some of the statements here are unclear.

o For example, the recommendation to increase setback from 30m to 50m is unreasonable, and we believe the statement that "a shift from SPR to RAPR would yield a reduction in streamside habitat" is incorrect. We recommend the setback not change.

To provide context, in the Streamside Protection Regulation, if a watercourse is identified within 50m of a developable area, this 50m area is used to trigger a Natural Features Development Permit under municipal policy.

The 50m measurement is used to assess potential vegetation conditions around the riparian area, and as a trigger for a development permit.

30m is the maximum setback to any water course, +- vegetation buffer, normally categorized for windthrow risk (protecting trees on the border of the 30m setback).

- Further, the development community could never bear the burden of setbacks in excess of 30m, and this practice (50m setbacks) is not recognized in other municipalities, nor is it reasonable.

- Lastly, RFI (Riparian Forest Integrity) is a macro-scale tool used to assess watershed health, and does not apply to land use decisions.

Page 111 Section 16-1:

- 4. Offset unavoidable impacts to habitat I how is unavoidable defined?

Overall, we look forward to working with the City and Staff to meet general objectives. If more specific information on alternatives and clarification could be provided, we would be happy to provide further comment.

We appreciate the opportunity to participate in this review. If you have any questions regarding our comments please don't hesitate to reach out.

Thank you kindly,

Addie Anderson Development Manager"

Addie Anderson Development Manager **MORNINGSTAR** Suite 580 – 8621 201 Street Langley, BC, V2Y 0G9 Call or Text: 778-688-4000

www.mstarhomes.com

Emails from UBC Malcolm Knapp Research Forest – December 10 & 11, 2020

Hi Joe – Thanks for your request to comment on the Draft Plan.

We see this is a very important initiative and view it as central to our role as managers of headwater portions of these high value watersheds. We also believe that management of these issues is the cornerstone of our value to the community. The fact that clean water flows out of this forest is a fulfillment of our goals, and we strive to maintain that standard every day.

Our Assistant Manager, Cheryl Power has done a thorough review of the draft Stormwater Management Plan as part of her long-time collaboration with ARMS. She did find some factual errors in the underlying maps and data, and I have attached her detailed comments to this email.

Overall though, Cheryl and I both felt that the report was a very good document that can guide us in doing a better job managing our forested landscapes, and also in recognizing downstream risks that are core to the community's interests.

We are very grateful to the City of Maple Ridge for preparing this draft plan and offer our full support for its implementation. We would be pleased to offer comment on any further initiatives that relate to this or other areas of mutual concern.

Sincerely,

Paul Lawson Director, University Research Forests Faculty of Forestry The University of British Columbia | Malcolm Knapp Research Forest | ģĺćəỷ Traditional Territory 14500 Silver Valley Rd. | Maple Ridge BC | V4R 2R3 Canada Phone 604 463 8148 press 1 - 102 | Cell 604 341 2168 | Fax 604 463 2712 Paul.lawson@ubc.ca mkrf.forestry.ubc.ca | afrf.forestry.ubc.ca | loonlake.ubc.ca | gallant.forestry.ubc.ca | wildlearnings.ca



THE UNIVERSITY OF BRITISH COLUMBIA

Here are my items noted for correcting errors in this draft ISMP. I also summarized yours.

- 1) The North Alouette watershed area is inaccurate, this originates from faulty government basemapping. This same error appears in all previous watershed maps I've seen, other than our own (e.g. the same error is in City of MR's consultants, NHC, floodplain analysis, Phase 2 - 2016 report). I've highlighted this error with government and others, many times over the last few decades. There's no stream or flow whatsoever from Katherine to Eunice Lake. This reduces the North Alouette watershed by approx. 158 hectares. Katherine flows into Pitt Lake.
- 2) The report states in a couple of places that the UBC MKRF covers 5,157 hectares of the upper Blaney / North Alouette watersheds. This is incorrect. Yes, the UBC MKRF is 5,157 ha total area. However, we are not entirely within those two watersheds. In fact, approx. 1,330 ha of the MKRF is in the Pitt Lake / Pitt River watershed, and another 245 ha. is in the South Alouette

watershed. This makes a combined total of approx. 1,575 ha (about 30% of our total area) which is neither in the Blaney or N. Alouette.

- 3) P. 15-10 'Dialog with External Stakeholders' -- the paragraph refers specifically to Blaney and N. Alouette watersheds, but there are no First Nations Woodland Licenses in them, nor are 3 of the 4 Provincial Woodlots in Maple Ridge. Only a portion of Woodlot W0037 (which is licensed to UBC and managed as part of MKRF), is in the Blaney watershed.
- 4) Fig. C-1 Fish Distributions Map
- We have no evidence of anadromous fish in Donegani Creek, this far upstream in the MKRF. Unless there's evidence we're missing, the upper section within our boundary should be removed or at least coloured 'unknown'.
- Muir Creek (and another small tributary directly north of it) again no evidence of fish, that far upstream, i.e. in the MKRF. From our side, the slopes appear to reach approx. 50% down the canyon to the North Alouette, presumably a fish barrier. (Report states they have LiDAR data which may help verify, if they haven't field-measured). Upper sections should be removed or 'unknown'.
- 5) Fig. C-2 Salmonid Spawning and Rearing Habitat (map)
- Same corrections based on the above.
- Also North Alouette River coloured portion goes upstream too far, anadromous fish don't enter the MKRF here (barrier --canyon with high falls).

Thanks,

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