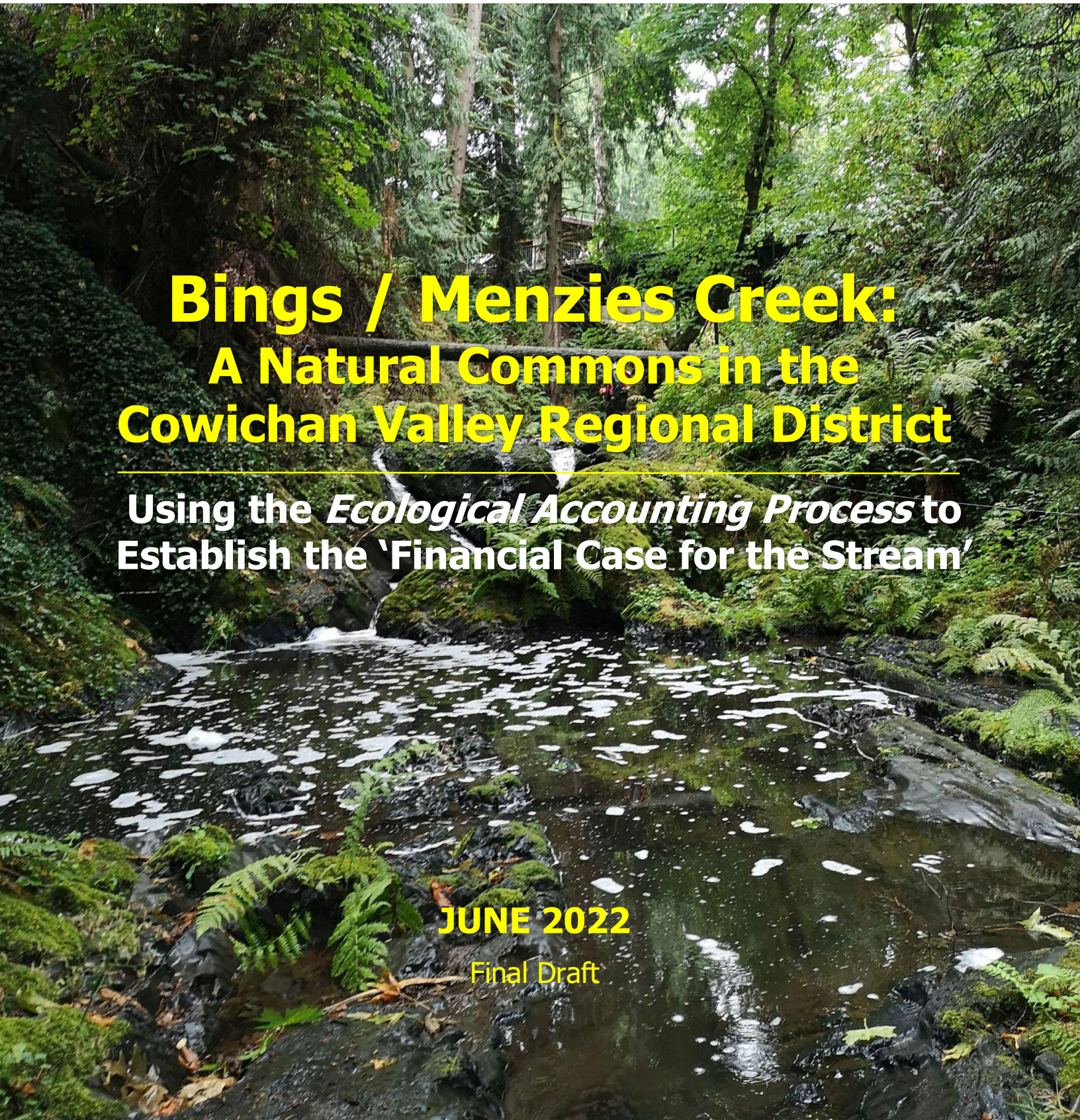
the partnership
for water sustainability in bc



Bings / Menzies Creek:
A Natural Commons in the Cowichan Valley Regional District

Using the *Ecological Accounting Process* to Establish the 'Financial Case for the Stream'

JUNE 2022

Final Draft

Note to Reader:

Under the umbrella of the Georgia Basin Inter-Regional Education Initiative, this publication is the seventh in a series of demonstration applications that have evolved EAP, the Ecological Accounting Process - A BC Process for Community Investment in the Natural Commons.

The EAP program is multi-year (2016-2022) and multi-stage to test, refine and mainstream the EAP methodology and metrics. EAP supports Asset Management for Sustainable Service Delivery: A BC Framework.

To download a PDF copy of this Bings / Menzies Creek EAP report, as well as any of the others in the series, visit the Green Infrastructure community-of-interest on the waterbucket.ca website at:

https://waterbucket.ca/gi/category/ecological-accounting-process/

ACKNOWLEDGMENTS: Funding from three organizations made it possible to undertake the project - Real Estate Foundation of BC, Cowichan Valley Regional District, and the Partnership for Water Sustainability in BC.

The members of the Project Committee contributed timely input and guidance to select appropriate study areas and parcel sample groups for purposes of EAP analyses. This was invaluable in helping the research team achieve a successful project outcome.

The Partnership also recognizes the valuable support provided by Ariel Verhoeks of the Mount Arrowsmith Biosphere Region Research Institute (Vancouver Island University) in carrying out the foundational GIS analyses.

C·V·R·D

real estate foundation BRITISH COLUMBIA

COVER PHOTO CREDIT: Somenos Marsh Wildlife Society

Application of EAP to Bings/Menzies Natural Commons
What the Reader Will Learn

For the past two decades, population growth in the Cowichan Valley region and Municipality of North Cowichan (MNC) has persisted at about 2% per annum. Resulting land use demands have altered regional streams as subdivision and development occur.

This is the context for the Partnership for Water Sustainability applying **EAP, the Ecological Accounting Process**, to quantify and describe the extent of land use impacts on the condition of the Bings / Menzies stream system which lies primarily in North Cowichan. The analysis applies primarily to 2.7kms of the stream flowing through the urban area.

The EAP findings contribute to the policy concerns of MNC's current Biodiversity Protection Policy Project.

The EAP analysis considered 79 abutting parcels. Fifty-eight in the urban reach of the stream while the other 21 parcels were in the upstream rural reach. The **Natural Capital Asset Value (NCA)** of the urban reach of the stream is $2100 per metre. The findings about the riparian condition of the stream are:

- The riparian setback zone of the stream in the urban reach is largely intact. The conditions are supported by MNC Development Permit Area 3 (natural environment) and the steep topography of this reach of the stream system.
- The upland land use for a zone that is 200m beyond the setback zone is characterized by subdivision and development that cuts off extended riparian area and drastically alters water pathways (rainwater falling in upland areas and moving to the riparian zone).
- The Cowichan Valley trail borders about 2 kms of the stream riparian corridor. This amenity is in high demand. Off-trail wandering negatively affects the stream.
- EAP analyzed 9 large strata subdivisions in upland areas bordering the stream or the Cowichan Valley Trail and the stream. These developments are characterized by impervious area (60% on average), engineered drainage systems which divert rainwater away from the riparian zone, and lack (<25%) of riparian vegetation on most sites.
- Parcels in the rural sample area included those with intact riparian zone and several where land use abuts the stream (agriculture and industrial uses).

EAP uses the term **Riparian Deficit** to describe these cumulative impacts on the riparian area that supports or might support the stream. The financial measure is the NCA value of $2100 per metre. However, this amount underestimates the upland land uses which negatively influence the stream. In fact, along the 2700 urban reach of the stream, the aggregate area of the strata parcels is about 183,000m² compared to the total riparian area of 178,000m². These upland developments may negate the gains made protecting the setback area.

Tim Pringle, Chair
Ecological Accounting Process (EAP) Initiative
June 2022

Bings / Menzies Creek EAP Project Committee

Participating Organization	Representative
Cowichan Valley Regional District	Kate Miller Keith Lawrence
District of North Cowichan	David Preikshot Sarah Grieves
Somenos Marsh Wildlife Society	Paul Fletcher Gina Hoar
Partnership for Water Sustainability in BC	Tim Pringle Kim Stephens
Vancouver Island University	Ariel Verhoeks
ex officio members	
City of Duncan	Michelle Geneau John Pite

Acknowledgment: Local government members of the Project Committee provided feedback that resulted in timely guidance that in turn helped shape the final form of the EAP Report. Their contributions ensured a successful project outcome insofar as how the EAP findings may potentially inform the strategy for addressing the riparian deficit in the Bings / Menzies Creek system; as well as potentially inform future decision-making related to development and implementation of asset management plans for stream corridors in other areas of the Cowichan Valley Regional Region.

Georgia Basin Inter-Regional Education Initiative (IREI)

Educational Goal

Build practitioner capacity within the local government context to implement the whole-system, water balance approach known as ***Sustainable Creekshed Systems, through Asset Management***.

Mandate: Provide value through collaboration and partnerships.

Acknowledgments

The Partnership for Water Sustainability gratefully acknowledges the financial support of the Real Estate Foundation of BC, as well as the support provided by the Province of British Columbia through the Ministry of Municipal Affairs.

About the Partnership for Water Sustainability

The Partnership for Water Sustainability in British Columbia has its roots in government – local, provincial, federal. Incorporation of the Partnership as a not-for-profit society, on November 19th 2010, was a milestone moment.

*The Partnership had evolved from a technical committee in the 1990s, to a "water roundtable" in the first decade of the 2000s, and then to a legal entity in 2010. Incorporation enhanced the capabilities of the Partnership to develop tools and resources, and facilitate peer-based learning, to sustain implementation of the vision for **Living Water Smart in British Columbia**.*

*The Partnership vision is to build **bridges of understanding** and pass the baton from the past to the present and future. To bring the intergeneration vision to fruition, the Partnership is growing a network in the local government setting, which encompasses both government and stream stewardship sectors. This network embraces collaborative leadership and **intergenerational collaboration**.*

The Partnership believes that when each generation is receptive to accepting the inter-generational baton and embracing the wisdom that goes with it, the decisions of successive generations will benefit from and build upon the experience of those who went before them.

Five regional districts have endorsed the IREI thru Board Resolutions

CVRD

Comox Valley Regional District

CRD — Making a difference...together

Regional District of Nanaimo

Metro Vancouver

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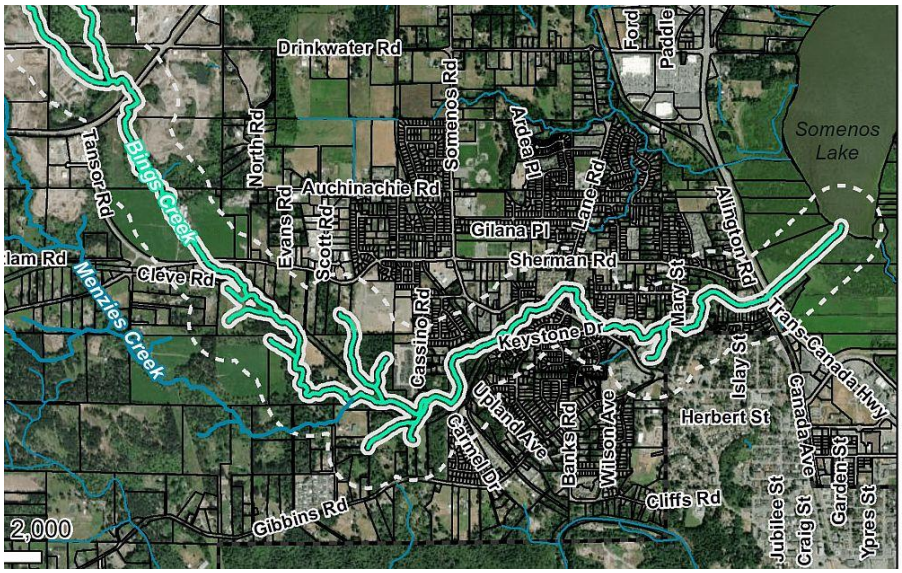
EXECUTIVE SUMMARY

Financial Case for the Stream



This front-end to the Technical Document provides a mind-map for the extremely busy reader who just wants to understand "what I need to know" about application of EAP to the Bings / Menzies system, especially what it would mean to operationalize EAP within an Asset Management Plan.

A Guide for the Busy Reader

Table of Contents / Storyline

EAP is breaking new ground. If the reader wishes to have a full understanding of the research objectives and concepts introduced in Part A (Findings), then Parts B (Framework) and C (Application) are essential reading. Below, the storyboard approach to the *Table of Contents* distils the essence of what the busy reader needs to know about each section in each of the three parts. So, read and reflect.

A Guide for the Busy Reader

Table of Contents / Storyline (continued)

Context for Bings / Menzies EAP Project

In recent years, the Municipality of North Cowichan (MNC) has taken steps to strengthen its management of environmental assets. Strategic action includes hiring a Senior Environmental Specialist and adoption of the *Biodiversity Protection Policy* which supports actions consistent with the MNC biodiversity strategy.

In this context the Cowichan Valley Regional District asked the Partnership for Water Sustainability in BC to form a collaboration to apply **EAP, the Ecological Accounting Process**, to the Bings / Menzies stream system, a Natural Commons which flows about 10 kms to Somenos Marsh. The final 3-plus kms of this journey lie in the most densely populated area of the municipality.

Measures of Bings / Menzies Financial Value

EAP metrics apply a land-use perspective to quantify the social, ecological, and financial values of the stream system. These measures provide two community perspectives. The first metric is **Worth** - expected social and ecological uses (refer to sidebar for examples).

The second metric is the **Natural Capital Asset Value (NCA)** which is based on parcels abutting the stream and using BC Assessment data. The stream corridor (channel plus setback zone on each side) in the urban area has a NCA value of $2.1 million per km.

Findings at a Glance: The concept of the **Riparian Deficit** is a way to interpret NCA implications. It considers the condition of the riparian setback as well as the upland parcels which border the riparian zone. Although the riparian zone is relatively intact (85% pervious) and has critical connections to several large adjoining parcels with intact riparian cover, the Riparian Deficit tells us that community expectations impede the functioning condition of the stream system in three ways:

The adjacent upland parcels include 10 strata developments which completely altered the landscape: impervious cover averages 60%.

Water pathways have been replaced partially or entirely by engineered systems; thus, rainwater bypasses the riparian zone in most cases.

The area of the strata (~183,000m²) is about equal to the area of the riparian zone (~178,000m²) along the same reach of the stream. The strata conditions offset the riparian quality.

Measures of Bings / Menzies Creek worth

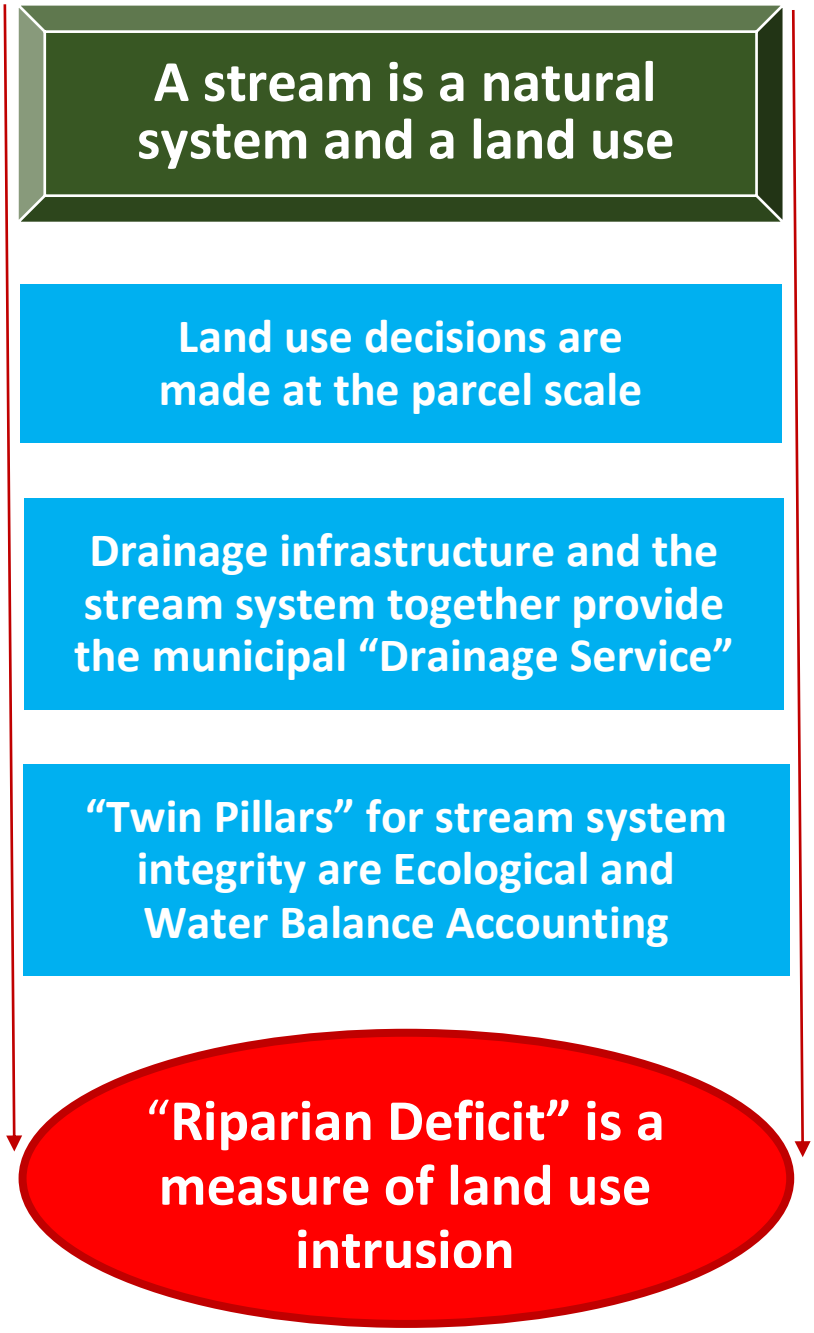
During the past decade, investment exceeding $300,000 for research, maintenance, and management. Timber West donated the 95ha lakebed of Somenos Marsh, which has a value of $7 million.

The Cowichan Valley Trail, heavily used by the community, borders about 3 kms of the riparian area along the stream.

The riparian assets of this reach of Bings Creek stand out on the municipality's Interactive Riparian Areas Web Map.

Cascading Concepts Create a Mind-Map for EAP

Figure ES1



Asset Management for Sustainable Drainage Service Delivery

Figure ES1 distils five key ideas. These underpin EAP, the Ecological Accounting Process. This is a mind-map for what follows.

The context for EAP is protection and restoration of stream systems. Streams are the natural component of the municipal **Drainage Service**.

The desired outcome is that BC local governments would apply EAP metrics to establish annual budgets for maintenance and management (M&M) of stream corridor systems.

Stream M&M would then be a line item within an Asset Management Strategy that accounts for both constructed and natural assets.

A stream corridor is a land use because stream setbacks are defined in regulation. Also, a proxy financial value is readily determined from the BC Assessment database.

EAP defines the regulated zone as the **Natural Commons Asset** (NCA). This foundation has two primary metrics or measures: the NCA financial value is expressed as **$ per km of stream**; the annual M&M budget is **1% of the NCA value** consistent with accepted practice for constructed assets.

EAP looks at individual parcels

Essentially, EAP analyses describe and quantify the alteration of riparian and nearby upland areas in the creekshed. The key metrics are loss of riparian cover, creation of impervious areas and alteration of water pathways. These concerns apply to all areas of the stream system and imply the following key questions:

Water Pathways – what happens to rainwater after it falls?

Riparian Cover and Conditions – how much is there and how natural are the existing vegetative and soil conditions?

Handling of Drainage – where does rainfall from impervious surfaces and engineered landscapes go to be conveyed away?

Bings Creek Parcel Sample Areas

Figure ES2 shows the locations of two urban parcel sample areas selected for the EAP analysis.

The Bings / Menzies system accounts for 8% of the North Cowichan land base.

The focus is on two zones of interest: EAP uses quantitative and qualitative metrics to evaluate land use realities that alter stream conditions. The Riparian Areas Protection Regulation is the starting point for applying EAP metrics to two "zones of interest":

- **Inner Stream Setback Zone**: This describes the 30m SPEA zone abutting the stream on each side plus the stream width at a nominal 5m.
- **Outer Land Use Zone:** This describes the 200m upland area adjacent to the setback zone on each side of the stream corridor.

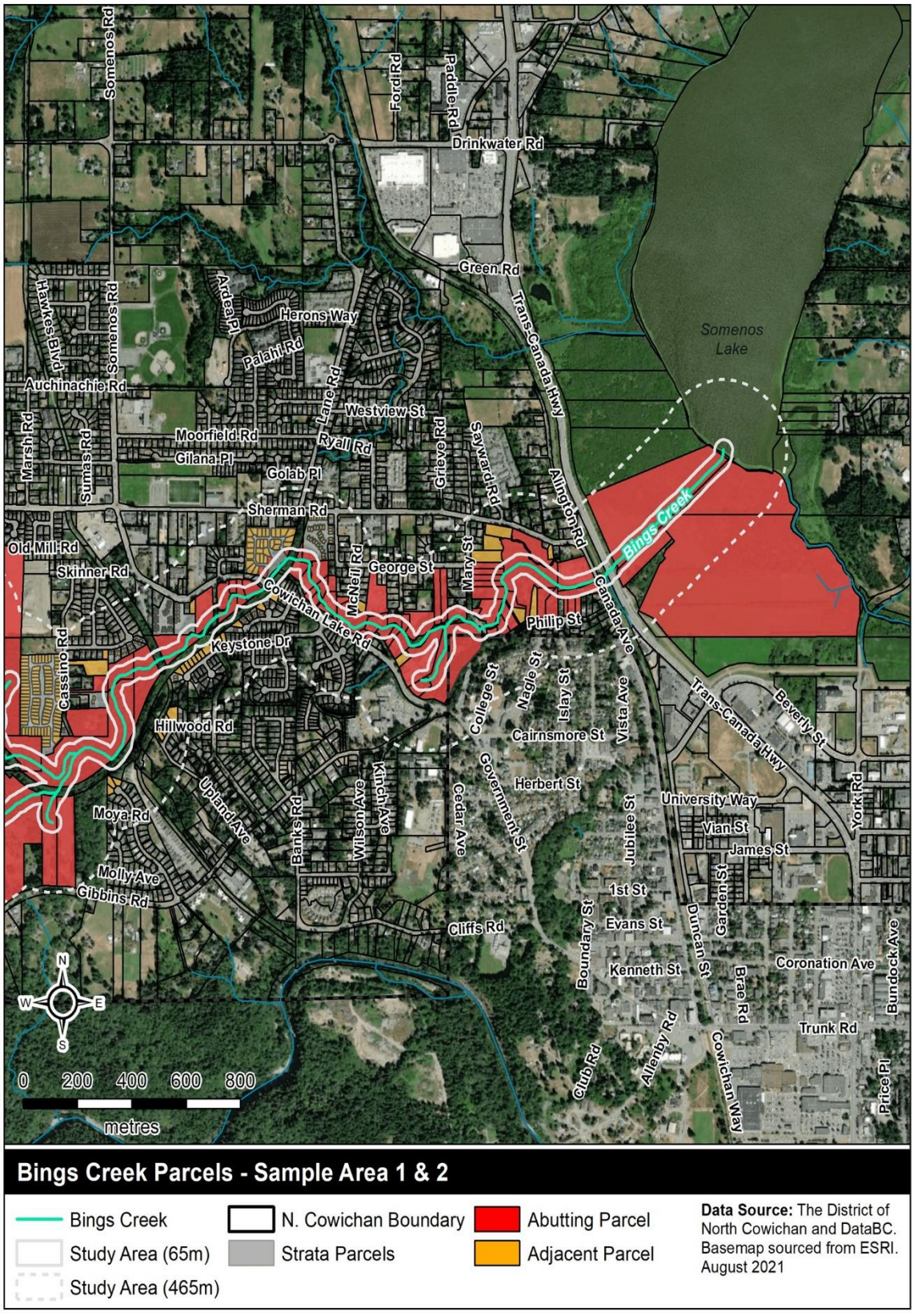
EAP looks at the upland "outer land use zone" in urban areas because infrastructure and buildings may have eliminated riparian and woodland cover, created impervious conditions, and altered how rainwater and runoff reaches streams.

Bings Creek parcel characteristics: Strata development is a predominant land use. Thus, the study area is characterized by a green zone encircled by a gray zone, with the area of the latter being larger. Clearly, the strata parcels take advantage of the green zone created by the streamside protection area.

The EAP project analyzed nine strata parcels and their subdivided lots and common areas. The strata parcels have an overall impervious area of 60% which is a highly urbanized condition.

The incursion of subdivided parcels, development, and land use practices into the riparian zone and nearby upland areas, once part of the larger riparian system, degrades streams. This condition is called the **Riparian Deficit**.

Figure ES2


Somenos Rd
Ford Rd
Paddle Rd
Drinkwater Rd
Green Rd
Trans-Canada Hwy
Somenos Lake
Hawkes Blvd
Ardea Pl
Herons Way
Palahi Rd
Auchinachie Rd
Lane Rd
Westview St
Moorfield Rd
Ryall Rd
Gilana Pl
Golab Pl
Grieve Rd
Sayward Rd
Alington Rd
Bings Creek
Marsh Rd
Sumas Rd
Sherman Rd
Old Mill Rd
Skinner Rd
McNeil Rd
George St
Mary St
Cowichan Lake Rd
Canada Ave
Philip St
Keystone Dr
Cassino Rd
College St
Nagle St
Islay St
Vista Ave
Beverly St
Hillwood Rd
Cairnsmore St
Herbert St
University Way
Upland Ave
Moya Rd
Kinch Ave
Wilson Ave
Banks Rd
Cedar Ave
Government St
Jubilee St
Vian St
James St
York Rd
Molly Ave
Gibbins Rd
1st St
Cliffs Rd
Boundary St
Evans St
Duncan St
Garden St
Kenneth St
Coronation Ave
Brae Rd
Bundock Ave
Trunk Rd
Alenby Rd
Cowichan Way
Club Rd
Price Pl
N
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E
S
0 200 400 600 800
metres
Bings Creek Parcels - Sample Area 1 & 2
Bings Creek
Study Area (65m)
Study Area (465m)
N. Cowichan Boundary
Strata Parcels
Abutting Parcel
Adjacent Parcel
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. August 2021

Using the Ecological Accounting Process (EAP) to Establish the 'Financial Case for the Stream'

The provincial umbrella for EAP, the Ecological Accounting Process, is Asset Management for Sustainable Service Delivery: A BC Framework. In 2019, the Union of BC Municipalities (UBCM) and the Ministry of Municipal Affairs established an expectation that grant applicants would integrate natural assets into their asset management processes. **EAP shows them how to do it for water assets (such as wetlands) and stream systems.**

The BC Framework emphasizes the services that constructed assets provide and their life-cycle costs. Over time, maintenance and management represents 80% of the total life-cycle cost for municipal infrastructure; the first 20% represents the initial capital investment.

EAP is a land use perspective

The EAP methodology focuses on the historical and current land use practices that have changed landscapes, modified hydrology, and have led to present-day community perceptions of the worth of a stream and/or other water assets in a creekshed, and the ecological services those assets provide.

In a sentence, the essence of EAP is expressed as follows: ***What is the environment that supports the package of ecological services?*** *This is a land use perspective.*

Reconnect Hydrology and Stream Ecology by Design

EAP provides communities with a philosophy, pragmatic methodology and metrics to make the financial case for annual investment to prevent degradation and improve the condition of ecological assets that constitute a stream corridor system.

Use of EAP to establish the 'financial case for the stream' would put maintenance and management (M&M) of stream corridor systems and water assets such as those in Bings / Menzies Creek on an equal footing with constructed assets (municipal infrastructure).

Whether constructed or natural, an asset is an asset. And in the built environment, each asset type requires an annual budget for M&M. The leap forward explicit in the vision for "sustainable drainage service delivery" is recognition of the need for whole-system action on the landscape that would ensure stream system integrity.

Once local governments embrace a guiding philosophy that ecological services and use of land for development are equally important, then the next step is for them to include M&M budgets for stream systems in their Asset Management Plans. This would begin the process of reconnecting hydrology and stream ecology by design.

Context for the Busy Reader

This Executive Summary provides a mind-map for the extremely busy reader who just wants to understand *"what I need to know"* about two aspects of the Bings / Menzies Creek EAP Project.

> First, how EAP, the Ecological Accounting Process, has been applied to the stream system. Secondly, what operationalizing EAP within an Asset Management Plan would look like.

An Introduction to the EAP Program

The Bings / Menzies Creek EAP Project is part of an applied research program, involving multiple local governments, to demonstrate application of the EAP methodology and metrics. The intent is that the findings would be used by participating local governments to establish line items in budgets for M&M of ecological assets in stream corridors.

The EAP program supports local governments adopting an integrated approach to life-cycle M&M of the drainage service. The integrated approach recognizes that constructed infrastructure and stream systems are inter-connected components of the drainage service. Effective M&M of natural assets (stream systems) requires local government commitment backed by line items in an annual report.

Integration of Natural Assets into Local Government Asset Management

The EAP methodology and metrics recognize the importance of the stream system and other water assets in the landscape. A stream is a land use because the stream corridor is defined in regulations and has a financial value.

Building Blocks Process: Three tables at the end of this Executive Summary consolidate key information for ease of review and absorbing.

Exhibit A is titled A Reader's Guide to EAP and is complemented by Exhibit C. The latter is a key visual because it illustrates Foundational Concepts that Underpin EAP.

Exhibit B depicts the three categories of **commons**. Communities rely on **natural, constructed**, and **institutional** commons for services that sup port quality of life and property enjoyment.

Exhibit C lists the case studies involving multiple local government partners in five regions. The EAP methodology and metrics have evolved through a building blocks process.

Framework & Synthesis of Findings

Each EAP case study is unique. However, a common framework for analysis facilitates comparison of findings among the cohort of EAP case studies (demonstration applications). Each is unique because each local government is dealing with a distinctive stream system management challenge driven by local circumstances.

Research Question

Previous EAP research has proven the validity of using parcel information for quantitative and qualitative analysis of land use impacts on the condition of stream systems. This EAP analysis provides CVRD and the Municipality of North Cowichan with information to answer the following research question:

What influence does the stream as an ecological system (as a natural commons) have on urban and rural land use near the stream system; and does the stream influence the utility and financial value of parcels?

Research Objectives

EAP analyses are guided by the set of research objectives listed below. Objective #2 is the lynchpin. The key metrics flows from it. Objective #2 provides a useful basis for comparison with Objective #3.

1. Establish a measure of "stream worth" to the community based on historic investment in M&M.
2. Quantify the "financial case" for the stream corridor as a Natural Commons Asset (NCA).
3. Suggest a "benchmark guideline" for maintenance and management (M&M) investment in stream corridors within the context of an Asset Management Budget.
4. Determine whether the stream influences the assessed values of parcels that abut or are adjacent to the stream.

EAP by the Numbers: For each of four research objectives, the numbers to note and remember are highlighted in red in **Table ES1**.

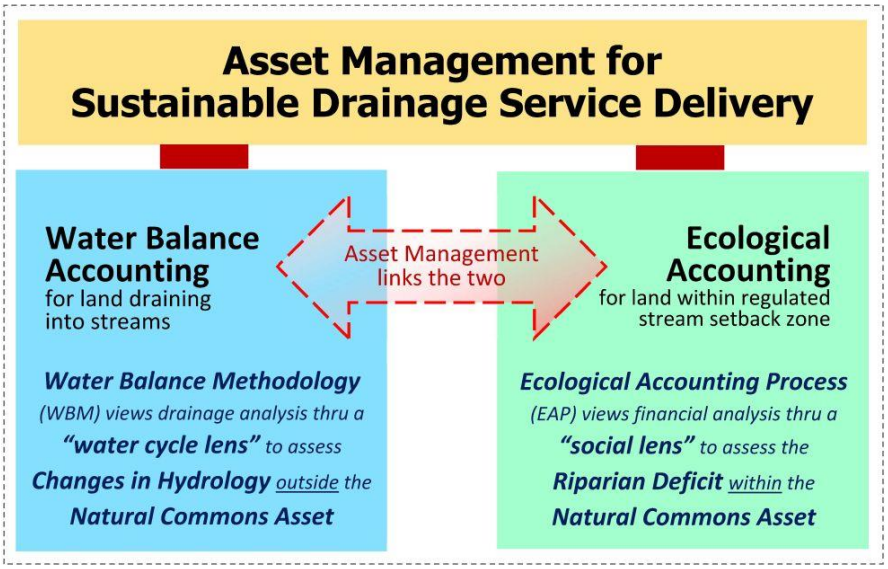
Table ES1

Research Objective	EAP by the Numbers
1. Establish a measure of "stream worth" to the community based on historic investment in M&M	Research into the history of community investment in the stream system identified numerous examples of investments during the period 2010-2020. At least $7.3M has been committed during the past decade. The actual investment is higher but supporting numbers are not readily available. The $7.3M represents an average **annual M&M investment of approximately $1500 per lineal metre** of stream and corridor.
2. Quantify the "financial case" for the stream corridor" as a Natural Commons Asset (NCA)	The NCA is the proportion of the stream corridor that lies in the regulatory setback zone. The NCA width is the sum of the stream width plus the setback distance on each side. **NCA Value = $2100 per lineal metre of stream and corridor**
3. Suggest a "benchmark guideline" for M&M investment in the stream corridor within the context of an Asset Management Plan	Based on established life-cycle practice, the annual budget for stream M&M would be **1% of the NCA Value**. The dollar amount is **$21 per lineal metre** of stream and corridor.
4. Determine whether the stream influences the assessed values of parcels that abut or are adjacent to the stream	EAP compares assessed financial values of parcels abutting or near to the stream. The operative metric is **$ per square metre** of parcel area. Parcels abutting the stream have a **Blended Financial Value** – that is, one value for the developable area of a parcel, and a lesser value for parcel area that cannot be developed due to streamside setback regulations. Purchasers essentially pay a premium for the developable. Nearby parcels benefit from proximity to the 'green zone' because it creates a desirable setting for development.

Twin Pillars of Stream System Integrity

In the 1990s, West Coast research correlated land use changes with impacts on **stream system condition**. The research defined four limiting factors in order-of-priority. These factors provide the road map for action to protect and/or restore stream integrity. The top two factors are **changes in hydrology** and **loss of riparian integrity**.

In Beyond the Guidebook 2015: Moving Towards Sustainable Watershed Systems, through Asset Management, the Partnership introduced EAP as a concept for integration of stream systems within an Asset Management Plan. To help our local government partners and others visualize the primary elements of the whole-system approach to sustainable drainage service delivery, we also introduced the **"twin pillars"** branding graphic.



The Ecological Accounting pillar addresses "loss of riparian integrity" within a stream corridor. The Water Balance Accounting pillar address "changes in hydrology" on the land draining to the stream. Integration of the two is the goal of the whole-system approach. Asset Management for Sustainable Service Delivery: A BC Framework provides local governments with an incentive to go down this path.

It took a building blocks process to bridge from the Partnership's starting point --- how EAP looks at the "stream as a whole-system" --- to reach the EAP destination - that is, a pragmatic methodology plus meaningful metrics for measuring the **Riparian Deficit** in a way that resonates with local government.

Road Map for Protecting Stream System Integrity

Four factors limiting the ecological values of urban streams are, in order of priority:

1. Changes in Watershed Hydrology

2.Disturbance and/or Loss of Integrity of Riparian Corridor

3.Degradation and/or Loss of Aquatic Habitat within the Stream

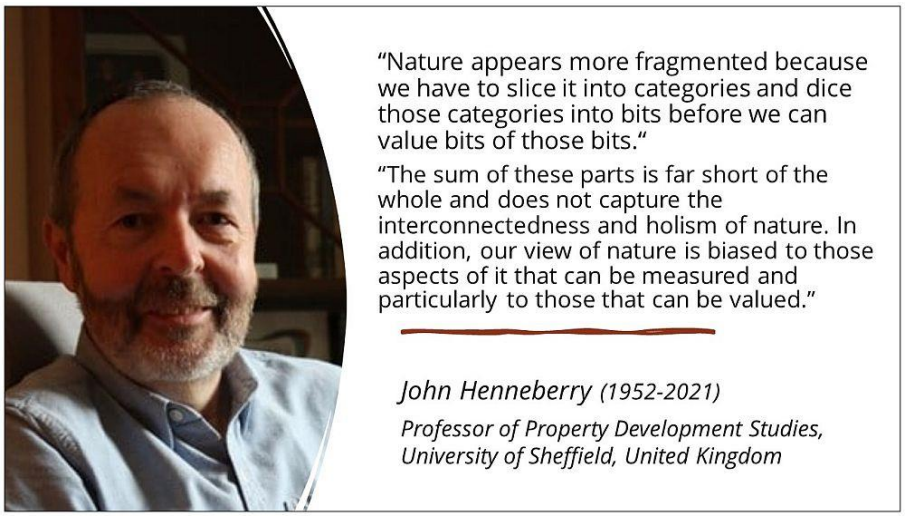
4.Deterioration of Water Quality

Reference: Chapter 2, Stormwater Planning: A Guidebook for British Columbia, 2002

Next Steps

No recommendations are made. However, guidance is provided for operationalizing EAP within the Asset Management Strategies for each local government participating in this EAP project:

1. Initiate internal and/or inter-departmental conversations about the Bings / Menzies Creek EAP Project findings within each of the CVRD, District of North Cowichan, and City of Duncan.
2. Share the Bings / Menzies Creek EAP Project findings with the appropriate advisory committees within each of the CVRD, District of North Cowichan, and City of Duncan.
3. Establish a central registry for tracking M&M investments, both cash and in-kind, in the Bings / Menzies creekshed as well as for other creeksheds in the Cowichan Region.
4. Take what CVRD and North Cowichan have learned from the EAP project and integrate this understanding into local decision processes for operationalizing Asset Management for Sustainable Drainage Service Delivery.
5. Embed the Twin Pillars of Stream System Integrity as the over-arching framework guiding rainwater management planning in the Cowichan region.



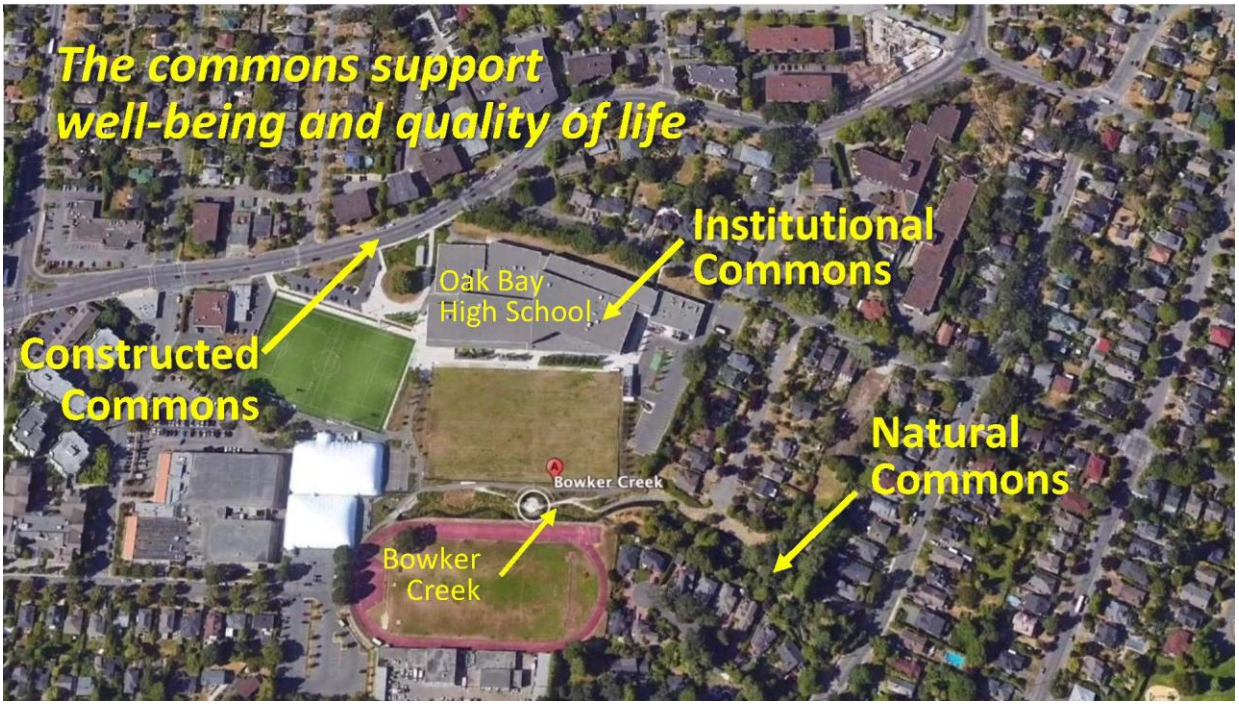
John Henneberry's pioneering work in the United Kingdom provided validation of how EAP looks at streams and water assets as a whole system.

Exhibit B

A READER'S GUIDE TO UNDERSTANDING "EAP, THE ECOLOGICAL ACCOUNTING PROCESS"	
What is the provincial context for the Bertrand Creek EAP Project?	The context is **Asset Management for Sustainable Service Delivery**, and a stream system is a **Natural Commons Asset (NCA)**). Refer to **Exhibit B**. EAP is a 3-stage program to *Test, Refine, Mainstream* the methodology and metrics for "maintenance and management", or **M&M**, of stream systems. The Partnership for Water Sustainability in BC is collaborating with multiple local governments in five regions within the Georgia Basin to determine **how to operationalize EAP within an Asset Management Plan**.
Why is EAP needed?	EAP bridges a gap. It provides local government with a methodology and metrics for integrating natural assets into municipal infrastructure. The driver for action is degradation of stream channels and streamside protection areas.
What are EAP core concepts?	A stream is a land use (defined in regulation; can assign a financial value). BC Assessment provides "real numbers" for a proxy financial value. The key metric is "$ per metre of channel length" as a measure of NCA value. Community investment in M&M is a measure of "what the stream is worth".
What would operationalizing of EAP achieve?	**PURPOSE:** Put maintenance and management (M&M) of stream corridor systems on an equal footing with constructed assets (municipal infrastructure). **END GOAL:** Establish an annual budget for stream corridor system M&M as a line item within an Asset Management Strategy.
How is EAP a game-changer?	1. EAP interweaves financial, social, and ecological perspectives within a single number to establish the financial case for a stream corridor system. This aggregate number is the **Natural Commons Asset** (NCA) value. 2. The NCA value is a measure of the **Riparian Deficit**. This is the environmental equivalent of the **Infrastructure Liability (Deficit)** for constructed assets such as underground utilities and buildings. 3. The NCA value provides environmental planners with a starting point for a *balanced conversation* with engineers and accountants about the **services** that natural and constructed assets both provide.
Why is EAP important?	EAP adds to the conceptual framework for riparian area maintenance and management strategy with new insights about financial metrics.
How is the presentation of information layered to distil EAP findings?	Three layers of filtering: **Technical Report** is in 3 parts, with Part A being a **"report within the report"**. **Synopsis Document** is stand-alone for interdepartmental conversations. **Executive Summary** is an overview of "what Council (Board) needs to know"

Exhibit C

The concept of the Natural Commons underpins EAP. The image below is a key visual. It depicts three categories of 'commons': natural, constructed, and institutional.



This location is in the District of Oak Bay

Foundational concepts that underpin EAP, the Ecological Accounting Process		
Natural Commons	**Constructed Commons**	**Institutional Commons**
As defined by the EAP, a **Natural Commons** is an ecological system that provides ecological services used by nature and the community. A stream is a land use and provides a "package of ecological services". Drainage, recreation, habitat, and enjoyment of property. This is plain language that Councils and Boards understand.	Communities rely on a range of services such as roads, underground utilities, and parks to support lifestyle and property enjoyment. These are **Constructed Commons**. Through taxation, they are maintained and managed to ensure the availability of desired services.	Services such as fire protection and schools are a related kind of constructed commons.

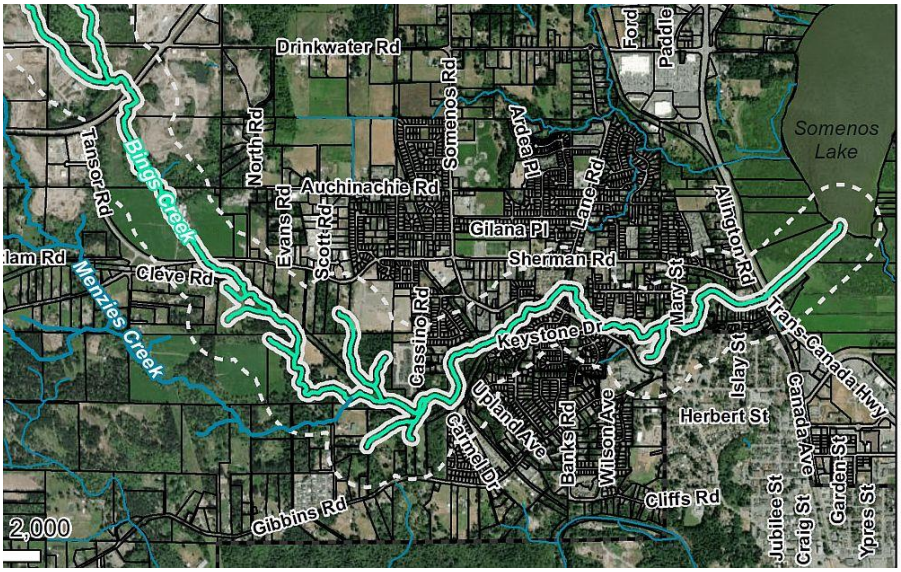
EXHIBIT C: Building Blocks in a Process

Region	Creek	Land Uses	Big Ideas
STAGE 1 – TEST THE EAP CONCEPT (2016-2018)			
Cowichan Valley	**Busy Place Creek -** *CVRD*	Agricultural, residential, industrial	**The EAP lens is the *Stream System*** ***Hydrology is the Engine that Powers Stream Ecology***
Comox Valley	**Brooklyn Creek -** *Comox & Courtenay*	Almost completely urbanized; some agricultural uses	**BC Assessment Data is a proxy for *Financial Value of a Setback Zone*** **Investment in stream restoration is a measure of *Stream Worth*** ***Package of Ecological Services* is the range of community uses**
STAGE 2 - REFINE THE EAP METHODOLOGY (2018 – 2020)			
Nanaimo Region	**Shelly Creek -** *Parksville*	Forest & agricultural areas (90%) drain to urban area	***Riparian Ecosystems* have been reduced to *Riparian Zones*** **M&M for *Maintenance* (prevent) and *Management* (improve)**
Metro Vancouver	**Kilmer Creek** *– District of North Van*	Forested mountain drains into urban area	***A Stream is a Land Use*** **The concept of the *Natural Commons* underpins EAP From *Remediation* to *Restoration***
STAGE 3 – MAINSTREAM EAP WITHIN AN ASSET MANAGEMENT STRATEGY (2020 – 2022)			
Nanaimo Region	**Millstone River –** *RDN & Nanaimo*	Agricultural lands drain into urban area.	***NCA Metric* drives decision-making** ***Target-Based Strategy for Riparian Area Restoration*** ***Framework for Operationalizing EAP, as a Budget Line Item, within an Asset Management Strategy***
Capital Region	**Bowker Creek** *- Saanich, Oak Bay, Victoria*	Completely urbanized	**EAP establishes the *Financial Case for a Stream*** **Streamside parcels have a *Blended Financial Value***
Cowichan Valley	**Bings/ Menzies Cr** *- N Cowichan*	Forest, rural and urban zones	**EAP addresses *Loss of Riparian Integrity* as a stream health factor** **NCA Value is a measure of the *Riparian Deficit***
Comox Valley	**Saratoga Beach**	Rural	**EAP methodology is applicable to all *Water Assets* additionally to the stream corridor** **An implementation mechanism would be a *Drainage Service Area***
Metro Vancouver	**Bertrand Creek** *- Langley Township*	Urban uplands drain to ag lowlands	**EAP quantifies the Riparian Deficit thus supporting *Equitable Urban / Rural Mitigation Investment***

PART A

EAP Findings

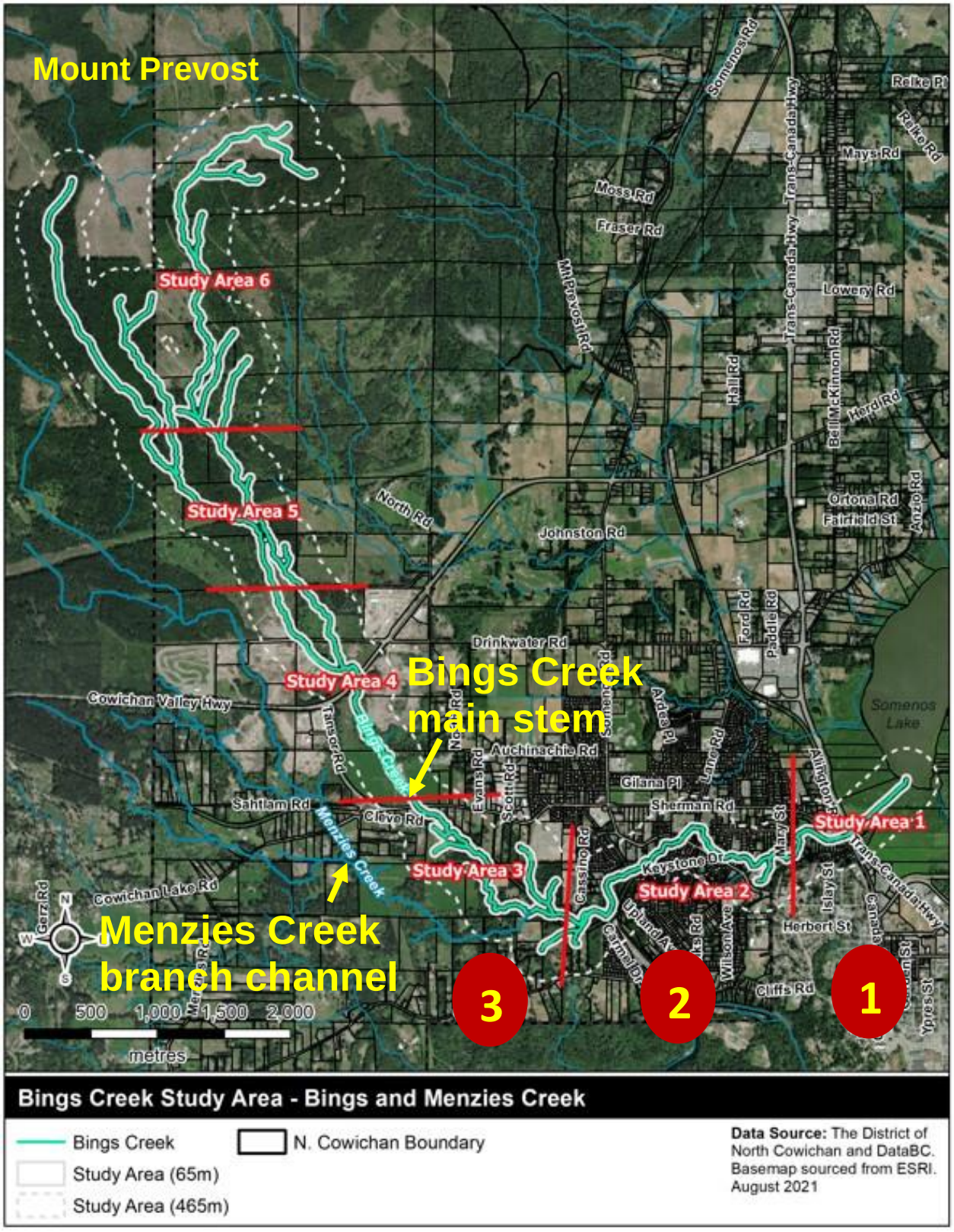
Report Within a Report



To provide the reader with an overview of the EAP case study application and findings, Part A is designed as a "report within a report" and structured in three sections:

1. ***Context for the Bings / Menzies EAP Project***
2. ***Research Application and Results***
3. ***Framework for Operationalizing EAP within an Asset Management Strategy***

Figure A1


Mount Prevost
Study Area 6
Study Area 5
Study Area 4
Study Area 3
Study Area 2
Study Area 1
Bings Creek main stem
Menzies Creek branch channel
Somenos Rd
Trans-Canada Hwy
Mays Rd
Moss Rd
Fraser Rd
McTavish Rd
Lowery Rd
Hall Rd
Bell McKinnon Rd
Herd Rd
Ortona Rd
Fairfield St
Anzio Rd
North Rd
Johnston Rd
Ford Rd
Paddle Rd
Drinkwater Rd
Cowichan Valley Hwy
Tansor Rd
Bings Creek
Evans Rd
Scott Rd
Auchinachie Rd
Ardes Pl
Lane Rd
Gilana Pl
Sherman Rd
Sahtlam Rd
Clivo Rd
Menzies Creek
Cowichan Lake Rd
Gerz Rd
Cassino Rd
Keystone Dr
Mary St
Islay St
Herbert St
Wilson Ave
Cliffs Rd
Ypres St
Somenos Lake
0 500 1,000 1,500 2,000
metres
3
2
1
Bings Creek Study Area - Bings and Menzies Creek
Bings Creek
N. Cowichan Boundary
Study Area (65m)
Study Area (465m)
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. August 2021

1. Context for Bings / Menzies EAP Project

Background & Road Map

This Part A serves as a **'report within a report'**. It provides the reader with a picture of the approach to the research plus what we learned from the Bings / Menzies EAP project. Part B then elaborates on the asset management context. Finally, Part C delves into the details of the financial case for the Bings / Menzies stream system.

No recommendations are made. However, a framework is outlined for operationalizing EAP within an Asset Management Strategy to establish line items in budgets for maintenance and maintenance (M&M) of ecological assets in stream corridors.

Road Map for Protecting Stream System Integrity

LIMITING FACTOR 1: ***Changes in Watershed Hydrology –*** *addressed thru the Water Balance Accounting Pillar*

LIMITING FACTOR 2: ***Disturbance and/or Loss of Integrity of Riparian Corridor –*** *addressed through the Ecological Accounting Pillar*

LIMITING FACTOR 3: Degradation and/or Loss of Aquatic Habitat within the Stream

LIMITING FACTOR 4: Deterioration of Water Quality

Creekshed Description: The Bings Menzies system originates on Mount Prevost and drains into Somenos Lake. As shown on **Figure A1**, the Menzies branch channel merges just upstream from the Cassino Road crossing in the rural area.

Figure A1 also identifies six riparian sample areas. The EAP analytical focus is on **Sample Areas Nos. 1, 2 and 3**. The first two are urban; the third is rural.

Overview of EAP Program

The road map in the sidebar provides the over-arching context for application of EAP, the Ecological Accounting Process. In this report, our spotlight is on the first two limiting factors because hydrology powers ecological services. Where landscapes are altered by development, the over-arching goal would be to reconnect hydrology and stream ecology by design. EAP points the way forward.

Beyond the Guidebook 2015 introduced the vision for EAP as one of the **twin pillars** for integrating water assets and stream systems within an Asset Management Plan. The other pillar is Water Balance Accounting. The twin pillars are explained in Part B.

EAP is the convergence and synthesis of parallel journeys. Valuing use and conservation of land equally is the financial journey. Reconnecting hydrology and stream ecology by design is the applied science journey. The outcome would be restoration of urban stream integrity.

Context for Bings / Menzies EAP Project

Until 2004 when the Riparian Areas Protection Regulation Act was passed, streams had no definition as landscape features (assets) separate from parcels. Today, stream systems can be counted as a land use. In fact, they are natural commons belonging jointly to the community and individual parcel owners, including levels of government.

Beneficial Impact of Riparian Area Regulation

Essentially North Cowichan bylaws and enforcement have prevented subdivision of large parcels abutting the stream. These parcels are encumbered by DPA3 for the Protection of the Natural Environment. Preserving the setback area, however, does not necessarily mean that it would be in good condition.

Key Analytical Findings: The riparian area within 30m of the centre of the stream in the urban area is intact or relatively intact – having at most 20% impervious area. Based on applying the Urban Salmon Habitat Program (USHP) methodology, others have determined that:

> **The riparian condition is rated as "fair". Vegetative cover has been altered in most of the setback zone for the 2.7km length in the urban area.**

In the upland areas extending 200m beyond the setback zone, land development has rendered the creekshed more than 50% impervious. This is a measure of highly urbanized conditions.

Attributes for EAP Assessment

Impervious Area
Impervious Percentage
Riparian Quality
Vegetative Cover

Quantifying Riparian Conditions – EAP Assessment: Applying the attributes listed in the sidebar, an air photo assessment of riparian conditions is included as **Part D**. The working document is titled Analysis of Riparian Qualities of Parcels in Sample Areas One and Two. This is a parcel-by-parcel compilation of attributes for 60 parcels in Sample Area Nos. 1 and 2. All 60 include setback area; some as much as 90% to 100%. Parcel conditions are summarized below:

Degree of imperviousness	Number of parcels	Average % of imperviousness
< 25% coverage	34	9%
> 25% but < 50%	21	37%
> 50%	5	60%

Focus on Strata Developments

Figure A2 identifies the locations of strata developments in the Bings drainage area. They demand particular attention because they are adjacent to parcels which abut the stream corridor. The location is not accidental. The strata parcels take advantage of the natural (green) area created by the streamside protection area.

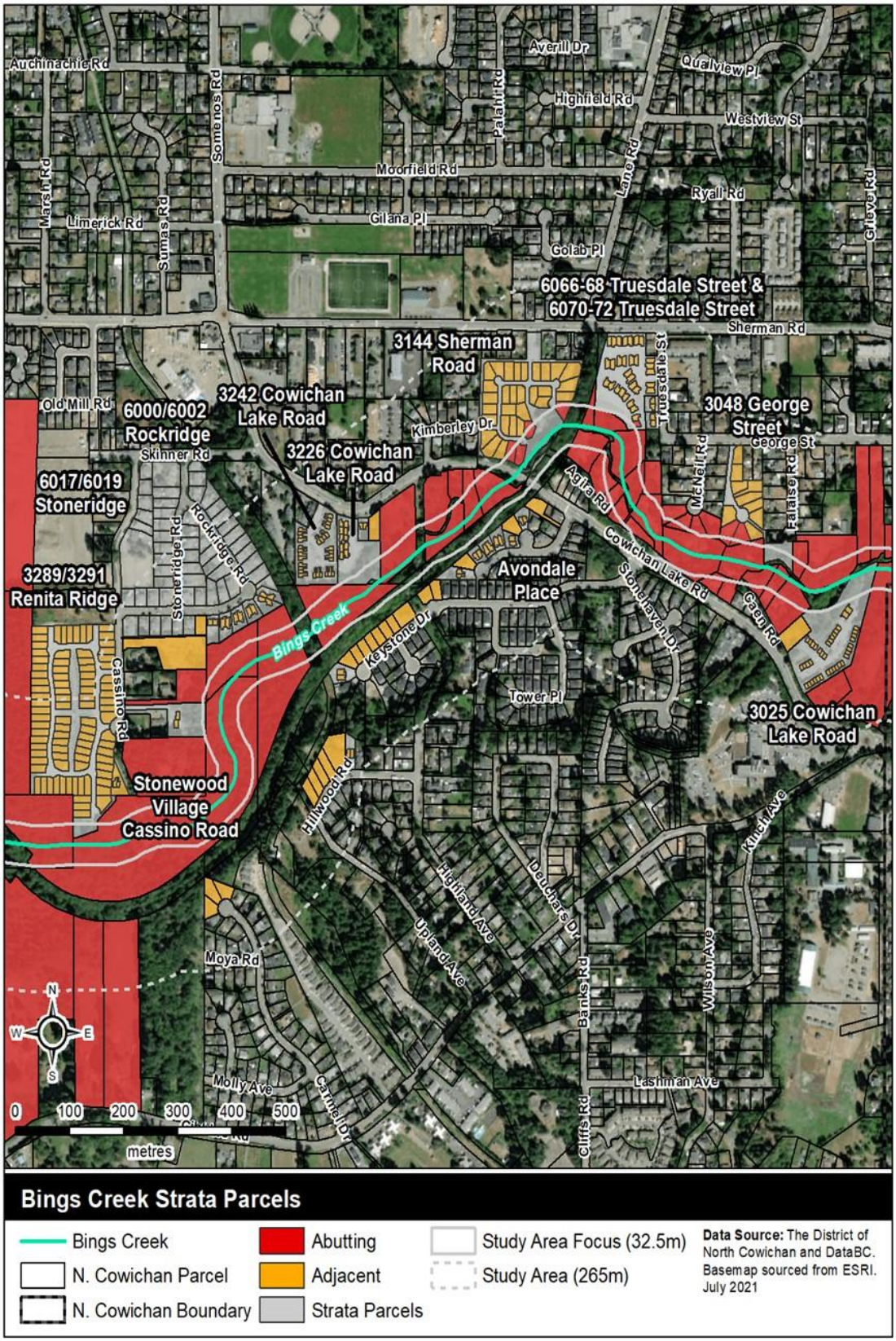
Strata Subdivision Characteristics: Analysis of nine strata parcels and their subdivided lots and common areas revealed that:

Proportion of the total area that has intact riparian. Note that: ▪ Includes Park land transferred as a community amenity. ▪ One development included an engineered infiltration zone comprising 6.6% of the strata parcel area. It is not included here.	Less than 10%
Impervious coverage as a proportion of total strata area	Range is 49% to 75% Average is 60%
Common area of the strata parcels	Range is 29% to 75% Average is 44%

Alteration of the landscape: Bare land and building strata developments have been and remain a common residential land use in North Cowichan. Strata parcel development removes native vegetation from 60% or more of the parcel and alters what remains. When one considers the large area of the strata parcels, it is apparent that such development has a material impact on water pathways.

A Revealing Comparison: Strata Area Exceeds Green Zone	
Total Area of Strata Parcels	182,700m^2
Total Area of NCA	178,200m^2
Strata Parcel Characteristics / Stream Health Consequences	
Aggregate Average Impervious Area	60%
Riparian Quality	Poor or non-existent
Absorbent Natural Landscape	Eliminated

Figure A2


Auchinachie Rd
Somenos Rd
Averill Dr
Qualview Pl
Highfield Rd
Westview St
Palahi Rd
Lane Rd
Moorfield Rd
Ryall Rd
Marsh Rd
Limerick Rd
Sumas Rd
Gilana Pl
Golab Pl
Clover Rd
6066-68 Truesdale Street &
6070-72 Truesdale Street
Sherman Rd
3144 Sherman Road
Truesdale St
3242 Cowichan Lake Road
Old Mill Rd
6000/6002 Rockridge
Skinner Rd
Kimberley Dr
3048 George Street
George St
3226 Cowichan Lake Road
McNeil Rd
Falaise Rd
6017/6019 Stoneridge
Agila Rd
Rockridge Rd
Stoneridge Rd
Cowichan Lake Rd
3289/3291 Renita Ridge
Avondale Place
Stonehaven Dr
Caen Rd
Bings Creek
Keystone Dr
Tower Pl
3025 Cowichan Lake Road
Cassino Rd
Hillwood Rd
Stonewood Village Cassino Road
Kinsel Ave
Highland Ave
Deuchars Dr
Upland Ave
Moya Rd
Banks Rd
Wilson Ave
Molly Ave
Carmel Dr
Lashman Ave
Cliffs Rd
N
W
E
S
0
100
200
300
400
500
metres
Bings Creek Strata Parcels
Bings Creek
N. Cowichan Parcel
N. Cowichan Boundary
Abutting
Adjacent
Strata Parcels
Study Area Focus (32.5m)
Study Area (265m)
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. July 2021

Implications for the Natural Water Balance

The current ecological condition of the Bings / Menzies stream system reflects the fact that the riparian ecosystems that once supported the stream system are gone. What remains are regulatory setback zones for riparian protection. A few unaltered parcels remain intact next to the stream and provide significant remnant riparian resources.

Strata development means that water pathways are interrupted and cut off by local engineered roads and drainage on a grand scale as the landscape is hardened and the natural absorbent capacity is eliminated. The key question is, where does the rainwater go when the natural pathways for slowing, sinking, and spreading rainwater runoff are short-circuited and/or bypassed?

Bings Creek Water Balance: Bings is a "creek of interest" to the Partnership for Water Sustainability. In 2013, the Partnership examined it as part of the Cowichan Regional Water Balance Analysis. It is one of four stream systems on Vancouver Island with hydrometric data (streamflow and precipitation) that are representative of urban creeksheds along the eastern shore of Vancouver Island.

Streamflow records confirm that Bings Creek is going dry when flow is needed most during the summer months.

The table below provides "water balance" context. It underscores the relative magnitude and importance of the **interflow component** of a properly functioning watershed system in coastal British Columbia. The interflow component has historically been eliminated when land development activities alter the landscape.

	Annual Water Balance by Region				
Flow Paths	Coastal BC	Alberta - Edmonton	Ontario - Ottawa	Nova Scotia	Maryland
Precipitation	**100%**	**100%**	**100%**	**100%**	**100%**
Evaporation	20%	92%	40%	28%	40%
Streamflow	**80%**	**8%**	**60%**	**72%**	**60%**
Surface Runoff	10%	4%	10%	10%	10%
Interflow	**60%**	3%	25%	52%	25%
Aquifer Flow	10%	1%	25%	10%	25%

2. Research Application and Results

Research Framework

Mainstreaming of EAP is built around a program of applied research to test **"usefulness"**, and EAP analyses are guided by a standardized set of research questions and objectives. This EAP Project addresses two reciprocal questions:

> ***What influence does the stream as an ecological system (as a natural commons) have on urban and rural land use near the stream system; and does the stream influence the utility and financial value of parcels?***

Because asset management is the program context, the over-arching intent is that EAP findings would be used to establish line items in local government annual budgets for M&M.

Research Objectives

Although the research framework is common to all, each EAP case study is unique. Each local government is dealing with a distinctive stream system management challenge driven by local circumstances.

1. Establish a measure of "stream worth" to the community based on historic investment in M&M.
2. Quantify the "financial case" for the stream corridor as a Natural Commons Asset (NCA).
3. Suggest a "benchmark guideline" for maintenance and management (M&M) investment in the stream corridor within the context of an Asset Management Plan.
4. Determine whether and how the stream influences the assessed values of parcels that abut or are adjacent to the stream.

Research Findings: The details of the research and analyses are presented in Part C. In this Part A, we simply present a single page synopsis for each of the four research objectives.

Community Investment in Bings / Menzies Stream System (Research Objective 1)

RESEARCH OBJECTIVE 1:
Establish a measure of "stream worth" to the community based on the historic investment in M&M.

The scale and magnitude of community investment in maintenance and management (M&M) is a demonstrable measure, over time, of the **worth to the community** of restoring and/or sustaining a properly functioning stream system so that it provides a "package of ecological services". Refer to the sidebar for the definition of M&M.

The package of ecological services provided by the stream system is the "range of uses" desired by the community, that is – drainage, recreation, habitat, and enjoyment of property.

Maintenance & Management (M&M) Defined

Maintenance is defined as actions that prevent or avoid degradation of ecological assets that constitute the stream corridor system.

Management is defined as actions that improve the condition of the ecological system and the services it provides.

Historic average annual investment is a proxy measure of community "willingness to pay" and "ability to pay". Social and ecological values are implicit in M&M expenditures. Research Objective #1 identifies six categories of investment:

- stream maintenance (by volunteer stream stewards)
- specific projects
- property acquisition
- public processes and planning
- outreach
- research (such as the EAP project)

EAP attempts to determine a rough measure of the magnitude of M&M investment (community and local government) over the past two decades. The six areas encompass both cash outlays and the dollar value of the substantial in-kind contribution by the community.

At least $7.3M has been committed during the past decade. The actual investment is higher but supporting numbers are not readily available.

This represents an average annual M&M investment of approximately $1500 per lineal metre of stream and corridor.

Excluding the $7 million capital value of Somenos Marsh from the calculation, the annualized amount for all other M&M activities is about $60 per metre per year.

Financial Value of the Bings / Menzies Natural Commons Asset (Research Objective 2)

RESEARCH OBJECTIVE 2:
Quantify the "financial case" for the stream corridor as a Natural Commons Asset (NCA)

A stream in settled areas is a **Land Use**. The setback zone for streamside protection is defined in regulation. If the stream did not exist, the land it occupies would be used for nearby (residential or other) development.

To fulfill Research Objective 2, the EAP methodology uses BC Assessment Authority property transaction data to quantify the financial value of the stream and corridor – that is, the Natural Commons Asset.

Natural Commons Asset Defined

The NCA is the portion of the stream corridor that lies in the regulatory setback zone. The NCA width measured from the centre of the stream is the sum of the stream width plus the setback distance on each side.

Based on the scientific research supporting RAR, a 30-metre setback is considered the minimum needed for protection of the riparian function of a stream system.

What the Numbers Tell Us: The most important finding is that the NCA value for urban area – **$2.1M per kilometre** - is relatively low compared to several other EAP case studies. A deeper dive into the analysis led to the observation that MNC policies and regulations - notably Development Permit Area 3 – Natural Environment (DPA3) – have prevented subdivision of large parcels abutting the stream.

Understanding what the numbers are telling us led to a breakthrough in the evolution of the EAP methodology as a tool to support integration of stream systems into Asset Management Plans. We describe this new concept as the "riparian deficit". In effect, DPA3 has minimized the order-of-magnitude of the deficit when compared to other case studies.

The NCA unit value is a measure of the Riparian Deficit. A comparatively low value is a positive indicator of the effectiveness of streamside setback regulation.

Financial Case for Stream Systems: The Riparian Deficit is the environmental equivalent of the Infrastructure Gap (Deficit). It adds balance to the asset management conversation by giving equal weight to the environmental protection perspective and financial case for stream systems. This is explained in Part B.

Guideline for an Annual M&M Budget
(Research Objective 3)

RESEARCH OBJECTIVE 3:
Suggest a "benchmark guideline" for M&M investment in the stream corridor within the context of an Asset Management Plan

The context for Research Objective 3 is that the interaction of a constructed drainage infrastructure system with a stream system typically results in an "unfunded infrastructure liability". And this grows over time in the absence of a funding mechanism for M&M of both natural and constructed assets.

Effective M&M of Natural Assets

The EAP program supports local governments adopting an integrated approach to life-cycle M&M of the drainage service. The integrated approach recognizes that constructed infrastructure and stream systems are inter-connected components of the drainage service. Effective M&M of natural assets requires local government commitment backed by line items in an annual report.

Benchmark for Budget Planning: Based on established life-cycle practice for M&M of constructed assets – that is, buildings and buried infrastructure - future annual expenditures for ongoing M&M of the restored Bings / Menzies stream corridor could reasonably be set at 1% of the NCA value (Research Objective 2).

The 1% guideline establishes a benchmark for budget planning purposes. Because it uses the BC Assessment database, the NCA value is as real a number as the replacement costs for buildings and buried pipes. In the absence of historic data (Research Objective 1), for comparison with the 1% guideline, we have included the following example for illustrative purposes. It provides a perspective.

NCA Value for existing open channel	**An Annual M&M Budget**	
	Based on the 1% Guideline	Compared with the average annual historic investment
$2100 per m	~$21 per metre per year	~$6 per metre per year (excluding Somenos Marsh)

The 1% benchmark for natural asset M&M need not be 100% funded by local government. The stewardship sector has access to resources and funding that complement what local governments bring to the table. This underscores the benefit of collaboration to tackle the potential unfunded liability associated with M&M of stream corridors.

Influence of the Stream on Parcel Values
(Research Objective 4)

RESEARCH OBJECTIVE 4:
Determine whether the stream influences the assessed values of parcels that abut or are adjacent to the stream.

The relevant measure (metric) of stream influence is the **$ per m²** value. This metric reflects two considerations: the developable area qualities of parcels; as well as streamside setback regulations when parcels abut the stream.

EAP looks at three case study scenarios to assess stream influence – **whether parcels abut the stream, are adjacent to the stream, or are distant from the stream.** For each scenario, parcel group samples are selected for analysis and comparison.

Recognition of a Blended Financial Value

Streamside protection policy and bylaws have been in force in MNC for two decades. A large amount of development within 200m of Bings Creek has occurred in that time and has been subject to regulation.

Clearly the application of DPA3 to Bings Creek in the urban area restricts potential development of parcels abutting the stream. Parcels are encumbered by the setback zone.

This condition suggests that owners and potential buyers accept the fact that some portion of a parcel is undevelopable. This required a closer look at the numbers to understand the $ value per m² for the abutting parcels without and without the influence of the riparian area.

Parcels abutting a stream exhibit a "blended financial value". We describe this as one value for the developable area of a parcel, and a lesser value for parcel area that cannot be developed due to streamside setback regulations.

What the Numbers are Telling Us: If the setback area is removed from the aggregate area of parcels abutting the stream, the $ value per m² exceeds that for the adjacent and distant parcels. This tells us that purchasers of streamside parcels essentially pay a premium for the developable portions of parcels.

In addition, upland parcels in the urban area benefit in directly from DPA3. The relatively good condition of the riparian area vegetation along Bings Creek creates a natural area ('green zone') that may make nearby upland parcels more a desirable location for residential development.

3. Framework for Operationalizing EAP within an Asset Management Strategy

Go to Part B for supporting details

The context for EAP is Asset Management for Sustainable Service Delivery. EAP is the starting point for a life-cycle approach to M&M of the drainage service. The goal would be to move **from reactive remediation** that is at best stopgap and of limited longevity**, to stream protection or restoration** that is effective and lasting.

Asset Management Readiness Scale Assessment (AMRS)

Table A1 is simplified version of AMRS, the spreadsheet tool developed by FCM for evaluating progress by local governments in implementing a life-cycle approach to renewal and replacement of constructed assets. It is included for illustrative purposes.

It is new territory to consider how the 'financial case for water assets' would fit into or influence AMRS. Interviews with local governments reveal that the competency category called *Planning and Decision-Making* is the one relevant to stream system management.

The topic area provides environmental planners with a point of departure for an inter-departmental conversation about the services that natural and constructed assets each provide.

Application of AMRS to a Drainage System: A whole-system understanding is the starting point for developing meaningful M&M metrics for stream protection. And managing the built and natural environments as interconnected systems is a guiding principle.

Context for the 1% Guideline: When stream system integrity is fully protected in a pristine creekshed, there should be no need for stream restoration or improvement. However, changes to hydrology and loss of riparian vegetation due to changes in land use are the top two factors influencing system integrity.

Whether constructed or natural, an asset is an asset. And in the built environment, each asset type requires an annual budget for M&M. Implementation of the 1% guideline would fulfill this need for assured funding. **hydrology and stream ecology by design**; restore and/or protect the natural flow paths by which rainwater reaches streams.

Application of EAP Findings

The intent is that the EAP findings would be used by local governments to establish line items in budgets for M&M of ecological assets in stream corridors.

TABLE A1: FCM Asset Management Readiness Scale Assessment for Constructed Assets (*included for illustrative purposes*)

Competency	Current State	Expected Future State
Policy and Governance	*By developing this competency, the local government is putting in place policies and objectives related to asset management (AM), bringing those policies to life through a strategy and roadmap, and then measuring progress and monitoring implementation over time.*	
A. Policy & Objectives		
B. Strategy & Roadmap	**Intentionally left blank** (typical)	
C. Measurement & Monitoring		
People and Leadership	*By developing this competency, the local government is setting up cross-functional teams with clear accountability and ensuring adequate resourcing and commitment from senior management and elected officials to advance asset management (AM).*	
A. Cross-Functional Teams		
B. Accountability		
C. Resourcing and Commitment		
Data and Information	*By developing this competency, the local government is collecting and using asset data performance data and financial information to support effective AM planning and decision-making.*	
A. Asset Data		
B. Performance Data		
C. Financial Information		
Planning and Decision Making	*By developing this competency, the local government is documenting and standardizing how it sets AM priorities, conducts capital and O&M planning, and decides on budgets.*	
A. Documentation & Standardization		
B. Asset Management Plans		
C. Budgets & Financial Planning		
Contribution to Asset Management Practice	*By developing this competency, the local government is supporting staff in AM training, sharing knowledge internally to communicate the benefits of AM, and participating in external knowledge-sharing.*	
A. Training and Development		
B. Internal Communication & Knowledge-Sharing		
C. External Communication & Knowledge-Sharing		

Asset Management for Sustainable Drainage Service Delivery

Move from Stopgap to Long-Term Solutions

A goal is to 'get it right' in the stream channel and on the land draining to it. The challenge in 'getting it right' is to move from stop-gap remediation of problems to long-term restoration of a properly functioning creekshed.

In 2014, three landmark provincial initiatives came to fruition. Together they provide a platform for integrated and coordinated actions.

In the 1990s, West Coast research correlated land use changes with impacts on stream system condition. **Water Balance Accounting** addresses changes on the land draining to the stream. **Ecological Accounting** addresses changes within a stream corridor which result in a loss of riparian integrity.

Protection of Stream System Integrity

Sustainable service delivery occurs alongside associated evolution in community thinking. It is a continuous quality-improvement process, and incremental. **Figure A3** conceptualizes the asset management journey for a local government as a continuum of steps:

- **Step One** – embrace the BC Framework
- **Step Two** – implement Sustainable Service Delivery
- **Step Three** – apply the Ecological Accounting Process

Once the life-cycle approach is standard practice for constructed assets, it would then be much easier to add M&M for stream systems. In Step Three, the principal focus of EAP is on the investment of resources already made by many stakeholders, as well as their aspirations concerning the management (prevention of degradation to and work on enhancement) of ecological services in the creekshed.

Community Benefits: Implementation of a whole-system approach to protecting stream integrity, founded on the twin pillars of Ecological Accounting and Water Balance Accounting, would result in these desired outcomes:

- **ENHANCE** the natural commons to create high value public assets.
- **AVOID** an unfunded liability (by limiting stream erosion, preventing flooding, improving water quality).
- **ADAPT** to a changing climate.
- **REDUCE** life-cycle costs for drainage infrastructure.

Reconnecting hydrology and stream ecology, and adapting to the new climate reality (*longer, drier summers followed by warmer, wetter winters*) depends upon the effectiveness of 'top-down & bottom-up' processes that align and accelerate implementation of reinforcing

Figure A3

Asset Management for Sustainable Drainage Service Delivery

'Continuum of Steps' for Protection of Stream System Integrity

Branding logo for
Asset Management for Sustainable Service Delivery: A BC Framework, released December 2014

WHAT is the issue (Ground Zero):
There is no **Asset Management Strategy**. There is an *'unfunded infrastructure (gap, deficit, liability)'*.

SO WHAT can be done (Step One):
Embrace the **BC Framework**. Focus first on constructed assets (pipes & buildings). Implement an *Asset Management Strategy / Program*.

NOW WHAT can we do (Step Two):
Life-cycle approach and **Sustainable Service Delivery** are standard practice for maintenance and management (M&M) of constructed assets.

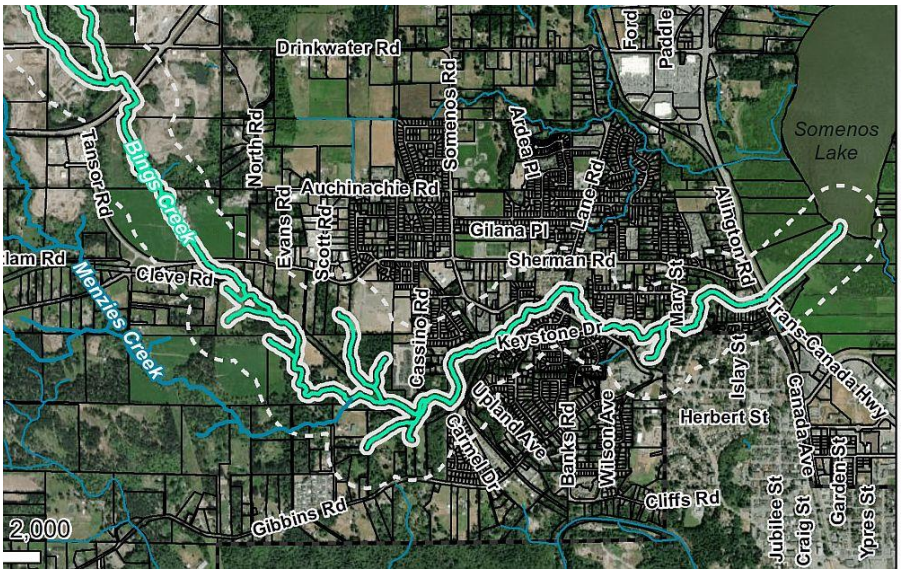
THEN WHAT will we do (Step Three):
"Twin Pillars" for protection of stream system integrity is standard practice for the drainage service. Apply **EAP, the Ecological Accounting Process,** to quantify *Riparian Deficit* values and establish annual budgets for ongoing stream corridor M&M.

As understanding of the **Local Government Finance Vision** grows, communities progress incrementally along the Continuum

PART B

EAP Framework

Asset Management Context



To provide the reader with an understanding of what is meant by the phrase "financial case for water assets", this second part of the Technical Report is structured in five sections:

1. ***Operationalizing EAP within Asset Management***
2. ***Road Map for Protecting Stream System Integrity***
3. ***A Stream System is a Natural Commons***
4. ***Use and Conservation of Land Are Equal Values***
5. ***What We Have Learned Through the EAP Program***

1. Operationalizing EAP within Asset Management

What Happens on the Land Matters to the Stream

With all the talk about integrating natural assets into asset management, the players forget that nature is a system. They focus too much on specific aspects of the system, rather than its interrelated functions. EAP looks at natural assets as a system. It is the system context that must be understood and supported. It is a mistake to focus just on parts of the system. The strength of EAP is in how we look at and value streams as systems and as a land use.

EAP interweaves financial, social, and ecological perspectives within a single number to establish the financial case for a stream corridor system. This provides environmental planners with a starting point for a balanced conversation with engineers and accountants about the services that natural and constructed assets both provide. **This alone is a game-changer**.

Move from Stop-Gap Remediation to Lasting Restoration: EAP is a leap forward in "addressing the elephant in the room", which is the unfunded liability due to degradation of stream channels and streamside protection areas. An EAP premise is that whole-system action on the landscape would ensure stream system integrity.

*The goal in having a budget line item for M&M of stream systems would be to move **from reactive remediation** that is at best stopgap and of limited longevity, **to stream restoration** that is effective and lasting.*

Whether constructed or natural, an asset is an asset. And in the built environment, each asset type requires an annual budget for **maintenance and management (M&M)**. It has been a 6-year process to evolve the EAP methodology from concept to application. The goal of making the financial case for the stream has been realized through a systematic approach founded on EAP case study applications.

The **Riparian Deficit** is a new way of defining "loss of riparian integrity". It is an attention-grabber because it is the environmental equivalent of the **Infrastructure Gap (Deficit or Liability)**. The latter is the driver for contemporary asset management which has a goal of sustainable service delivery for constructed assets such as water, sewer, and drainage infrastructure.

EAP Builds on a Science-Based Foundation

EAP is the culmination of a 25-year journey that began with seminal research by Chris May, Richard Horner and others at the University of Washington in the 1990s. They applied a whole-system approach and correlated land use changes with impacts on stream condition.

Horner and May also ranked the four limiting factors that provide a road map for science-based action to protect and/or restore stream integrity (refer to sidebar). The top two consequences of changes in land use are short-circuiting of water balance pathways, and loss of riparian integrity.

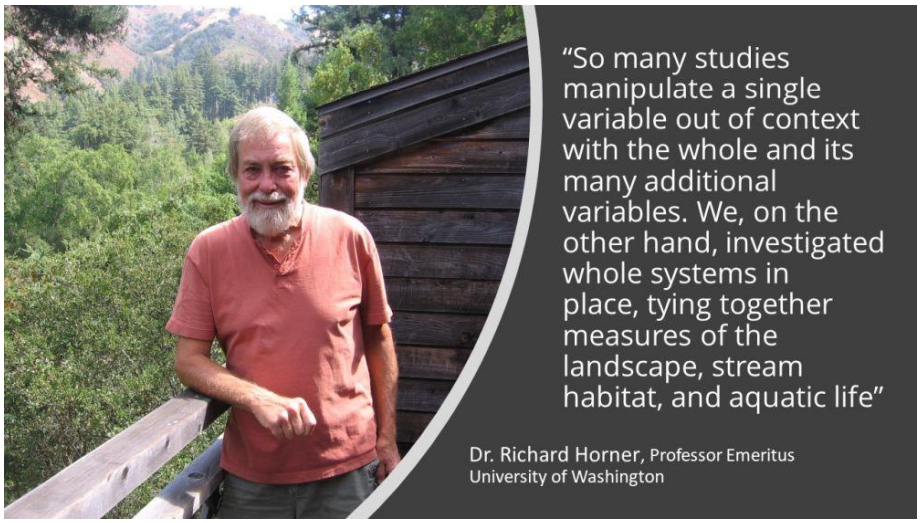
Road Map for Protecting Stream System Integrity

LIMITING FACTOR 1:
Changes in Watershed Hydrology –
addressed thru the Water Balance Accounting Pillar

LIMITING FACTOR 2:
Disturbance and/or Loss of Integrity of Riparian Corridor –
addressed through the Ecological Accounting Pillar

LIMITING FACTOR 3:
Degradation and/or Loss of Aquatic Habitat within the Stream

LIMITING FACTOR 4:
Deterioration of Water Quality



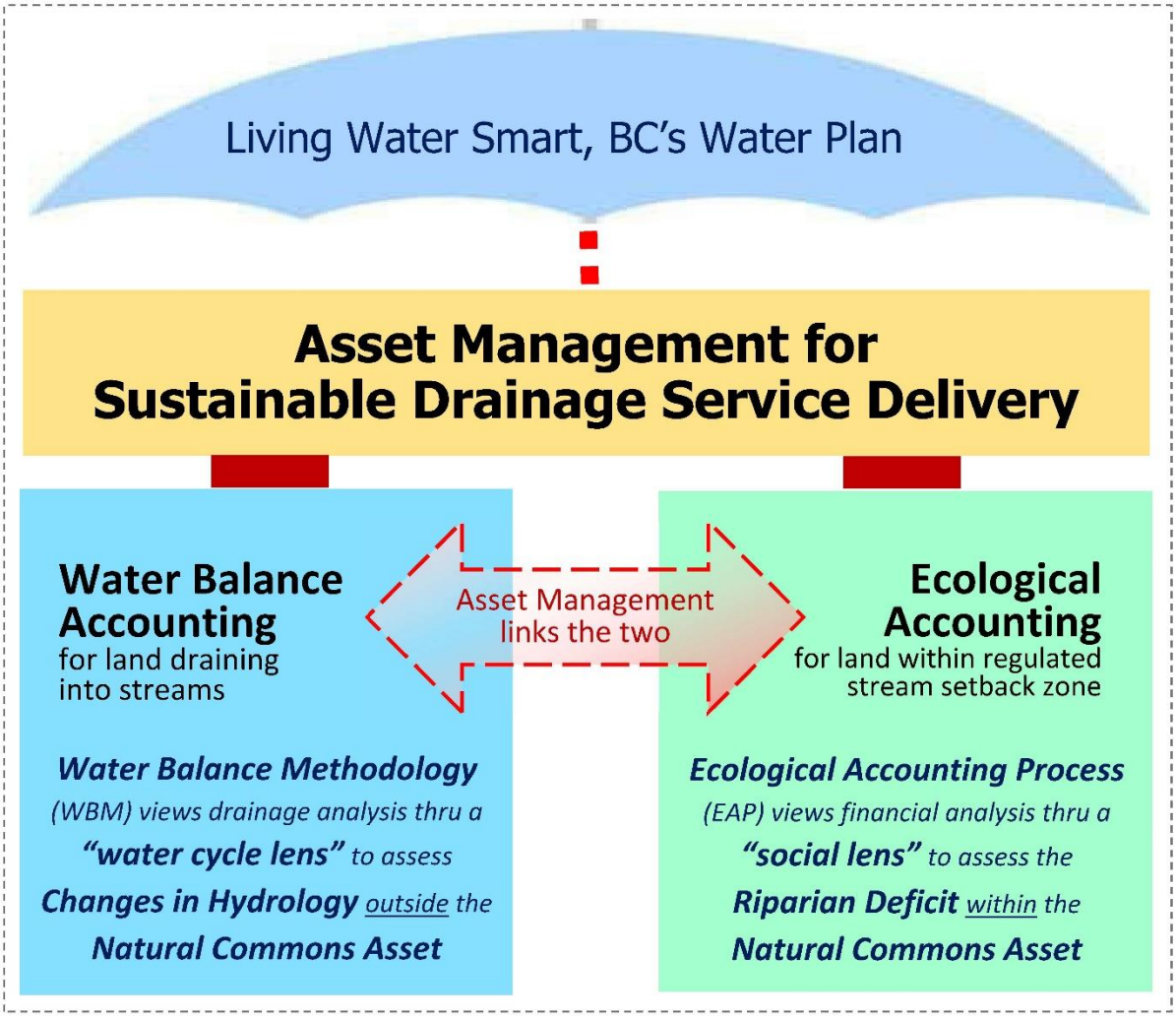
Twin Pillars of Stream System Integrity: In Beyond the Guidebook 2015: Moving Towards Sustainable Watershed Systems, through Asset Management, the Partnership introduced the **"twin pillars"** branding graphic included as **Figure B1**.

The Ecological Accounting pillar addresses "loss of riparian integrity" within a stream corridor. The Water Balance Accounting pillar address "changes in hydrology" on the land draining to the stream. Integration of the two is the goal of the whole-system approach. Asset Management for Sustainable Service Delivery: A BC Framework provides local governments with an incentive to go down this path.

It took a building blocks process to bridge from the Partnership's starting point --- how EAP looks at the "stream as a whole-system" --- to reach the EAP destination - that is, a pragmatic methodology plus meaningful metrics for measuring the **Riparian Deficit** in a way that resonates with local government.

Figure B1

Twin Pillars of Stream System Integrity



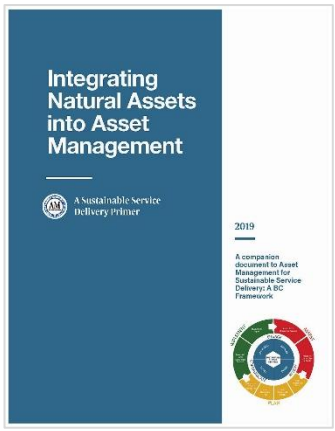
Hydrology is the Engine that Powers Ecological Services

Source: The "road map" introduced as Figure 60 on page 156 in *Beyond the Guidebook 2015: Moving Towards "Sustainable Watershed Systems, through Asset Management"*. Released by the Partnership for Water Sustainability, November 2015

Financial Case for the Stream

EAP provides communities with a guiding philosophy, a pragmatic methodology and relevant metrics to make the financial case for annual investment to prevent degradation and improve the condition of ecological assets that constitute a stream corridor system.

The EAP methodology focuses on the historical and current land use practices that have changed landscapes, modified hydrology, and have led to present-day community perceptions of the worth of the stream or creekshed and the ecological services it provides.



Context for Integration of Stream Systems with Engineered Assets

Released in September 2019 by Asset Management BC, the Primer introduces EAP with this statement:

"Significant strides have been made in natural asset management in British Columbia and across Canada. Several initiatives have built on each other, forming a foundation for local governments to increase their consideration of the potential of natural assets."

Use of EAP to establish the 'financial case for the stream' would put M&M of stream corridor systems on an equal footing with constructed assets (municipal infrastructure). **Table B1** lists ten key messages that capture the essence of EAP.

Local Government Services: Core services such as utilities, roads, parks, and recreation take up the bulk of a local government budget and are the traditional focus of asset management. Prior to release of the Primer on Integrating Natural Assets with Asset Management in 2019, ecological services were not typically part of the asset management mind-set.

At best, ecological services have been considered as an add-on. They are not intuitively understood by the public, elected representatives and asset managers. To stimulate awareness and advance uptake of a 'whole-system approach' to asset management, it helps to define ecological services in terms of drainage, recreation and habitat uses.

Ecological Services are Core Services: Once communities make the mental transition to view ecological services as core local government services, and then look at their budgets differently, the change in mind-set should lead to this question: how can we do things better? This shift in perspective logically leads to the next question:

How do we establish an annual budget for M&M that sustains the 'package of ecological services' in a stream system that humans depend upon for drainage, recreation, habitat, and enjoyment of property uses?

TABLE B1:

10 Key Messages to Remember about EAP

1. Every urban creekshed (watershed) comprises a **Constructed Commons** (roads, utilities, etc.) and a **Natural Commons** (streams, riparian corridors, etc.). Each "commons" is a system.
2. **Hydrology is the engine that powers** ecological services. Both hydrology and the ecological services it supports are defined as natural assets.
3. **Impaired hydrological function** results in diminished ecological services.
4. The **worth of a creekshed is a package of ecological services** made possible by the hydrology. EAP focuses on wetlands, ponds, streams, and riparian areas because these natural features provide services desired by communities.
5. **EAP deals with real numbers** which practitioners in local government need to deliver outcomes.
6. **EAP uses the BC Assessment database** regarding land value to calculate the financial value of the Natural Commons Asset (NCA) – that is, the land underlying the stream itself plus the adjacent regulated setback area.
7. View choices through the **Worth Lens** if the goal is to motivate communities to implement strategies that restore stream function.
8. Both the record of expenditures for maintenance and management (**calculation of worth**) and the financial value of the **NCA calculation** provides information about ecological (natural) assets that can be included in local government financial planning and **Asset Management Strategies and Plans**.
9. The likelihood of a community taking action depends on **what a community thinks** the stream is worth.
10. Distinguish between maintenance and management – because maintenance is about **preventing or avoiding** degradation, whereas management is about **improving** the condition of the ecological asset.

How Much to Invest in the Stream System?

EAP focuses on "worth to the community" rather than a theoretical value.

EAP emphasizes both social and financial values.

EAP employs one financial valuation process - that is, calculation of the land value of the Natural Commons Asset (NCA).

In the case of a stream, this is the ribbon of land underlying the stream itself and the adjoining setback area required in bylaws and Riparian Areas Regulations.

BC Assessment land values are used for this calculation, thus reflecting the social commons. Property owners purchase in locations that they think are worth their investment.

Both the calculation of the land value of the NCA and the account of investment in maintenance and management of a stream are reports that can be used for budget strategy and planning as well as for asset management analysis.

Integration of Stream Systems into Sustainable Drainage Service Delivery

A whole-system understanding is the starting point for developing meaningful M&M metrics. Managing the built and natural environments as interconnected systems is a guiding principle.

Unless communities measure the effect of impacts, degradation of riparian assets and streamside protection areas will continue. EAP helps to quantify the unfunded and growing cost (hence liability) to protect, remediate or enhance stream systems in disturbed urban and rural landscapes. **This is the starting point for a life-cycle approach to M&M of the drainage service**.

Effective M&M requires an understanding of how water balance pathways connect creekshed hydrology and stream ecology, how changes on the land disconnect them, and how green infrastructure design can reconnect them.

Budget Line Items: EAP bridges a gap. While local governments have existing tools in the form of policies and legislation for 'maintenance and management' of ecological assets, they have until now lacked a pragmatic methodology and meaningful metrics to incorporate stream systems as line items in Asset Management Plans.

Asset Management BC, which is co-chaired by UBCM and the Ministry of Municipal Affairs, points out that M&M represents 80% of the total life-cycle cost. The first 20% represents the initial capital investment. Whether constructed or natural, assets do need to be maintained. As and when the annual shortfall in M&M investment accrues over time, it is known as the ***infrastructure liability*** *(gap or deficit).*

Using numbers generated through application of EAP, however, local governments would have a sound basis for implementing a baseline annual budget for enhancement of the stream system (which is the natural or ecological asset) within a setback zone.

A Stream is a Land Use: The EAP methodology and metrics recognize the importance of the stream system in the landscape. A stream is a land use because the stream corridor is defined in regulations and has a financial value. EAP uses real numbers from BC Assessment, not hypothetical assumptions, to establish the financial case for the stream corridor system.

Over the past six years, a series of "big ideas" have emerged during the 3-stage program of testing, refining and mainstreaming EAP. These big ideas are transformative in their implications for local government asset management. These are introduced later in Part B.

The Unfunded Infrastructure Liability

As a financial objective, the term "sustainable service delivery" was coined in 2010 when the Province of BC introduced the concept in order to focus local governments on two desired outcomes:

> Shift the local government focus from the infrastructure itself to the **service** AND the **level-of-service** that the infrastructure asset provides.
>
> Reduce the unfunded liability due to initial infrastructure capital costs being a mere 20% of life-cycle costs over time.

Reconnect Hydrology and Stream Ecology: Stream systems are natural infrastructure assets. They support drainage of urban and rural lands. But there is typically no funding mechanism for stream M&M such as for water and sanitary sewer utilities.

Although several local governments in BC do have stormwater utilities, their purpose is to fund conventional piped infrastructure. So, the unfunded M&M liability caused by drainage impacts on stream systems due to subdivision and development grows over time. This liability is the driver for a life-cycle approach to drainage systems that is founded on 'whole-system' understanding.

A life-cycle approach to sustainable drainage service delivery means communities would manage the built and natural environments as interconnected components of **one system**. The way to do that is through line items in an annual budget. This is standard practice for constructed infrastructure assets.

Once local governments embrace a guiding philosophy that ecological services and use of land for development are equally important, then the next step is for them to include M&M budgets for stream systems in their Asset Management Plans. This would begin the process of reconnecting hydrology and stream ecology by design.

Table B2 Complements Twin Pillars Graphic (Figure B1): The table is a synthesis of what is necessary to integrate M&M of the natural and built environments under the umbrella of an Asset Management Strategy or Plan. **The table conceptualizes considerations that shape a strategy for moving from stop-gap remediation to long-term restoration of stream corridors** – by connecting land and water by design, and over time restoring water balance in altered landscapes.

Hydrology Powers Ecology

*The flow of rainwater from cloud to stream is comprised of three water balance pathways: **surface runoff, horizontal shallow interflow**, and **deep groundwater** (aquifer discharge).*
Yet the latter two are routinely ignored by planners and designers. Time, a critical factor, is also ignored. These omissions have stream health consequences.

What / So What / Now What / Then What

***Table B2** distills what has been learned over two decades, and factors in sustainable service delivery.*

TABLE B2 - RECONNECT HYDROLOGY & STREAM ECOLOGY

"Whole-System Approach" (4 Steps) to Integration of Built & Natural Environments

	1. WHAT is the issue? – **"Call to Action"**	*2. SO WHAT can be done? –* **"Core Building Blocks"**	*3. NOW WHAT can we do? -* **"Desired Outcomes"**	*4. THEN WHAT? –* **"Mainstreaming"**
Under each step, Cascading Key Messages define "What Really Matters"				
	Success in solving 'In your face' problems would mean:	***Integrating Natural Assets into Asset Management relies on understanding that:***	***There are paybacks when a community 'gets it right':***	***Restorative development results in sustainable stream restoration:***
1	Less flooding	Hydrology is the engine that powers ecological services	AVOID an unfunded and unaffordable financial liability for drainage infrastructure	Require 'design with nature' standards of practice for drainage and servicing of land
2	Less stream erosion	Three pathways by which rainfall reaches streams are 'infrastructure assets' that provide 'water balance services'	ADAPT to a changing climate to restore the water balance and reduce risks	Shrink the destructive footprint while growing the restorative footprint
3	More streamflow when needed most	Taking action depends on what a community thinks a creekshed is worth.	REDUCE life-cycle costs for drainage infrastructure	Demonstrate what is achievable thru a restoration imperative
Below, each "Problem Statement" establishes Context & defines the Central Issues in the 4-Step Process				
	Recognize that it is necessary to 'get it right' with respect to planning, engineering and asset management standards of practice – especially as they relate to and impact upon creekshed health and restoration - because "getting it right" would mean the sustainable and cumulative "community benefits" would then ripple through time	**Acknowledge** that there is a problem with current standard practices for servicing and drainage of land - and that these practices are the root cause of degraded urban streams – because 'getting it wrong' results in an unfunded and unaffordable infrastructure liability that is then a financial barrier to restoration of creekshed function	**Re-focus** local government business processes on outcomes so that they align with provincial policy, program and regulatory framework for **Living Water Smart** - which encompasses both the *Whole-System Approach* and *Sustainable Service Delivery* - and thereby achieve desired outcomes that would have tangible community and financial benefits	**Get it right**, province-wide. B.C. is one of the last places on the planet where it is still possible to transcend the climate debate and lead by example. B.C. has enough remaining natural capital to protect and restore its way back to true sustainability. Improve where we live.

Application of Asset Management Readiness Scale to the 'Financial Case for a Stream'

The Regional District of Nanaimo Board passed this resolution o April 27, 2021:

"That the Millstone River Ecological Accounting Process report be used to inform future Corporate Asset Management Planning."

"This report has given the RDN, as well as the City of Nanaimo, further insight as we develop our existing framework for the protection and enhancement of our important natural features in our communities, including stream corridors," stated Chair Tyler Brown, Regional District of Nanaimo

Introduced in Part A, **Table A1** is a single-page version of the Asset Management Readiness Scale (AMRS), a spreadsheet tool developed by FCM. The tool defines five areas of competency. Partnership experience is that it has value as a conversation starter with local government asset managers.

Developed for constructed assets, it is new territory to consider and/or interpret how EAP, with its focus on the 'financial case for a stream', would reasonably fit into or influence AMRS.

Local Government Perspectives: The process for understanding how EAP might be applied to AMRS by local governments has involved conversational interviews with asset managers in partner municipalities.

Their responses yielded insights into how an EAP case study aligned with and/or fitted into the big picture which is their organization's approach to asset management planning for sustainable service delivery.

Conversations revolved around the question of how likely is it that one small study would shift the overall ratings in a 15 x 5 matrix, shown as **Table A1**, for 5 areas of competency.

Starting Point for Interdepartmental Conversations: The short answer by the partners is that it would not. However, they said, EAP does help broaden and balance the asset management conversation. This alone achieves the goal of EAP in providing local governments with a methodology and metrics for making the financial case for streams.

Among the participating local governments, there is a consensus that Planning and Decision Making is one area of "asset management competency" where an uptick would be anticipated as an EAP project outcome.

The focus on decision-making is a starting point for inter-departmental conversations that put stream systems and constructed assets on an equal footing. That would be the game-changer. A selection of quotable quotes follows **Table A1**.

TABLE A1: FCM Asset Management Readiness Scale Assessment for Constructed Assets (*included for illustrative purposes*)

Competency	Current State	Expected Future State
Policy and Governance	*By developing this competency, the local government is putting in place policies and objectives related to asset management (AM), bringing those policies to life through a strategy and roadmap, and then measuring progress and monitoring implementation over time.*	
A. Policy & Objectives		
B. Strategy & Roadmap	**Intentionally left blank** (typical)	
C. Measurement & Monitoring		
People and Leadership	*By developing this competency, the local government is setting up cross-functional teams with clear accountability and ensuring adequate resourcing and commitment from senior management and elected officials to advance asset management (AM).*	
A. Cross-Functional Teams		
B. Accountability		
C. Resourcing and Commitment		
Data and Information	*By developing this competency, the local government is collecting and using asset data performance data and financial information to support effective AM planning and decision-making.*	
A. Asset Data		
B. Performance Data		
C. Financial Information		
Planning and Decision Making	*By developing this competency, the local government is documenting and standardizing how it sets AM priorities, conducts capital and O&M planning, and decides on budgets.*	
A. Documentation & Standardization		
B. Asset Management Plans		
C. Budgets & Financial Planning		
Contribution to Asset Management Practice	*By developing this competency, the local government is supporting staff in AM training, sharing knowledge internally to communicate the benefits of AM, and participating in external knowledge-sharing.*	
A. Training and Development		
B. Internal Communication & Knowledge-Sharing		
C. External Communication & Knowledge-Sharing		

"The value of projects like EAP to the asset management program in Oak Bay is that it helps us better understand the financial case for Bowker Creek. We are then able to make some planning decisions about how much money to put aside to sustain and maintain the creek for the future. Council buy-in is important."

Dan Horan, Director of Engineering & Public Works, District of Oak Bay

"Decision-making is the key. In the City of Victoria, we are creating new ways of making decisions about what we do with our assets, whether they be natural or hard. Embracing EAP would introduce a structured asset planning approach. It provides metrics for integrating natural assets into the municipal infrastructure inventory and place them on an equal footing with constructed/engineered assets. This provides a starting point for a balanced conversation about the services that the natural and constructed assets both provide. EAP will be used for Bowker Creek, and for future planning and decision-making."

Trina Buhler
Asset Management Specialist
City of Victoria

"Asset management and ecological frameworks are merging closer than ever before. This is good news as Saanich continues to catalogue and valuate storm water natural assets with the intent of establishing resources to steward both hard, linear infrastructure and natural systems alike. Modern asset methodologies can sync well with other frameworks, such as EAP, which provides additional tools and metrics to improve maintenance and management across the District, and in collaboration with our regional partners on such initiatives as the Bowker Creek Initiative."

LESLEY HATCH, SENIOR MANAGER OF WATER RESOURCES, DISTRICT OF SAANICH

2. Road Map for Protecting Stream System Integrity

About the Water Balance Pillar

In the 1990s. Puget Sound research in Washington State's part of the Salish Sea was game-changing in nature and yielded the science-based understanding that is the foundation for Stormwater Planning: A Guidebook for British Columbia, released in 2002. A generation later, the Puget Sound findings have renewed meaning. This section provides the reader with a basic understanding of how the Water Balance Methodology addresses "changes in hydrology".

Water Pathways and Water Balance Distribution

Figure B2 is an expanded view of the **water balance pillar** in **Figure B1**. It illustrates the three pathways that comprise the water balance for the portion of the annual precipitation that reaches the stream. The guiding principle for application of the Water Balance Methodology is to maintain the proportion of rainwater volume entering the stream via each pathway.

The table below provides context for **Figure B2**. It underscores the relative magnitude and importance of the interflow component of a properly functioning watershed system in coastal British Columbia. The interflow component has historically been eliminated when land development activities alter the landscape.

	Annual Water Balance by Region				
Flow Paths	Coastal BC	Alberta - Edmonton	Ontario - Ottawa	Nova Scotia	Maryland
Precipitation	**100%**	**100%**	**100%**	**100%**	**100%**
Evaporation	20%	92%	40%	28%	40%
Streamflow	**80%**	**8%**	**60%**	**72%**	**60%**
Surface Runoff	10%	4%	10%	10%	10%
Interflow	**60%**	3%	25%	52%	25%
Aquifer Flow	10%	1%	25%	10%	25%

Road Map for Protecting Stream System Integrity

West Coast research in the 1990s demonstrated that the order of priority for factors limiting ecological values of urban streams is:

1. Changes in Watershed Hydrology

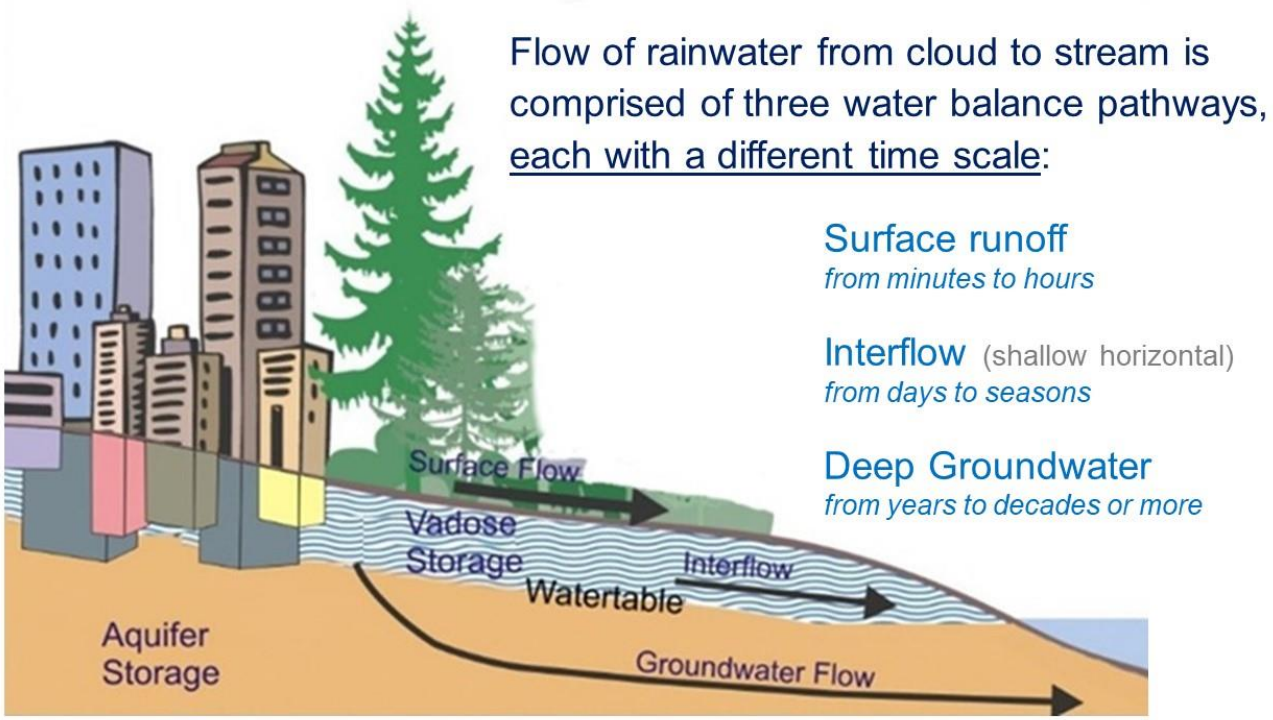
2.Disturbance and/or Loss of Integrity of Riparian Corridor

3.Degradation and/or Loss of Aquatic Habitat within the Stream

4.Deterioration of Water Quality

Reference: Chapter 2, Stormwater Planning: A Guidebook for British Columbia, 2002

Figure B2



Stream Integrity

This deceptively simple equation embodies the basic principles and concepts for dealing with uncertainty and managing risk

Climate change is not a driver; rather, it is another variable.

The Water Balance

OUT = IN

IN = *f*unction of climate, season, durations of wet and dry periods, and….

OUT = *f*unction of land uses, integrity of water pathways, volume distribution by pathway, dry-weather recession pattern, and….

and where both sides of equation are variable!

Water OUT = Water IN

The equation in the bottom half of **Figure B2** represents the essence of water balance thinking as applied to stream integrity. The **Water OUT = Water IN equation** was developed two decades ago to inform BC's Drought Response Plan for water supply in a changing climate.

As of 2015, Western North America has clearly crossed an invisible threshold into a different hydrometeorological regime. Summers in British Columbia are longer and drier. Winters are warmer and wetter. This new reality has major consequences for all aspects of water security, sustainability, and resiliency.

Understand the Whole-System Approach: Both sides of the **Water OUT = Water IN equation** presented on **Figure B2** are variable. This means there are multiple *what if* combinations and permutations to consider. As a result, the inherent variability creates uncertainty which in turn creates risk.

The risk is compounded when local governments and community fail to address disturbance of water pathways when land use changes the hydrology of a creekshed. Whenever rainwater runoff is collected and conveyed away from development sites, it no longer has a role in sustaining interflow.

Guiding Principle for Whole-System Approach: Stream system condition is a function of water balance integrity and riparian integrity. The consequences of changes to both (due to land use activities and development) play out as **degradation of aquatic habitat** and **deterioration of water quality**. These are the third and fourth limiting factors listed in the road map introduced on the previous page.

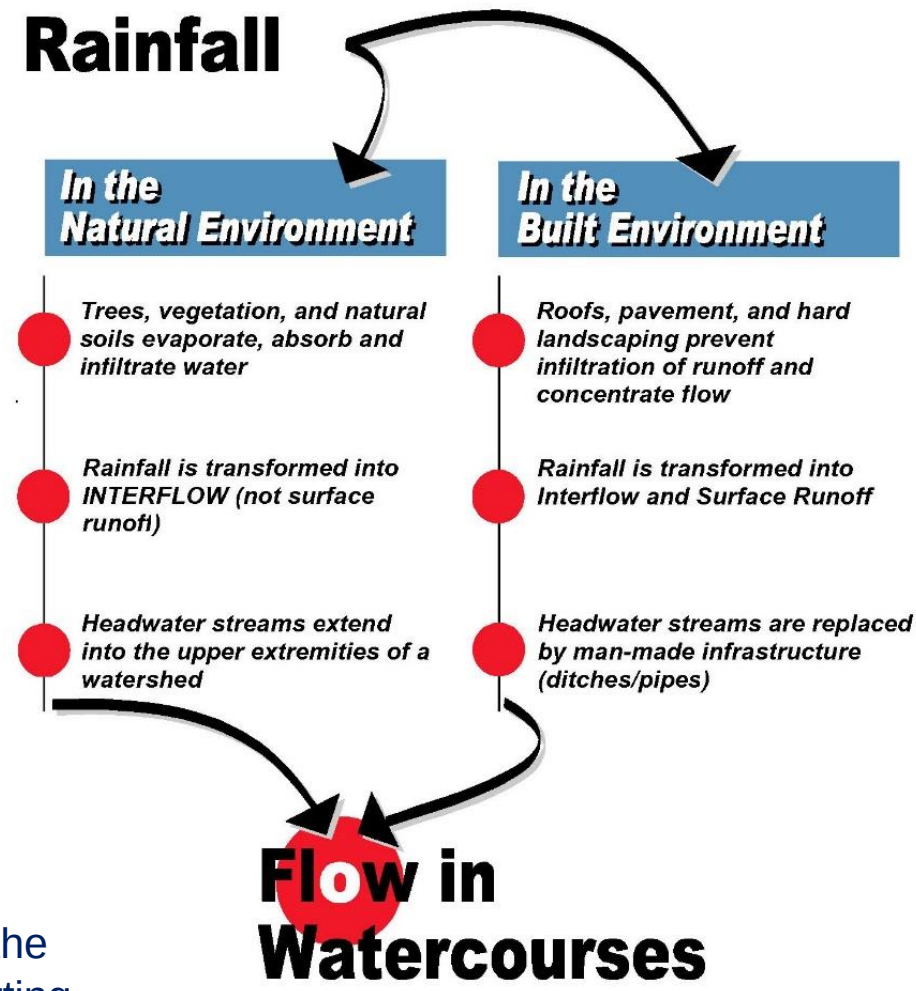
Build in Resiliency on the Landscape: The *Water OUT = Water IN equation* will always represent a snapshot in time as its' inputs shift, evolve and change over time. Because many factors are in play, an over-arching goal for any stream system would be to build in resiliency on the landscape that addresses risk related to water pathways.

Climate change is exacerbating vulnerability on the **'IN side'** of the equation. Thus, it makes sense to build in resiliency on the **'OUT side'**. There is no silver bullet. Communities need to do many little things related to land development and servicing practices – for example, preserving the interflow zone to maintain an absorbent soil sponge. Over time the cumulative benefits of doing many things do add up.

Urban Drainage and the Stream System

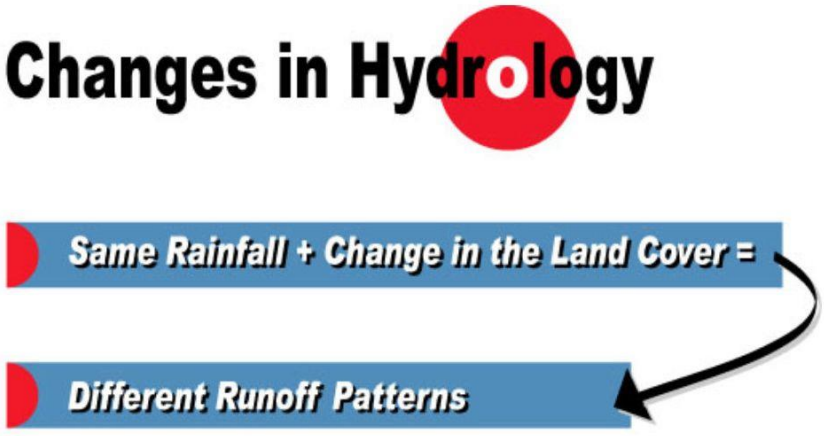
Figure B3 *conceptualizes the inter-connectedness of a constructed infrastructure system (for drainage collection, conveyance, and outfall to a stream), and the stream corridor system itself. Because these are systems within a system, they require similar M&M strategies.*

Figure B3



Natural and Built Environments are Inter-Connected in the Urban Drainage Setting

"Changes in Hydrology" refers to unbalancing of the natural water balance when alteration of the landscape ***short-circuits the three pathways*** *(surface, interflow and groundwater)* ***and the timing*** *by which rainfall reaches a stream.*



Source: *Stormwater Planning: A Guidebook for British Columbia*, 2002

3. A Stream System is a Natural Commons

About the Ecological Accounting Pillar

The concept of the **Natural Commons** underpins EAP. A stream system is a Natural Commons. This is a foundational concept that EAP builds on. It is guided by the principle that use and conservation of land are equal values. Because natural systems and human settlement share the landscape, the values associated with the commons must include social, ecological. and financial considerations.

Figure B4 is a key visual aid because it depicts the three categories of "commons". Communities rely on **natural, constructed,** and **institutional** commons for services that support quality of life and property enjoyment.

Examples of Commons

A stream is an example of a natural commons.

Drainage infrastructure is a type of constructed commons and schools are institutional.

Parks may combine elements of all three commons.

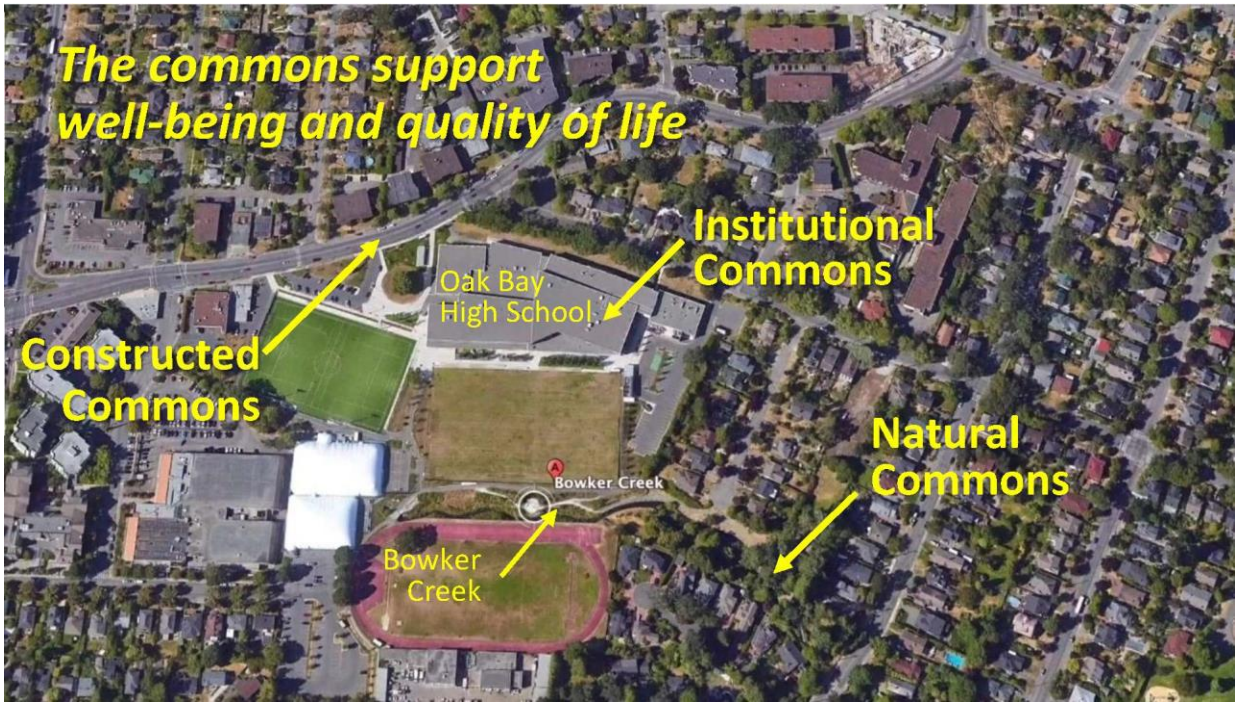
Use and conservation of **Natural Commons Assets** implies a social contract; that these natural assets will be maintained and managed to ensure access to ecological services in the future. The community has similar expectations concerning constructed commons such as roads and buried infrastructure; and institutional commons such as schools.

Central Ideas of the EAP Methodology: EAP broadly deals with naturally occurring features in the landscape which produce ecological services intrinsic for nature but also used and enjoyed by residents and property owners. EAP focuses on streams and the riparian system. Four Natural Commons concepts are introduced below. Then, each is described in the order below.

1. **Package of Ecological Services** – *refers to drainage, recreation, habitat, and enjoyment of property.*
2. **Riparian Ecosystems vs Riparian Zones** – *the distinction is important because the two are fundamentally different*.
3. **Worth of the Stream** – *community investment in restoration work is a measure of "willingness to pay"*.
4. **Financial Value of the Natural Commons Asset (NCA)** - *this is the key metric which drives decision-making.*

Figure B4

The concept of the Natural Commons underpins EAP. The image below is a key visual. It depicts three categories of 'commons': natural, constructed and institutional.



This location is in the District of Oak Bay

Foundational concepts that underpin EAP, the Ecological Accounting Process		
Natural Commons	**Constructed Commons**	**Institutional Commons**
As defined by the EAP, a **Natural Commons** is an ecological system that provides ecological services used by nature and the community. A stream is a land use and provides a "package of ecological services". Drainage, recreation, habitat, and enjoyment of property. This is plain language that Councils and Boards understand.	Communities rely on a range of services such as roads, underground utilities, and parks to support lifestyle and property enjoyment. These are **Constructed Commons**. Through taxation, they are maintained and managed to ensure the availability of desired services.	Services such as fire protection and schools are a related kind of constructed commons.

Concept 1 – Package of Ecological Services

A stream that is protected by streamside regulations comprises the stream channel plus the riparian zone. Both support ecological systems. The stream itself is part of a hydrologic system that originates in the landscape draining into the stream.

The surrounding zone and interrelated ecological systems work with the hydrology to provide a range of ecological services and aesthetic uses. These constitute the 'Package of Ecological Services' (refer to the sidebar). The table below provides supplementary details that further illustrate the 'range of uses' desired by the community.

'Package of Ecological Services' Defined

This concept refers to the combined range of uses desired by the community. Thus, a strategic plan that supports this diversity will appear worthwhile to the greatest number of interested parties.

Three key words capture the essence of what the phrase 'range of uses' means: drainage, recreation, and habitat. A fourth attribute is enjoyment of property.

Use of these terms helps readers visualize what the package of ecological services encompasses.

Hydrology	*Rainwater interception, detention, infiltration, release to interflow and ground water, attenuation of flooding, aquifer recharge, supply to wells and springs*
Aesthetic Uses	*Landmarks, features in parks, natural areas, alignments for trails and greenways, and dedicated conservation areas*
Intrinsic Nature	*Interface with riparian areas – water temperature influence, nutrients for streams, detain infiltration in vegetation and soils* *Habitat for terrestrial and aquatic life, rearing conditions for fish*
Support of Municipal Infrastructure	*Conveyance of stormwater from roads and drainage systems* *Detention of rainwater, attenuation of flooding*

What the Range of Uses Looks Like: The phrase 'package of ecological services' was as an outcome of the Stage 1 EAP program. It was coined by Marvin Kamenz, Director of Development Services with the Town of Comox, to describe the uses the community expects to receive from a creekshed, now and in future.

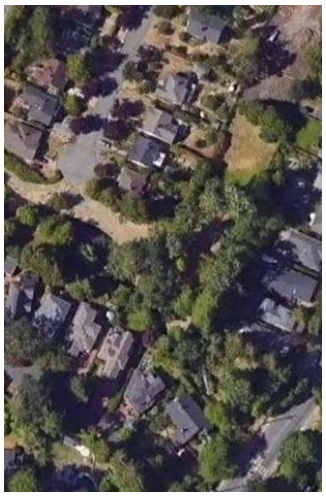
Illustration of the “Package of Ecological Services” – the range of uses desired by the community, specifically: recreation, habitat and drainage

Drainage

Recreation

Habitat

Photo Credits: Jody Watson, Capital Regional District, from a presentation in 2010



Riparian Network

An alternative term, riparian network, could also be used to describe a system composed of a physical stream channel and adjacent riparian (vegetated) corridor. This system provides a critical ecological function in linking terrestrial and aquatic ecosystems in a watershed or creekshed (i.e., 1st order stream)

Concept 2 – Riparian Ecosystems versus Riparian Zones

The EAP analysis makes a distinction between **'riparian ecosystems'** and **'riparian zones**. A stream in a natural condition is supported by a riparian ecosystem, those areas of a watershed that directly influence the functioning condition of the stream. A riparian zone is a fragmented portion of the riparian ecosystem in developed areas where land uses have reduced the vegetated streamside area to the channel width plus a regulated setback each side (typically 15 to 30 meters metres).

Human Alteration of the Landscape: A common history of land use (settlement) on the east coast of Vancouver Island has been the fragmentation of the riparian network in both rural and urbanizing landscapes. However, current official plans contain policies, zoning (bylaws) and development permit area designations that intend to improve the balance between use and conservation of land, especially the valued NCA.

Riparian ecosystems (networks) have become reduced to riparian zones as shown on the maps of today.

Definitions: EAP considers diminution due to fragmentation to be a loss of a riparian network's ecological services that a Natural Commons provides for aquatic and terrestrial life, as well as for property owners, residents, and others in the community. EAP also describes the actions that intervenors undertake to improve streams and riparian areas through ongoing maintenance and management. In a financial valuation context, the following definitions are applied in this document:

Riparian Ecosystem Defined	Riparian Zone Defined
A *riparian ecosystem* in a pristine setting broadly describes a stream and supporting hydrological pathways that sustain flow to the stream as rainwater is infiltrated through surface and sub-soils, gradually moving to groundwater, and then to the stream itself. Within a stream corridor, a riparian ecosystem is the transitional zone between aquatic and terrestrial systems. Typically, it is wetter, cooler and has more diverse habitat then adjacent upland areas. It is also more biologically distinctive.	A *riparian zone* is a fragmented portion of the riparian network in developed areas where land uses have reduced the vegetated streamside area to the channel width plus a regulated setback each side (typically 15 or more metres).

A stream in a natural condition is supported by a riparian ecosystem. A riparian zone is a fragmented portion of the riparian ecosystem in developed areas.

Riparian Ecosystem

Remnant Riparian Area

Photo Credit: Jody Watson, Capital Regional District, from a presentation in 2010

Concept 3 - Worth of the Stream

The concept of **Worth** refers to the ecological and other uses that the community expects and draws from the stream. These include social, ecological and infrastructure expectations of this natural asset.

The scale and magnitude of community investment in M&M is a demonstrable measure, over time, of the worth to the community of a stream corridor. The section about Research Objective 1 in Part C elaborates on how the community views Bings / Menzies Creek.

A community's perceptions of worth include an implied social contract - that is, the stream will be maintained and managed for future uses and enjoyment. This is an asset management challenge.

Concept 4 - Financial Value of the Natural Commons Asset (NCA)

The sections on Research Objectives 2, 3 and 4 in Part C of this report provide details about the Financial Value of the stream corridor based on the NCA concept.

A Stream is a Land Use: EAP defines the stream width and setback area as a land use. The rationale is that the stream is defined in regulations and has a financial value. This ribbon of land is the **Natural Commons Asset** (NCA).

EAP uses BC Assessment data to calculate the NCA value based on the assessed value of abutting and adjacent parcels. The implication is that if the stream were not there, the land area it occupies would be committed to the existing nearby land uses.

Based on a representative sample of parcels, EAP finds the aggregate average area and values of the parcels. The portion of parcels in the regulatory setback area is found. This ratio or percentage of aggregate parcel values is the basis to determine the financial value of the NCA.

The 30m criterion is the minimum width of riparian cover required to support stream health.

Width of the Natural Commons Asset: In 2004, the Riparian Areas Protection Regulation formally recognized the connection between land use activities and stream condition. The science behind the Regulation establishes the boundary of the riparian area protection zone at 30 metres from the top of the bank of the stream.

4. Use and Conservation of Land Are Equal Values

About the Ecological Accounting Pillar

Use and conservation of land are equal values – this is the starting point for EAP. Therefore, one should not be subrogated to the other. But that is traditionally what communities have done. Use of land has been the dominant consideration.

The EAP methodology is universal but application to each case study is unique in that partners frame creekshed-specific research questions. In terms of the road map for protecting stream integrity, EAP closes the circle with guidance for addressing loss of riparian integrity.

A Collaborative Building Blocks Process: Each EAP case study has yielded key lessons and resulted in fresh observations and insights. We describe these as 'big ideas' and they are summarized in a table at the end of Part B. Each case study has supported the depth of analysis for subsequent EAP applications.

The EAP process is collaborative. We modify our theoretical and intellectual approach through conversations with the players. Our goal is to express EAP in language that works for them. That is why the term **Riparian Deficit** resonates. It is intuitive. We still have work to do with EAP in terms of getting our ideas into language that is easy for a wide audience to use. But we are getting close.

John Henneberry was a source of inspiration during the early years of the EAP program. John's pioneering work in the United Kingdom validated the whole-system philosophy that guides use of EAP. His interests lay at the interface between planning and property; and focused on the use of economic instruments in planning and reproduction of the urban built environment.

John Henneberry (1952-2021)

Professor of Property Development Studies, University of Sheffield, United Kingdom

Land Use Context for Riparian Deficit

The essence of EAP is to discover the "riparian deficit" for a stream system. This is a new concept. It means that the conversation between environmental planners and engineers would be balanced because the **Riparian Deficit** is the environmental equivalent of the **Infrastructure Deficit (Gap or Liability)** for engineered assets.

When land development takes place, there is necessarily a riparian deficit. Thus, when applying EAP, one must always come up with some measure of the riparian deficit. This is the most useful output.

EAP assigns a value to the stream – that is, the NCA. And one can show what the community has invested in the stream as a measure of what it is worth. But from a purely quantitative point of view, **what is not measured at all, by anyone, is the 'riparian deficit' from the land use perspective**.

Application of EAP Metrics: The riparian deficit is an important takeaway about EAP because the idea of a riparian deficit is relevant to organizations that deal with natural assets, especially streams. This applies to the stewardship and local government sectors, to businesses, to First Nations, and to anyone else involved in collaborative efforts related to stream restoration.

The EAP metrics give all the players a way to focus on using their time to get the most effective result. The reason is that EAP allows them to see what aspect of the riparian deficit they can deal with. It is necessary to think of the riparian deficit as something that is social, ecological. and financial in nature. That is a complicated package of values.

The EAP structure helps address each of those values, and not only relate them to the riparian deficit and the work that needs to be done for maintenance and management, but also relate them to asset management, both planning and strategy.

An Order-of-Magnitude Measure of Impacts: Streams and other water assets are Natural Commons Assets. Everyone has expectations, enjoys and uses them, and so on. There is an implied contract to maintain and manage them so that they will be there in the future. But from an asset management point of view, we do not have the metrics and so we do not measure ecological services. While we know their impacts, we just don't know the order-of-magnitude of harm or problems that those impacts have. EAP at least gives us an order-of-magnitude measure.

Why the term 'Riparian Deficit'?

EAP uses the term, Riparian Deficit, to interpret the full implications of the Natural Commons Asset (NCA) financial value.

Because EAP uses BC Assessment financial values for parcels, the resulting NCA number reflects social and ecological values. When the community wants more development near the stream, more ecological features for trails and parks, aesthetic advantages for parcels abutting the stream, etc., the result is higher financial expectations and increased assessed values. The NCA expresses these expectations in a number.

The Riparian Deficit refers to the order of financial magnitude of these demands. A high deficit equals a latent need for increased M&M as well as remediation of stream system deficiencies.

Implications of the Riparian Deficit for Maintenance and Management Budgets

The EAP methodology focuses on the riparian condition of streams because legislation allows a steam to be defined as a land use. It has an area, which is the required setback or protected zone, and its financial value may be inferred by using the assessment database maintained by the BC Assessment Authority.

Looking ahead to Part C, the EAP methodology measures the area of the Natural Commons Asset (NCA) of the stream system and calculates its financial value. The NCA area is the stream channel width plus 30m setback on each side of the stream. The financial value of the NCA is derived from the assessed value of parcels which abut the stream and have some area (m²) in the setback zone.

Riparian Area Condition Realities: Where stream systems have reduced riparian setbacks, the costs of maintenance and management are expected to be higher than for stream areas that have adequate riparian area. Riparian deficits may also contribute to flooding, erosion, and other problems. The EAP program confirms these realities:

A stream can provide a package of ecological services that support natural and human communities.

Where riparian areas are intact and, possibly, include riparian ecosystems, the ecological services will be greater.

Where there is no riparian zone, the stream will provide only conveyance and few, if any, ecological services.

Many communities recognize the importance of ecological values that streams provide and which support quality of life and property enjoyment.

Many communities invest in maintenance (prevent degradation) and management (enhancement) of streams. Investment may include adding to riparian area through property acquisition or legal tools, community amenities (parks, natural areas) derived at time of development of parcels, collaboration of stewardship organizations with local government and businesses, restoration projects, long term plans shared by operating departments, etc.

BC Assessment Data Explained

BC Assessment data is longitudinal and reflects the social (size, location), financial (price, condition) and ecological preferences (price differentials for proximity to a stream and the stream's functioning condition) of purchasers and sellers.

Steps in the NCA Calculation

The NCA calculation is the foundation piece for EAP. Simply put, the NCA calculation underpinning Research Objective 2 determines the financial value of the stream for all or any portion of its length. **The NCA calculation uses BC Assessment data for the financial analysis**.

The NCA analysis enables the community to appreciate the financial value of the stream as a unique natural asset. It is a linear system requiring private parcel owners and the community to be involved in protecting its functioning condition.

Figure B5 illustrates the NCA and associated terms and is a useful visual guide. To prime the reader for the detailed financial analysis that follows in Part C, the steps in the NCA calculation are listed as follows:

1. Find the Aggregate Area in m² **of the entire setback zone** for the length of the stream under analysis.

2. Find the Aggregate Area **of the portions of parcels that extend into the entire setback zone**. *Where the percentage of parcel area extending into the setback zone is less than 10%, the factor of 10% is used for the aggregate calculation.*

   Express the aggregate portions of parcels in the entire setback zone as a percentage of the aggregate area of the entire setback zone. This can be calculated by sample area and for the entire stream corridor. The expressions are in m².

3. Find the Aggregate Assessed Value of parcels that abut the stream, and which have area in the setback zone.

4. Calculate the aggregate assessed value of parcel area in the setback zone as a percentage of the entire setback zone. This is the Factor.

5. Use the Factor to calculate the aggregate assessed value of the portions of parcels in the setback zone. This is the Product and it will be expressed as **$ per m².**

6. The Product (value of the setback area per m²) can be applied to the setback area of the entire stream length or portion of its length. This is the Natural Commons Asset (NCA) value.

EAP brings clarity by defining the stream setback zone as a land use - because it can be measured and has definition under various pieces of legislation. If the stream did not exist, the land it occupies would be used for residential, commercial, institutional, or other development.

BC Assessment Data vs a Land Appraisal

BC Assessments relate to property prices reflected in market trends for property sales over time.

BC Assessments may differ considerably from present market prices.

Appraisals differ. They are current financial valuations related to market conditions for a specific parcel or property.

The basis of BC Assessment information is data collected over several decades from completed real estate transactions for classes of property. In the case of residential parcels, the current assessment reflects the financial commitments that buyers make to acquire property in a particular location with or without improvements.

Figure B5

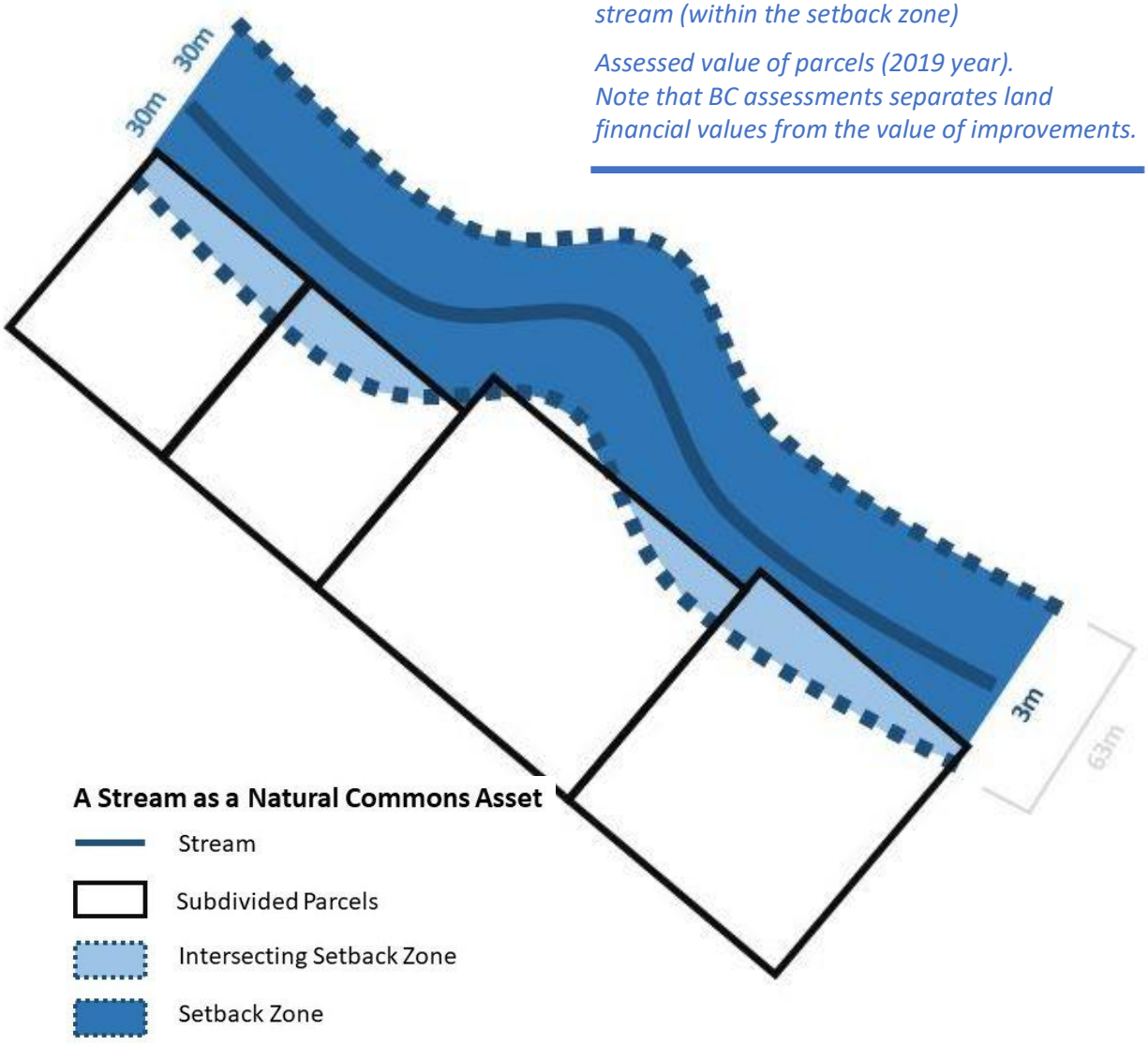
NCA Calculations

EAP metrics take the information listed below about parcels to complete the NCA calculations. The information sources are local government and provincial GIS databases. BC Assessment valuations are used. The metrics are:

Parcel area in m²

Area of abutting parcels within 30 m of the stream (within the setback zone)

Assessed value of parcels (2019 year). Note that BC assessments separates land financial values from the value of improvements.



5. What We Have Learned through the EAP Program

"Integrating natural assets into asset management processes leads to a full understanding of the role of natural assets in sustainable service delivery and how local governments can integrate the protection, maintenance, and enhancement of these assets into strategic and operational decision-making," states the 2019 Primer.

Financial Case for the Stream: Overview of Key Findings

The EAP methodology focuses on historical and current land use practices that changed landscapes, modified hydrology, and led to present-day community perceptions of the worth of the stream or creekshed and the ecological services it provides.

A whole-system understanding is the starting point for developing meaningful metrics.

The EAP methodology is universal in nature, but each case study situation is unique. **Table B3** provides a concise synopsis of a set of takeaways that paint a picture for the reader of what EAP is about.

Each EAP Project Enhances Understanding: Four major observations have emerged from the projects completed to date:

Each EAP case study advances refinement of the methodology

Each case study is unique in that partner communities frame creekshed-specific questions to be addressed by their EAP application. Each case study yields key lessons and results in fresh observations. Each has supported the depth of analysis for subsequent EAP applications.

Observation #1 - Some streams may be so altered by changes in the landscape and hydrology that few "normal" ecological functions are observable. In essence, the stream is a discounted natural asset.

Observation #2 - In urban areas, the value of the Natural Commons Asset can be calculated, with confidence, using BC Assessment data. This is yet another game-changing consideration.

Observation #3 - The degree of influence that a stream may have on the financial value of abutting (streamside) and adjacent (bordering the abutting) parcels depends on the variables in play. Size of parcels, date of subdivision, proximity to the stream, neighbourhood and other variables sometimes result in very broad generalizations.

Observation #4 - Rural residential subdivision and agricultural land uses impair the riparian ecosystems that sustain streams. The riparian zone required under regulations is, at best, a partial measure for management.

TABLE B3

THE FINANCIAL CASE FOR A STREAM SYSTEM	
What is the provincial context for EAP Demonstration Application Program?	The context is **Asset Management for Sustainable Service Delivery**, and a stream system is a **Natural Commons Asset (NCA**). EAP is a 3-stage program to *Test, Refine, Mainstream* the methodology and metrics for "maintenance and management", or **M&M**, of stream systems. The Partnership for Water Sustainability in BC is collaborating with multiple local governments in five regions within the Georgia Basin to determine **how to operationalize EAP within an Asset Management Plan**.
What is the driver behind EAP?	The driver for EAP is degradation of stream channels and streamside protection areas. EAP addresses the elephant in the room which is the unfunded cost (hence liability) to protect, remediate or enhance stream systems in urban and rural landscapes.
Why is EAP needed?	EAP bridges a gap. It provides local government with a methodology and metrics for integrating natural assets, notably stream corridor systems, into municipal infrastructure.
What are EAP core concepts?	A stream is a land use (defined in regulation; can assign a financial value). BC Assessment provides "real numbers" for a proxy financial value. The key metric is "$ per metre of channel length" as a measure of NCA value. Community investment in M&M is a measure of "what the stream is worth".
What would operationalizing of EAP achieve?	**PURPOSE:** Put maintenance and management (M&M) of stream corridor systems on an equal footing with constructed assets (municipal infrastructure). **END GOAL:** Establish an annual budget for stream corridor system M&M as a line item within an Asset Management Plan.
How is EAP a game-changer?	1. EAP interweaves financial, social, and ecological perspectives within a single number to establish the financial case for a stream corridor system. This aggregate number is the **Natural Commons Asset** (NCA) value. 2. The NCA value is a measure of the **Riparian Deficit**. This is the environmental equivalent of the **Infrastructure Liability (Deficit)** for constructed assets such as underground utilities and buildings. 3. The NCA value provides environmental planners with a starting point for a *balanced conversation* with engineers and accountants about the **services** that natural and constructed assets both provide.
Why is EAP important?	EAP adds to the conceptual framework for a riparian area maintenance and management strategy with new insights about financial metrics.

Financial Case for the Stream: Evolution of EAP Methodology

Introduced at the beginning of this Part B, the road map in the sidebar provides the over-arching context for EAP. Our spotlight is on the first two limiting factors and the twin pillars – **Ecological Accounting** and **Water Balance Accounting**.

Historical Context: EAP closes the loop on the 1990s breakthrough in science-based understanding of the correlation between land use changes and impacts on stream integrity, including the riparian ecosystem.

Beyond the Guidebook 2015[1] introduced the vision for EAP as one of the **twin pillars** – illustrated on **Figure B1** at the beginning of this Part B - for integrating stream systems within an Asset Management Plan. The goal of the 3-stage program is to operationalize – that is, "make real" - the EAP pillar.

Building Blocks in the Process: **Table B4** lists the case studies involving multiple local governments in five sub-regions of the Georgia Basin / Salish Sea bioregion. It has been a 6-year process to evolve the methodology and metrics from concept to application and reach the destination, which is:

> **A methodology plus meaningful metrics for measuring the *Riparian Deficit*, the environmental equivalent of the *Infrastructure Liability (Deficit)* for constructed assets; and establishing budgets for *Maintenance and Management*.**

Table B4 also lists the nineteen "big ideas" that power the EAP methodology and metrics. Each was introduced earlier in Part B. Now they are consolidated in one place along with the key metric – that is, the NCA Value. It took a building blocks process to evolve EAP because one "big idea" would lead to the next one. This is the beneficial outcome of a systematic approach to applied research that tests and refines the methodology and metrics to get them right.

Road Map for Protecting Stream System Integrity

LIMITING FACTOR 1: ***Changes in Watershed Hydrology –*** *addressed thru the Water Balance Accounting Pillar*

LIMITING FACTOR 2: ***Disturbance and/or Loss of Integrity of Riparian Corridor –*** *addressed through the Ecological Accounting Pillar*

LIMITING FACTOR 3: Degradation and/or Loss of Aquatic Habitat within the Stream

LIMITING FACTOR 4: Deterioration of Water Quality

[1] https://waterbucket.ca/wp-content/uploads/2017/10/Beyond-The-Guidebook-2015.pdf

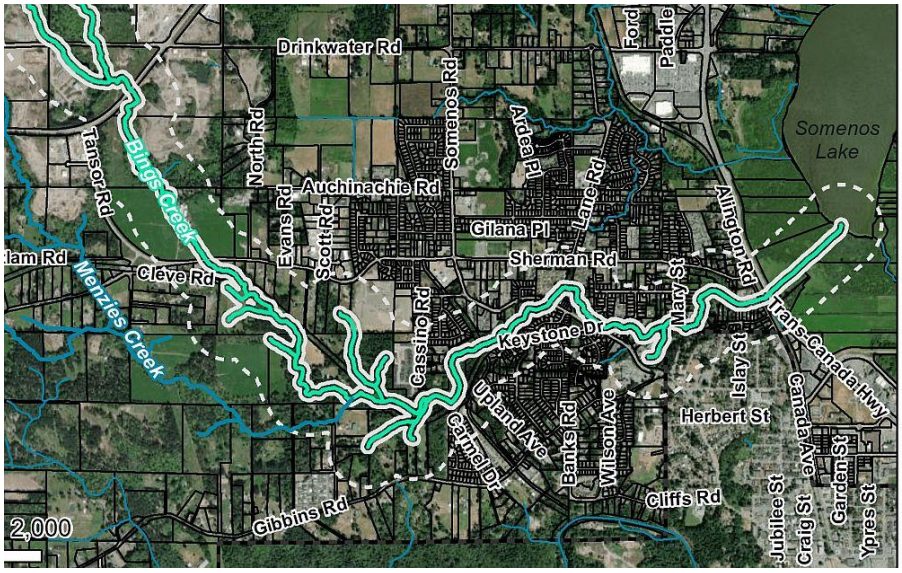
TABLE B4: What We Learned through the EAP Program

Region	Creek	Big Ideas	NCA Value
STAGE 1 – TEST THE EAP CONCEPT			
Cowichan Valley	**Busy Place Creek** - *CVRD*	**The EAP lens is the *Stream System*** ***Hydrology is the Engine that Powers Ecology***	**$1.2M per km**
Comox Valley	**Brooklyn Creek** - *Comox & Courtenay*	**BC Assessment Data is a proxy for *Financial Value of a Setback Zone*** **Investment in stream restoration is a measure of *Stream Worth*** ***Package of Ecological Services* is the range of community uses**	**$2.7M per km**
STAGE 2 - REFINE THE EAP METHODOLOGY			
Nanaimo Region	**Shelly Creek** - *Parksville*	***Riparian Ecosystems* have been reduced to *Riparian Zones*** **M&M for *Maintenance* (prevent) and *Management* (improve)**	**$1.4M per km**
Metro Vancouver	**Kilmer Creek –** *District of North Vancouver*	***A Stream is a Land Use*** **The concept of the *Natural Commons* underpins EAP** **From *Remediation* to *Restoration***	**$2.9M per km**
STAGE 3 – MAINSTREAM EAP WITHIN AN ASSET MANAGEMENT PLAN			
Nanaimo Region	**Millstone River** *RDN & City of Nanaimo*	***NCA Metric* drives decision-making** ***Framework for Operationalizing EAP, as a Budget Line Item, within an Asset Management Plan***	**$9.6M per km** in urban area **$1.4M per km** in rural area
Capital Region	**Bowker Creek** - *Saanich, Oak Bay, Victoria*	**EAP establishes the *Financial Case for a Stream*** **Streamside parcels have a *Blended Financial Value***	**$11M per km**
Cowichan Valley	**Bings/ Menzies Creek** - *North Cowichan*	**EAP addresses *Loss of Riparian Integrity* as a stream health factor** **NCA Value is a measure of the *Riparian Deficit***	**$2.1M per km**
Comox Valley	**Saratoga Beach**	**An implementation mechanism would be a *Drainage Service Area***	**$0.74M per km**
Metro Vancouver	**Bertrand Creek** *Langley Township*	**EAP supports *Equitable Urban / Rural Mitigation Investment***	**$11.0M per km** in urban area **$1.6M per km** in rural area

PART C

EAP Applied

Analysis for Research Objectives



To satisfy the curiosity of the reader who wishes to delve deeply into the numbers and appreciate the relevance of the financial case, this third part of the Technical Report is structured in five sections:

1. ***Influence of Land Use Conditions***
2. ***Riparian Areas & Rainwater Pathways Influence on Bings / Menzies Functioning Condition***
3. ***Worth of Stream as a Natural Commons***
4. ***Financial Value of Stream as a Natural Commons***
5. ***Influence of the Stream on Parcel Values***

Figure C1

Bings / Menzies Creekshed – *view looking north (from the direction of the City of Duncan) at the Municipality of North Cowichan's highly urbanized South-End*

The Bings/Menzies creekshed has a past, and it will have a future. The EAP methodology focuses on historical and current land use practices that changed landscapes, modified hydrology, and led to present-day community perceptions of the worth of the stream or creekshed and the ecological services it provides.

1. Influence of Land Use Conditions

Why EAP Looks at Land Use

The Bings/Menzies creekshed has a past, and it will have a future. These realities are inescapably connected by historic and anticipated land uses. In recent decades the community has added conservation of natural assets to its expectations of the creekshed.

The foregoing statement sets the stage for providing the reader with the big picture regarding land uses in the creekshed area tributary to Bings/Menzies Creek. This establishes the frame of reference for the EAP analyses presented in the four following sections of Part C.

The use and conservation of land perspective yields useful outcomes. When we use key analytical perspectives – such as water pathways, riparian cover and condition, and handling of drainage – this helps us understand stream condition.

EAP uses the concepts of use and conservation of land perspective to frame the analyses: This focus illuminates three realities that define the evolving relationship of land use and conservation activities to the condition of the Bings/Menzies stream system.

Water pathways – what happens to rainwater once it hits the ground?

Riparian cover and conditions – how much is there and how natural are the vegetative and soil conditions?

Handling of drainage – where does rainfall from impervious surfaces and engineered landscapes go to be conveyed away?

Thus, the over-arching purpose of this first section is to identify concerns that the Cowichan Valley Regional District and District of North Cowichan have about how land use (subdivision and development) alters the creekshed? How will local government deal with pressures to accommodate expected population growth?

EAP is a land use perspective

The EAP methodology focuses on the historical and current land use practices that have changed landscapes, modified hydrology, and have led to present-day community perceptions of the worth of the stream or creekshed and the ecological services it provides.

In a sentence, the essence of EAP is expressed as follows: ***What is the environment that supports the package of ecological services?*** *This is a land use perspective.*

Creekshed / Ecological Condition / Ecological Character

To further set the stage for the EAP analyses, we introduce and define three terms:

This discussion uses the term **"creekshed"** as the basic area for understanding how land use alters a stream system in a specific landscape.

The term **"ecological condition"** is used to refer to the altered state of the stream system resulting from economic land use activities.

The term **"ecological character"** refers to the natural or pre-economic land use condition of the watershed.

EAP focuses on stream systems as a land use. Streams are natural assets. Specifically, streams are Natural Commons which produce ecological services that all residents and property owners may enjoy.

A Focus on the Regulatory Setback Zone: In this section, we present a broad view of the present-day condition of the regulatory setback zone of the stream corridor and its capacity to provide ecological services needed for nature and desired by the community. The EAP methodology measures the width of this zone from the centre of the stream extending 30m on each side.

Later sections of Part C drill down and quantify the developed characteristics of parcels near the stream which cumulatively influence its function. The EAP methodology uses these definitions: abutting parcels which have some area in the setback zone, and adjacent parcels which extend 200m or more beyond the 30m setback border.

Next, we address four questions:

How do historic and current land use and conservation activities influence the condition of the stream system?

What ecological services does the community use and expect to draw from the stream system?

What are the maintenance and management opportunities and risks associated with the present-day condition of the stream?

How do riparian area realities relate to an asset management plan for sustainable delivery?

Creekshed Explained

Fin Donnelly, founder of the Rivershed Society of BC, defines three watershed types: River Basin (highest order watershed), Rivershed (river tributary), and Creekshed (creek tributary).

"Watershed is a generic term. Rivershed and creekshed, on the other hand, are place specific. They steer attention to a river or creek in a particular geographical location and all activities and phenomena related to that area."

"When a sense of place is organized around a creek or river rather than a town or city, it encourages a mental shift from human settlement to the larger interconnected natural environment."

QUESTION 1:

Land Use and Conservation Influences

QUESTION 1:
How do historic and current land use and conservation activities influence the condition of the stream system?

"The big flowing creek of the past was big enough to hold salmon and canoes. People could travel up the creek into the base of the mountain. And when they got up there they could take a detour and go up Menzies Creek up into the Hill 60 and Chemainus River area. So, imagine once again, that these creeks were highways from cultural and hunting areas to the village of S'aumna. The base of these creeks, and the whole way up for that matter, would be populated with homes, people, and artifacts." – recalled Jared Qwustenuxun Williams, a member of the Cowichan Tribes.

Found in:
https://thediscourse.ca/cowichan-valley/whats-the-first-nations-history-of-the-duncan-area

Prior to 1850, the ecological character of the Bings/Menzies watershed and stream system was natural. Today, the watershed is unlike the ecosystem dominated by forests that existed two centuries ago.

Historically, First Nations people of the Cowichan region lived in villages located throughout their traditional territory, including the Bings/Menzies system.

After 1850, the Cowichan valley landscape changed dramatically. As settlement by European immigrants occurred, economic pursuits transformed the landscape. Logging, farming, roads, buildings, constructed drainage systems and numerous other land uses impacted most of the watershed area, altering the hydrology and the riparian ecosystems.

Since the 1850s the characteristics of land use to accommodate settlement growth and property development in the CVRD have been determined by parcel boundaries, ownership, and zoning.

Until 2004 when the Riparian Areas Protection Regulation Act was passed, streams (wetlands, ponds, lakes, etc) had no definition as landscape features (assets) separate from parcels. Today, stream systems can be counted as a land use. In fact, they are natural commons belonging jointly to the community and individual parcel owners, including levels of government.

Land Uses by Zoning

The quantitative review of land use by zoning presented herein pertains to Bings Creek. Menzies Creek has not been analyzed in detail. In the CVRD, the creek passes through areas zoned F1 (primary forestry) as well as a few parcels zoned A2 (secondary agriculture).

Bings Creek is considered in three lengths starting at the source (495m on Mount Prevost).

The first third is rural. It crosses 3 kms of community forest lands, some A1 and A2 parcels as well as several parcels zoned for industrial uses.

The next third, roughly from Drinkwater Road to a point 350m east of Curry Road passes through parcels zoned A2 and RR.

For the final three kilometres, Bings Creek flows through urban development, most of which is zoned residential.

Parcels Characteristics: Four broad observations help to paint a picture regarding land use and conservation influences in Bings Creek. These are:

- Dating back to 1945, forest lands in the District of North Cowichan are managed for timber production. The lands are permeable and have mixed vegetative cover along the stream.
- Agricultural parcels tend to have riparian vegetation limited to shrubs, herbaceous plants, and grasses. The soils are permeable.
- The industrial parcels have almost no riparian cover along the stream. Portions of these parcels are impermeable.
- The setback zones on rural and urban residential parcels provide some of the most complete (intact or <25% impermeable) riparian areas along the stream. It is significant that many of these larger parcels may be subdividable in the future.

Strata parcels are characterized by unfavourable riparian conditions. They are large (with an average size of 6 to 6.4 acres) and, in aggregate, comprise about 25% of the land area within 200m of the stream in the urban third of Bings Creek. The strata parcels often have a common border with parcels that abut the stream and provide intact riparian cover. The proportion of impermeable area on strata parcels is about 57% of the site. Most lack any intact riparian area.

Historical Perspective on Streamside Protection: For decades the Planning and Development Services departments of local government have determined where land uses (development) would be permitted. Until the 1990s, in nearly all BC communities, streams were not protected by specific regulation other than the Fisheries Act (1979, 1985).

Environmental Services departments, often with less than three decades of work history, are recent additions to local government land use management strategies. Most still are setting priorities and obtaining metrics to manage their responsibilities.

In the Cowichan Valley, where population and land use growth are anticipated at rates that appear overwhelming, it suggests that the management capabilities of local government – through the Planning, Development Services and Environmental Services departments - will need to collaborate to cope.

This presents a broad asset management challenge for stream systems. The EAP analysis provides metrics that will support solutions.

QUESTION 2:

Expectations for the Stream System

QUESTION 2:
What ecological services does the community use and expect to draw from the stream system?

The Bings/Menzies stream system is a landmark in the community landscape and in the cultural history of Cowichan region First Nations. Residents and property owners use the ecological services of the stream system to support quality of life and property enjoyment. The following uses describe the community's expectations for this Natural Commons.

Fish Habitat: Bings/Menzies flows into Somenos Marsh, which provides fish habitat in the Cowichan River system. The community together with external funders has invested in preserving the marsh as a natural area supported by management plans and stewardship work in the creeksheds that flow into the marsh.

Conservation Area: Bings/Menzies is the largest "conservation" area in the Municipality of North Cowichan (MNC). Conservation means that permanent land use activities are not permitted within the streamside protection area which is 4% of the area of MNC.

Greenway and Trail Alignment: The Cowichan Valley Trail parallels about 2.6 kms of Bings Creek from Sherman Road to Cowichan Lake Road north of the end of Cleve Road. The portion from the confluence of Bings Menzies to Sherman Road is about 1.7 kms. The trail system is a heavily used and it is promoted as a recreation asset for the community and visitors.

Conveyance of Drainage Runoff: In a large portion of the urban area, rainwater from impervious surfaces and engineered drainage features travels via catch basins and drain laterals to outfalls that discharge into Bings Creek. Some outfalls go to the ground in parks and wetland/conservation areas. Approximately 3 sq. kms of neighbourhoods use these conveyances.

Riparian Areas: A number of large parcels with <25% impervious area abut the stream and provide riparian area supported by adjacent upland forested area. A number (11) strata developments take advantage of this ribbon of green along one or two boundaries.

Aquifer: Bings/Menzies creekshed lies over one groundwater aquifer (fluvial and deltaic soils above) in the MNC (Source: Ministry of Environment – see page 47)

Wells: About 41 wells occur in the Bings Creek area above the confluence with Menzies Creek. About 85 wells lie in the Menzies creekshed. Most are in MNC (Ministry of Environment – see page 47).

Settlement Growth and Regional Demographics

The nine-year rate of population growth in five Vancouver Island regional districts, excluding the regional districts of Capital and Mount Waddington, has ranged from 7.2% to 15.5%. The following table provides details.

Regional District	2011	2020	Amount of change	Percentage of change over 10 yrs.
Alberni Clayquot	31,623	33,885	2,262	7.2%
Comox Valley	64,486	73,664	9,178	14.2%
Cowichan Valley	81,567	90,776	9,210	11.3%
Nanaimo	148,912	171,990	23,078	15.5%
Strathcona	43,972	49,308	5,336	12.1%

A Closer Look at the Population Data: Each regional district has municipal centres. The growth rate has been similar for municipal areas and unincorporated areas during the past decade. The sidebar lists the 9-year rate of population growth in the unincorporated areas in the five regional districts.

Alberni Clayquot 4.0%
Comox Valley 11.2%
Cowichan Valley 12.1%
Nanaimo 12.8%
Strathcona 9.1%

In the Cowichan Valley, the City of Duncan has grown at a 9-year rate of 2.4% while the Municipality of North Cowichan experienced 11% growth.

The Cowichan Valley Regional District Planning Department projects the regional population "to grow to 108,905 residents by 2050. This reflects growth of 28% through the addition of 23,670 people, averaging 715 additions each year over the course of the projection period (commencing 2018)."

"Over this period, the annual rate of population growth would slow considerably (similar to what is expected for Canada and BC) due in large part to the aging of the regional population and the growing natural decrease headwind: from 1.4% year-over-year growth today, this would slow to less than 1% by 2030 and further to 0.4% by 2050."

Did You Realize

Looking ahead four years, the rate of permitting residential units for construction would have to more than double to meet projected housing needs.

According to the Regional Housing Needs Assessment Report (January 2021, CVRD) the expected rate of population growth from 2019 to 2025 is 15% or 10,000 persons. Housing needed to shelter this increase would be 5000 units. During the past six years (2015 to 2020) CVRD, MNC and the City of Duncan have issued permits for about 2000 residential units.

A Look at Building Permit Trends: Permits issued for single family residential units by MNC showed an average increase of about 4.7% per year since 2015. However, the actual number of units permitted has not exceeded 151 in any of the past 6 years. During the same 6-year period, the demand for housing units has increased due to the net effects of four factors:

Net migration to the CVRD has averaged 900 persons per year since 2011.

Natural increase has been negative - deaths have exceeded births.

Renters purchase homes.

Adult children leave the family home and purchase their own residence.

Municipality of North Cowichan Building Permits 2015-2020						
Year	**Multi Family**		**Secondary Suite**		**Single Family**	
	units	$ value	units	$ value	units	$ value
2015	0	55,000	10	99,000	87	23,247,000
2016	26	3,695,000	12	134,000	101	27,918,000
2017	11	2,206,000	14	342,000	121	33,419,000
2018	3	2,023,000	15	359,000	142	39,972,000
2019	7	6,286,000	14	225,000	135	33,599,000
2020	39	6,407,000	8	192,000	151	36,476,000
Totals	86	20,672,000	73	1,351,000	737	194,631,000
6-yr average	14.3	3,445,333	12.16	225,167	122.8	32,438,500

Source; Municipality of North Cowichan

A Look at Migration as a Source of Population Growth: Net inter-provincial and intra-provincial migration contributes a substantial potion of the annal population growth.

For the 12-year period 2007 to 2019, the net migration to the CVRD was 10,100 persons. Because the rate of natural increase for the CVRD has been negative, **the overall population growth from 2011 to 2020 has been due to net migration**.

What This Finding Means: The reality that growth is driven by newcomers to the region suggests that local governments have an on-going challenge to inform households about the location and importance of natural assets such as the riparian environment of the Bings/Menzies stream system.

A Look at Real Estate Market Trends: During the past decade, average annual sales volumes and prices for single-family homes have steadily increased in the Cowichan Valley.

Average prices were up about 4.7% per year; the number of units sold annually increased about 3.8% per year.

For comparison, during the same period, the average price of homes (properties) and volume of sales were:

Year	Cowichan Valley		Nanaimo Area	
	Average price	Unit sales	Average price	Unit sales
2011	$329,900	1099	$316,750	1811
2020	$485,000	1513	$511,950	2420
% change	47%	37.7%	61.5%	33.1%

A survey of 2018 homebuyers by the Vancouver Island Real Estate Board found that 56.4% moved for retirement purposes. (Source: thediscourse.ca – Nov. 16, 2019).

In the CVRD "the population 65 years of age and older was 20% in 2011, 24% in 2016 and is projected to be 32% in 2050" (Source: CVRD long-range projections and Statistics Canada).

A Look at Household Incomes and Maintainer Ages: Data about sources of income is not available for the CVRD. However, it is considered likely that the trend for the CVRD would be similar to the one documented in the Regional District of Nanaimo. The companion Millstone River EAP project reported that:

"Over the past two decades, RDN households depending on employment income have decreased in number while those relying on government transfers and investment income have increased."

"These trends are consistent with an aging population including in-migration of retirees. In 2009, for example, 52% of households in the Nanaimo region relied on employment income while 34% used pension and investment income to support their needs."

"These population and economic trends suggest that resident views (preferences / ideas) regarding conservation, land use, and community growth are changing."

Overview of Current Ecological Condition

The broad view of land use influences in the Bings/Menzies creekshed is that protection of the riparian area along the stream can be characterized on a timeline as follows:

- PAST: Indifferent before the 1990s.
- PRESENT: Inadequate since then.
- FUTURE: Challenging due to existing zoning (parcels that can be subdivided and/or developed) as well as population growth.

The present-day ecological condition of the stream system reflects the fact that the riparian ecosystems that once supported the stream system are gone. What remains are regulatory setback zones for riparian protection. A few unaltered parcels remain intact next to the stream and provide significant remnant riparian resources.

The details of these influences are considered in detail in the next section of Part C dealing with the riparian condition of the stream.

Community Use and Regulation of the Stream System: The demographic realities for the Cowichan Valley paint a picture of variable but persistent rates of net migration. Newcomers see the community as it is. This is their baseline. Apparently, the land use realities are “acceptable and or approved”.

The Cowichan Valley offers good services and nature seems to be abundant. This prosperous place is relatively affordable. According to BC Stats, 73% of household incomes in 2016 could afford to acquire a property while paying less than 30% of income for the cost (mortgage and expenses) of the purchase.

A series of research and project initiatives illustrate the community’s concern about the condition of the Bings/Menzies Stream system. These are listed in **Table C1**.

TABLE C1

List of Research and Project Initiatives

Year	Title
2001	Somenos Marsh Management Plan (Madrone Environmental Services)
2007	City of Duncan update DPA5 – “Natural Environment”
2011	Municipality of North Cowichan updates DPA-3 – “Natural Environment Development Permit Area”
2010	State of the Environment Report (CVRD)
2014	State of the Environment Report Update (CVRD)
2015	Somenos Basin Coho Salmon Summer Habitat Assessment (Madrone Environmental Services)
2014	Cowichan Watershed Assessment Phase 2 – Lower Watershed (Ministry of Environment)
2019	Cowichan Watershed Assessment Phase 2 – Lower Watershed (Ministry of Environment)
2019 - 2021	Cowichan Water Use Planning (CVRD, Cowichan Tribes, Cowichan Watershed Board, Catalyst Paper)
Current	Clean Water Action Project (Somenos Marsh Wildlife Society)
2010 - current	Friends of Cowichan Creeks
2010	CVRD established an Environmental Initiatives department
2008?	CVRD established an Environmental Services Department
2020	Municipality of North Cowichan engages a Senior Environmental Services Specialist
2021	North Cowichan Environmental Policy Regulation Review

QUESTION 3:

Risks and Opportunities for Stream System

QUESTION 3:
What are maintenance and management opportunities and risks associated with the present-day condition of the stream?

The Bings system is a “creek of interest” to the Partnership for Water Sustainability. In 2013, the Partnership examined it as part of the Cowichan Regional Water Balance Analysis. The stream system integrity framework presented in Part B provide context for commenting on streamflow conditions in this Question 3.

Bings Creek Water Balance: Bings Creek is one of four stream systems on Vancouver Island with concurrent hydrometric data, streamflow and precipitation, that are representative of the developed portions along the eastern shore of Vancouver Island.

As the landscape is altered by residential and other development, the proportion of impervious coverage increases. This poses a major risk to interflow which accounts for 60% of the annual water balance. Loss of interflow is what causes a stream system to “dry up”.

In two of the last 25 years, the annual flow volume exceeded the annual precipitation falling on the drainage area. Considering the time scales shown on the previously introduced **Figure B2** for the three types of water pathways, this suggests that the annual volume deficits were offset from deep groundwater.

BC’s Climate is Changing: The risk to interflow is exacerbated by a changing climate. According to the Cowichan Watershed Board, “The Cowichan watershed, including the adjacent and intertwined Koksilah sub-basin, has changed dramatically in recent decades.”

“Land use practices over many years had already degraded the natural functions of this wild pacific salmon dominated ecosystem; new stresses due to climate change have now put these watersheds in crisis.”

“Climate modeling predicts warmer, wetter winters and longer drier summers for the region, with extreme droughts and flood events already becoming the ‘norm" in the past decade.”

“If no action were taken, it is likely that in many future years, the Cowichan and its sub-watersheds may be too dry to support fall salmon returns, and already the populations are reduced.”

More than ever, the Bings / Menzies system would need recharge of interflow and groundwater from the landscape to sustain streamflow. As described in Part B, this would require doing many little things.

QUESTION 4:

Operationalize Stream System Management

QUESTION 4:
How do the riparian area realities relate to an asset management plan for sustainable delivery?

Question 2 introduced the land use and settlement growth lenses. Next, Question 4 brings the discussion full circle with the spotlight on EAP metrics because having real numbers makes it possible to achieve a vision for land use change in balance with stream system protection. This concluding page also provides a springboard to the EAP analyses that follow in the other sections of this Part C.

A unifying theme that is interwoven through this report is that the EAP methodology examines the stream setback area as a land use. It can be valued socially, ecologically, and financially. As well, the science supporting the *Riparian Areas Protection Regulation Act* defines the riparian setback as one of two necessary conditions to prevent decline of the stream system. The other is changes in hydrology.

Metrics for the Stream System: EAP describes the riparian deficit that is the result of historic land use practices. It can be looked at in a similar way to the infrastructure liability (deficit) that communities must also deal with to achieve sustainable service delivery through the asset management process.

The key takeaway is the need for metrics to operationalize stream system maintenance and management (M&M) as a budget line item in a local government Asset Management Plan.

EAP metrics would help staff and the community understand how desired outcomes for M&M of the stream system could be achieved through a local government's Asset Management Plan.

Regulatory Tool for Riparian Protection and Restoration: EAP metrics quantify the extent of riparian area in relation to various land use conditions along the course of the stream. Where riparian conditions are inadequate or insufficient, restoration strategies can be employed. These include:

- **Stream stewardship** – that is, riparian area maintenance and enhancement, along with measures to protect water quality.
- **More effective regulation of land use activities** in proximity to the stream to prevent loss of intact riparian area and to protect and/or restore water pathways.

In the case of the Cowichan region, and especially North Cowichan, there is considerable pressure to accommodate population growth due to net migration. The primary tool for implementing environmental policy objectives is Development Permit Area 3 – Natural Environment (DPA3). This establishes the 30m setback zone on each side of the Bings stream system.

2. Riparian Areas & Rainwater Pathways Influence on Bings / Menzies Functioning Condition

Scope of Analysis

Settlement activities have altered the Bings / Menzies stream system. In the last section, we included this overview to set the stage for delving into the details in this section:

> *The present-day ecological condition of the stream system reflects the fact the riparian ecosystems that once supported the stream system are gone. What remains are regulatory setback zones for riparian protection. A few unaltered parcels remain intact next to the stream and provide significant remnant riparian resources*.

Spring boarding from the Road Map for Protecting Stream System Integrity presented in Part B, this section draws on GIS data and other information resources to elaborate on the functioning condition of the Bings / Menzies stream system.

Riparian Integrity and Changes in Rainwater Pathways: Four analytical questions are addressed herein to paint a picture of the Bings / Menzies system.

Riparian Areas: What is the extent and condition (alteration and vegetative cover) of riparian areas which influence the stream system.

Impervious Cover: How impervious is the setback area along the stream in the three sample areas? How impervious are upland areas within 200m of the stream? **NOTE:** *This analysis includes 10 notable strata parcel developments as well as a 1km² urban neighbourhood developed after the year 2000.*

Hydrology: To what extent have land use activities altered water pathways - where does the rainwater go?

Maintenance and Management: What actions by local government and collaborators, including landowners, have been employed to maintain and manage the stream system?

Bings / Menzies Geographic Context

The Municipality of North Cowichan (MNC) has a land area of 19,554 hectares.

With its drainage area of 1550 hectares, the Bings creekshed comprises some 8% of the MNC total.

The stream system flows 10km from its source on Mount Prevost to its outlet at Somenos Marsh.

This passage through forest lands, industrial and agricultural areas as well as the most urbanized area of the municipality makes Bings Creek a highly recognized and utilized natural asset.

Condition of Riparian Areas

The community actively works to maintain and manage the stream. A partial list of actors include:

Cowichan Watershed Board
Cowichan First Nations
Somenos Marsh Wildlife Society
Friends of Cowichan Creeks
Cowichan Trails Stewardship Society
Tourism Cowichan Society
Parcel owners
Businesses

Six riparian sample areas shown on **Figure C2** have provided the basis for the riparian condition assessment. The focus of the quantitative analysis is on **Sample Areas Nos. 1, 2 and 3**. The first two are urban; the third is rural.

Sample Area Nos. 4, 5 and 6 have not been considered in detail. However, aggregate summary information about zoning, parcel area, and area in the setback is provided later.

From a regulatory point of view, two measures have had and continue to influence the extent of impacts that land use has on the stream system in the urban and rural sample areas. These are:

Municipality of North Cowichan Development Permit Area 3 – Protection of the Natural Environment (DPA3)

Riparian Areas Protection Regulation Act (BC), Streamside Protection and Enhancement Area (SPEA) provisions

Key Analytical Findings

The riparian area within 30m of the centre of the stream in the urban area (from Canada Avenue to Cassino Road) is intact or relatively intact – having at most 20% impervious area.

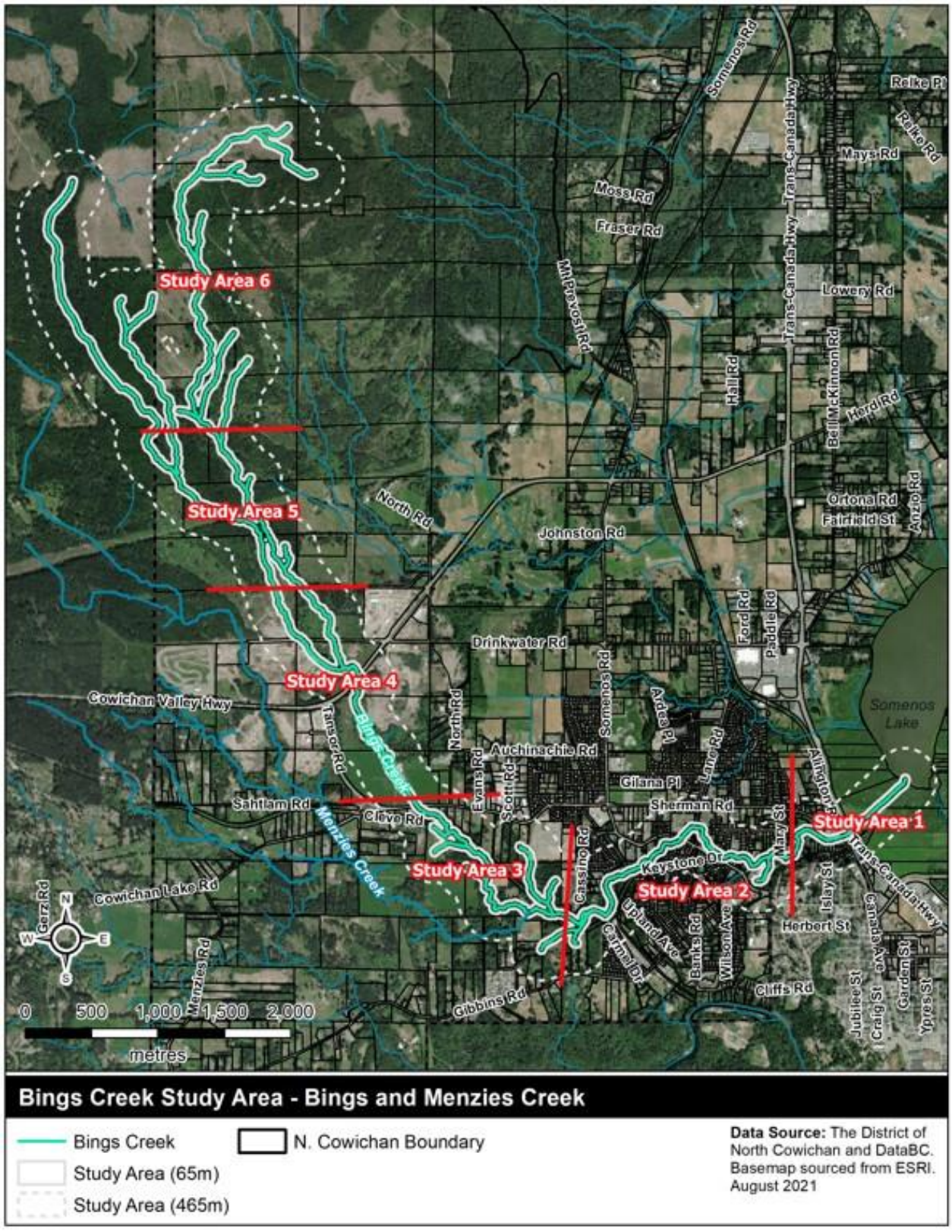
The riparian condition is fair. Vegetative cover has been altered in most of the setback zone for the 2.7km length in the urban area.

In the upland areas extending 200m beyond the setback zone, land development has rendered the creekshed more than 50% impervious. This is a measure of highly urbanized conditions.

Quantifying Riparian Conditions – Assessments by Others:
Previous research by Burns (2002) and Clough (2020) provides a quantitative view of the extent to which prevailing land uses have altered the stream system.

The research by Burns described the riparian extent and crown cover conditions to be intact (extending 30 metres or more) for much of Bings Creek from the Trans Canada Highway to the Cowichan Lake Road near Cleve Rd.

Figure C2


Study Area 6
Study Area 5
Study Area 4
Study Area 3
Study Area 2
Study Area 1
Somenos Rd
Trans-Canada Hwy
Reike Pl
Reike Rd
Mays Rd
Moss Rd
Fraser Rd
McIsaac Rd
Lowery Rd
Hall Rd
Bell McKinnon Rd
Herd Rd
North Rd
Johnston Rd
Ortona Rd
Fairfield St
Anzio Rd
Drinkwater Rd
Ford Rd
Paddle Rd
Cowichan Valley Hwy
Tansor Rd
Bings Creek
North Rd
Somenos Rd
Arden Pl
Lane Rd
Auchinachie Rd
Evans Rd
Scott Rd
Gilana Pl
Sherman Rd
Alderlea Rd
Somenos Lake
Sahtlam Rd
Cleve Rd
Menzies Creek
Cassino Rd
Mary St
Keystone Dr
Islay St
Herbert St
Cowichan Lake Rd
Gerz Rd
Menzies Rd
Upland Ave
Carmel Dr
Banks Rd
Wilson Ave
Cliffs Rd
Gibbins Rd
Garden St
Ypres St
Jubilee St
Craig St
N
S
E
W
0 500 1,000 1,500 2,000
metres
Bings Creek Study Area - Bings and Menzies Creek
Bings Creek
N. Cowichan Boundary
Study Area (65m)
Study Area (465m)
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. August 2021

Condition Ratings: In 2020 Dave Clough completed an Urban Salmon Habitat Assessment for Bings Creek for the Somenos Marsh Wildlife Society. His findings for the 5.8km of Bings Creek (Trans Canada Highway to Cowichan Valley Highway) included ratings for riparian conditions.

The following summary provides the measures of riparian quality most relevant to the EAP analysis. These are five reaches that Clough defined and which correspond to EAP Sample Area Nos. 1 through 3.

Riparian Metric	Scores	Observations
Land Use *Interference in setback zone*	3 Good 2 Fair	Reach 1 heavily altered by historic diversion of the stream
Crown Cover *Presence of shrubs and trees*	5 Good	Rural reach has areas with cover removed
Riparian Extent *Vegetative cover extending away from the stream on two sides*	2 Fair 3 Poor	Rural area has intrusion by farm and industrial uses. There are few intrusions in the urban area.

Attributes for EAP Assessment

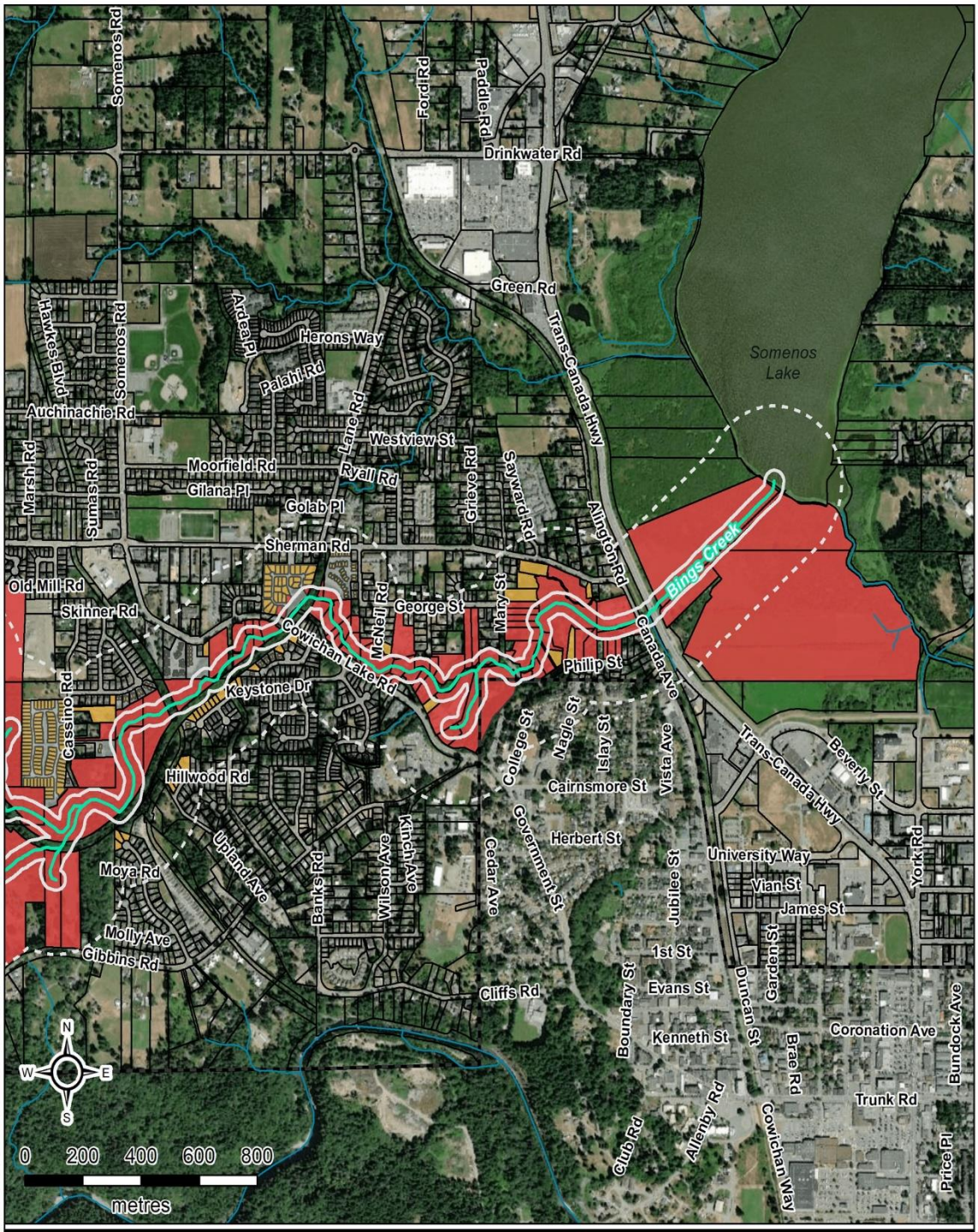
Impervious Area
Impervious Percentage
Riparian Quality
Vegetative Cover

Quantifying Riparian Conditions – EAP Assessment: Part D contains a working document titled Analysis of Riparian Qualities of Parcels in Sample Areas One and Two. This is a parcel-by-parcel compilation of attributes for 60 parcels in Sample Area Nos. 1 and 2. These have some area abutting the stream, and therefore are within the NCA (i.e., defined previously as the regulatory setback zone width plus stream width). **Figure C3** is a map of the study sub-area.

All 60 are zoned residential. Three parcels near Somenos Marsh, zoned for agriculture, were not included. These parcels vary in size; the average area is 5696 m². All include setback area; some as much as 90% to 100%. Parcel conditions are summarized below:

Degree of imperviousness	Number of parcels	Average % of imperviousness
< 25% coverage	34	9%
> 25% but < 50%	21	37%
> 50%	5	60%

Figure C3



Bings Creek Parcels - Sample Area 1 & 2

Bings Creek
Study Area (65m)
Study Area (465m)
N. Cowichan Boundary
Strata Parcels
Abutting Parcel
Adjacent Parcel

Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. August 2021

Condition Ratings: Based on the data compiled in Part D, the riparian setback in the urban area is rated "fair to good". This means that:

- At least 80% of the setback area along the stream is more than 75% pervious.
- Vegetation extends in most of the urban reach 30 m away from the centre of the stream; only 6 of 53 parcels lack vegetative continuity.
- Vegetation includes herbaceous, shrubs and trees throughout most of the reach.

An observation is that the riparian condition, which is based on extent plus vegetative cover, corresponds to imperviousness caused by land use activities. The analysis documented in Part D also confirms the following metrics:

Total area of *Natural Commons Asset* based on 2.7km length and 66m average width including 30m from each side of top of bank	178,200 m^2
Proportion of *Natural Commons Asset* accounted for by the parcel-by-parcel compilation	96%
Proportion of the setback zone that is more than 75% pervious	80%
Average impervious coverage within the setback zone	20%

What the Numbers Tell Us: The analysis in Part D suggests that 26 parcels could be primary targets for building up the riparian quality of the setback zone through regular maintenance and management (M&M).

This analysis of riparian area includes parkland and wetland area - 14,300m^2 - owned by MNC.

It also includes about 55,500 m^2 of area occupied by the Cowichan Valley trail. About half of the trail area is in the setback zone. The trail alignment area includes pavements and off-trail wandering that has damaged riparian cover. This area also would be a target for riparian maintenance and restoration.

Influence of Adjacent Parcels and Upland Areas on the Stream Condition

In the urban area, we have examined some of the dominant land use impacts on the stream system beyond the setback zone. Here we refer to parcels that are categorized as "adjacent". By definition, we describe adjacent as extending 200m or more beyond a boundary with the 30m setback zone.

When we look at the numbers, two factors stand out.

First, there are 10 adjacent parcels in the urban area, other than strata parcels and lots, which are more than 70% pervious. These are about average area (5696 m²) and lend riparian support to neighbouring abutting parcels.

There are 11 strata parcels adjacent to the abutting parcels along the stream corridor.

This part of the EAP analysis reviews the strata parcels as a land use that alters water pathways and removes or alters riparian cover near the important junction with the setback zone.

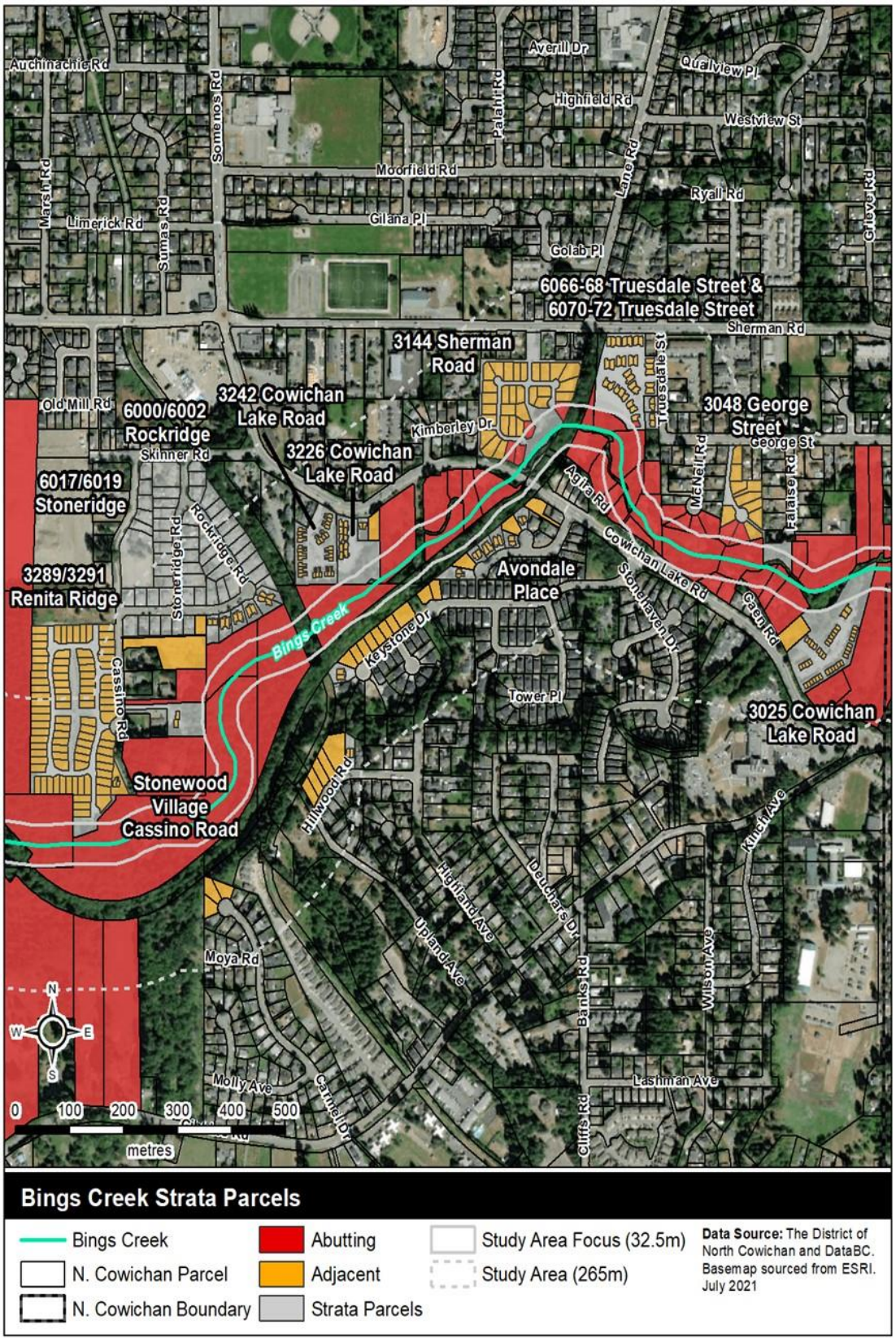
Focus on Strata Developments

The strata developments demand particular attention because they are adjacent to parcels which abut the stream corridor. The location is not accidental. The strata parcels take advantage of the natural area created by the streamside protection area. **Figure C4** identifies the locations of strata developments.

Analysis of Nine Strata Parcels: The EAP analyzed nine strata parcels and their subdivided lots and common areas. Two of the stratas had conveyed area to the municipality for parkland (community amenity). The years of development of these stratas range from 1982 to 2021. Currently, one parcel has lots under development. The residential land use characteristics are:

Total area for 9 strata lots	182,654 m^2
Number of subdivided residential lots on bare land strata	302
Average bare land strata residential lot size Average building strata lot size	412 m^2 68 m^2

Figure C4


Auchinachie Rd
Averill Dr
Qualview Pl
Highfield Rd
Westview St
Somenos Rd
Palahi Rd
Lane Rd
Moorfield Rd
Ryall Rd
Marsh Rd
Limerick Rd
Sumas Rd
Gilana Pl
Golab Pl
Clover Rd
6066-68 Truesdale Street &
6070-72 Truesdale Street
Sherman Rd
3144 Sherman Road
Truesdale St
Old Mill Rd
6000/6002 Rockridge
Skinner Rd
3242 Cowichan Lake Road
Kimberley Dr
3048 George Street
George St
3226 Cowichan Lake Road
McNeil Rd
Faraise Rd
6017/6019 Stoneridge
Agila Rd
Rockridge Rd
Stoneridge Rd
Cowichan Lake Rd
3289/3291 Renita Ridge
Avondale Place
Stonehaven Dr
Caen Rd
Bings Creek
Keystone Dr
Cassino Rd
Tower Pl
3025 Cowichan Lake Road
Stonewood Village
Cassino Road
Hillwood Rd
Kuhl Ave
Highland Ave
Deuchars Dr
Upland Ave
Moya Rd
Banks Rd
Wilson Ave
Molly Ave
Cartwell Dr
Lashman Ave
Cliffs Rd
N
W
E
S
0
100
200
300
400
500
metres
Bings Creek Strata Parcels
Bings Creek
N. Cowichan Parcel
N. Cowichan Boundary
Abutting
Adjacent
Strata Parcels
Study Area Focus (32.5m)
Study Area (265m)
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. July 2021

Strata Subdivision Characteristics:

Proportion of the total area that has intact riparian. Note that: ▪ This includes park land transferred as a community amenity. ▪ One strata development included an engineered infiltration zone which is 6.6% of the strata parcel area. It is not included here.	Less than 10%
Impervious coverage as a proportion of total strata area	Range is 49% to 75% Average is 60%
Common area of the strata parcels	Range is 29% to 75% Average is 44%

Rainwater and Drainage – Water Pathways: Bare land and building strata developments have been and remain a common residential land use in MNC. When one considers the large area of the strata parcels, it is apparent that such development has a material impact on water pathways. Next, we provide a brief overview.

Alteration of the Landscape: Strata parcel development removes native vegetation from 60% or more (conservative estimate) of the parcel and alters what remains. This means that water pathways are interrupted and cut off by local engineered roads and drainage. The key question is where does the rainwater go when natural interception, detention and infiltration is short-circuited and/or bypassed?

Current Drainage Practice: A general observation is that rainwater runoff is collected from the impervious areas as well as the common areas of the strata and eventually released to the stream or a bordering natural area.

The piped drainage system has the real effect of bypassing riparian area that needs the interflow to sustain stream baseflow during extended periods of rain-free weather.

Table C2 summarizes the on-site drainage solution implemented for rainwater management on each of nine strata parcels. The purpose is to provide the reader with a “picture at a glance”.

TABLE C2

On-Site Drainage Solutions for Strata Parcels

Strata Parcel	Drainage Type	Rainwater Destination
3048 George St	Pipes and ditch	Natural area which abuts the stream
6078 Truesdale St.	pipes	To Sherman Road and then to an outlet on Bings Creek
3144 Sherman Road	pipes	Same as above
Stonewood Village Cassino Road	Engineered infiltration zone and pipes	Conveyed to a drainage basin about 90m from Bings Creek
3225 Cowichan Lake Road	Pipes and natural area (wetland)	Receives drainage from Stonehaven area. Conveyed to natural area 150m from Bings
6089 Truesdale	Pipes	To Sherman Road and then to an outlet on Bings Creek
3226 Cowichan Lake Road	Pipes and ditch	Outlet to Bings riparian setback zone
3242 Cowichan Lake Road	Pipes and ditch	Outlet to Bings riparian setback zone
3225 Cowichan Lake Road	Pipes and ditch	Outlet to a wetland area owned by MNC

A Revealing Comparison: Strata Area Exceeds Green Zone	
Total Area of Strata Parcels	182,700m2
Total Area of NCA	178,200m^2
Strata Parcel Characteristics / Stream Health Consequences	
Aggregate Average Impervious Area	60%
Riparian Quality	Poor or non-existent
Absorbent Natural Landscape	Eliminated
This type of upland development reduces or eliminates rainwater detention and infiltration from areas bordering the riparian zone that is larger than the NCA itself. Although rainwater does reach the stream directly by pipe or indirectly by abutting infiltration zone, there is a material loss of infiltration passage and groundwater recharge.	

3. Worth of Stream as a Natural Commons

RESEARCH OBJECTIVE 1:
Establish a measure of "stream worth" to the community based on the historic investment in M&M.

Scope of Research Objective 1

The purpose of Research Objective 1 is to help the reader understand what Bings / Menzies Creek is worth to the community by looking at the **investment made by the community over time** in the maintenance and management (M&M) of the stream corridor. This metric provides a measure of the worth of the stream system as a Natural Commons Asset (NCA). Refer back to Part B for the details.

A second measure of worth is the **financial value of the NCA**; and this is addressed under Research Objective 2. In the EAP methodology, financial value refers to the assessed value of the portion of the land underlying the stream corridor. This land is the NCA and comprises the stream channel width plus the setback zone on each side. Worth of land refers to more than financial value.

Financial Value versus Worth

Financial value is the price paid at a point in time; whereas worth is the individual's or community's perception of the utility (personal and collective) of a property or several properties - for example, the community finds it worthwhile to acquire land for parks, schools, conservation of natural areas and other collective uses. Typically, the acquisition of the land is priced at current market rates, or these rates are used to calculate discounts or other financial variables.

Illustration of Worth in Bings/Menzies Natural Commons Context: Worth is defined as the social, ecological and financial values residents and property owners attribute to the stream. The community's appreciation of worth is illustrated by the following examples.

Residents and property owners "vote with their feet". They use parks, trails, greenways and appreciate conservation areas; they consistently (last two decades) place a priority on these assets in the context of strategic plans and budget allocations.

Investment in Bings/Menzies Natural Commons by the Community, Cowichan Tribes, and Local Governments

Information about the community's view of the worth of the stream system is drawn from two sources:

- **Green Streams Strategy Residents Survey 2020**, by the Somenos Marsh wildlife Society.
- **A summary of expenditures made by the community as a whole** during the past decade for research, maintenance and management activities pertaining to the stream system. Listed in **Table C3**, this information provides an order of magnitude estimate of community investment.

A community's perceptions of worth include an implied social contract; that is, the stream will be maintained and managed for future uses and enjoyment. This is an asset management challenge.

Table 7 summarizes many of the investments made by the community to protect the Bings / Menzies stream system. Many of the financial amounts are estimates, which indicate order of magnitude rather than precise figures.

The scale and magnitude of community investment in M&M is a demonstrable measure, over time, of the worth to the community of the Bings/Menzies Creek stream corridor.

Findings of the Green Streams Strategy Residents Survey 2020

The survey process included 48 in-person interviews. Respondents were asked about their concerns related to the stream and about their support for investment of municipal funds to maintain and enhance the stream. Reported findings of the survey were:

- *"Of all the concerns expressed, seasonal flooding, bank erosion, and the presence of garbage and homeless camps along the Creeks were the most frequent."*
- *"95% of the residents asked about the allocation of $100,000 of Municipal Tax revenues towards the restoration of the Somenos Watershed were supportive of this initiative."*

The findings reported from the Green Streams survey process indicate residents concerns about the M& M of the stream.

Average Annual Investment in the Stream System

Table C3 summarizes a range of investment made by the community during the past decade for measures to protect the stream and the services it provides. The grand total is substantial. This tells us that community efforts have resulted in a significant asset value.

Table C3 (page 1 of 2)

Investment in Bings / Menzies Natural Commons by the Community, Cowichan Tribes, and Local Government*

Investment Category	Description of Work (during the period 2005 through 2020)	Investment Amount
Maintenance	▪ Regular outlays by local government departments (including Parks, Public Works, Environmental Services) for maintenance and enhancement work related to or affecting trails, public facilities, and riparian areas adjacent to Bings/Menzies Creek. ▪ Involvement of community organizations, secondary school programs in riparian area maintenance and other work (signage, educational programs) ▪ City of Duncan, watermain repair/relocation, at rail trail culvert at the end of Agira Road (2020)	Unknown (estimate of $100,000 – ten years) Unknown $60,000
Enhancement / Specific projects	▪ Green Streams, Somenos Marsh Wildlife Society and Cowichan Tribes ▪ Somenos Marsh viewing platform (Timber West)	$25,000
Property acquisition	▪ Somenos Marsh Lake bed donated by Timber West (94.5 ha) ▪ Ducks Unlimited Somenos Conservation Area Management Plan (2001 – 2026)	$7,000,000 $15,000 (est.)
Public Processes and Planning	▪ Municipality of North Cowichan Parks and Trials Master Plan: Public Engagement Summary Report, Stantec consulting, 2016 ▪ Green Streams survey of residents	N/A $2000 (est.)
Research *Examples of the relevant research initiatives*	▪ Bings Creek Watershed Habitat Assessment and Restoration Plan, Dave Clough for Somenos Wildlife Marsh Society, 2020 ▪ Restoring Wetlands in the Somenos Basin, K. Rasmussen for Somenos Marsh Wildlife Society, 2012 ▪ A Salmonoid Production Plan for the Cowichan Valley Regional District, T. Burns for Cowichan Fish and Hanbitat Renewal, 2002	No financial information was readily available The estimated amount re. the Bings/Menzies stream system is $80,000 during the past decade.

* This financial information indicates order of magnitude. The dollar amount of actual outlays was not available for many of the cited items.

Table C3 (page 2 of 2)

Investment in Bings / Menzies Natural Commons by the Community, Cowichan Tribes, and Local Government*

Investment Category	Description of Work (during the period 2005 through 2020)	Investment Amount
Research (continued) *Examples of the relevant research initiatives*	▪ Somenos Management Plan for The Somenos Steering Committee. Madrone Consultants, 2001 ▪ Somenos Lake Hydraulic Model, Northwest Hydraulic Consultants for Fisheries and Oceans Canada, 2005 ▪ Lower Cowichan / Koksilah River Integrated Flood Management Plan: Final Report, Northwest Hydraulic Consultants, 2009 for CVRD ▪ Riparian Vegetation Survey of Somenos Creek, D. Preikshot for Somenos Marsh Wildlife Society, 2018	
Regulatory Actions	▪ Municipality of North Cowichan Zoning Amendment Application (Vancouver Island Motor Sport Circuit) – Cowichan Watershed Board – 2019 ▪ Staff report to MNC Council, 2019, regarding Vancouver Island Motor Sport Circuit, zoning amendment. Includes: *"transfer (to MNC) of lands for a water storage reservoir, and lands adjacent to Bings Creek"* and changes in stream crossings to protect Menzies Creek.	The proposed "community amenity" requirements has a value of about $600,000**
	GRAND TOTAL Annualized average	**$7,282,000** (say $7.3M) $730,000 /yr.

**The $600,000 amount is not included in the Grand Total.

4. Financial Value of Stream as a Natural Commons

Key Findings

In the Municipality of North Cowichan, Development Permit Area 3 - Natural Environment (DPA3) protects the regulatory setback zone along streams. The zone is 30m on each side of the stream measured from the top of the bank. As explained in Part B, the regulatory setback zone establishes the boundaries of the Natural Commons Asset.

The Bings / Menzies Creek NCA extends from Mary Street to Cowichan Lake Road near the junction with Cleve Road. This distance is 4.7 kilometres. The riparian area is generally complete.

RESEARCH OBJECTIVE 2:
Quantify the "financial case" for the stream corridor as a Natural Commons Asset (NCA)

For Research Objective 2: The NCA financial values for the **urban** and agricultural portions of the creek system are **$2.1M per kilometre** and less than $0.2M per kilometre, respectively.

RESEARCH OBJECTIVE 3:
Suggest a "benchmark guideline" for M&M investment in the stream corridor within the context of an Asset Management Plan

For Research Objective 3: The benchmark guideline for an annual M&M budget is **$21 per lineal metre of channel length** in the urban portion.

Framework for Calculation of Financial Value

The stream is a land use. It has a defined area, and a financial value can be assigned. Part B introduced this framework for analysis:

- The area of the NCA is the stream itself plus regulatory setback zone for any length. Stream width is either nominal or taken from previous research.
- Parcels which abut the stream have some area in the setback zone. The ratio of area in the setback zone to total parcel area provides a factor (%).
- The factor is used to calculate financial value of the NCA portion of the aggregate group of parcels.

The NCA calculation uses property transaction information from the BC Assessment database to assign a financial value to the NCA.

Parcel Information for Bings / Menzies Creek

The financial value of the NCA is based on the assessed land value of residential parcels which abut or are adjacent to the stream. EAP defines three categories of property types:

ABUT means that the parcel has some area within the NCA.

ADJACENT means that a parcel is within 200 m of the stream and has no area in the setback zone.

Note: *adjacent parcels that border a natural area continuous to the stream are considered abutting and 10% of the parcel area is used for calculation.*

DISTANT means that a parcel is usually more than 200 m from the stream.

The behaviour of buyers and sellers of parcels that abut or are adjacent to natural commons includes their perception of the premium or discount they might attribute to a parcel (land only) or property (includes improvements). BC Assessment data reflects the influence of this behaviour over time.

Selection of Parcel Samples

The EAP analysis for Bings/Menzies considered 105 parcels.

Eighty-two are located within the urban area – that is, Canada Ave. to Cassino Road. The analysis only considered parcels that are zoned and used for residential occupation.

The remaining twenty-three parcels are in the rural area – that is, Cassino Road north to Cowichan Lake Road.

Figure C5 shows the "urban area" which has **Sample Areas One and Two**. These were described earlier in this report. The Menzies tributary merges with Bings Creek in the upstream rural area. For the analysis of urban parcels, only Bings Creek is involved.

Figure C6 shows the "rural area" which corresponds to **Sample Area Three**. The few parcels abutting Menzies Creek are considered to have the same characteristics as the rural portion of the parallel Bings Creek main stem.

Figure C5 – Bings Creek Urban Area

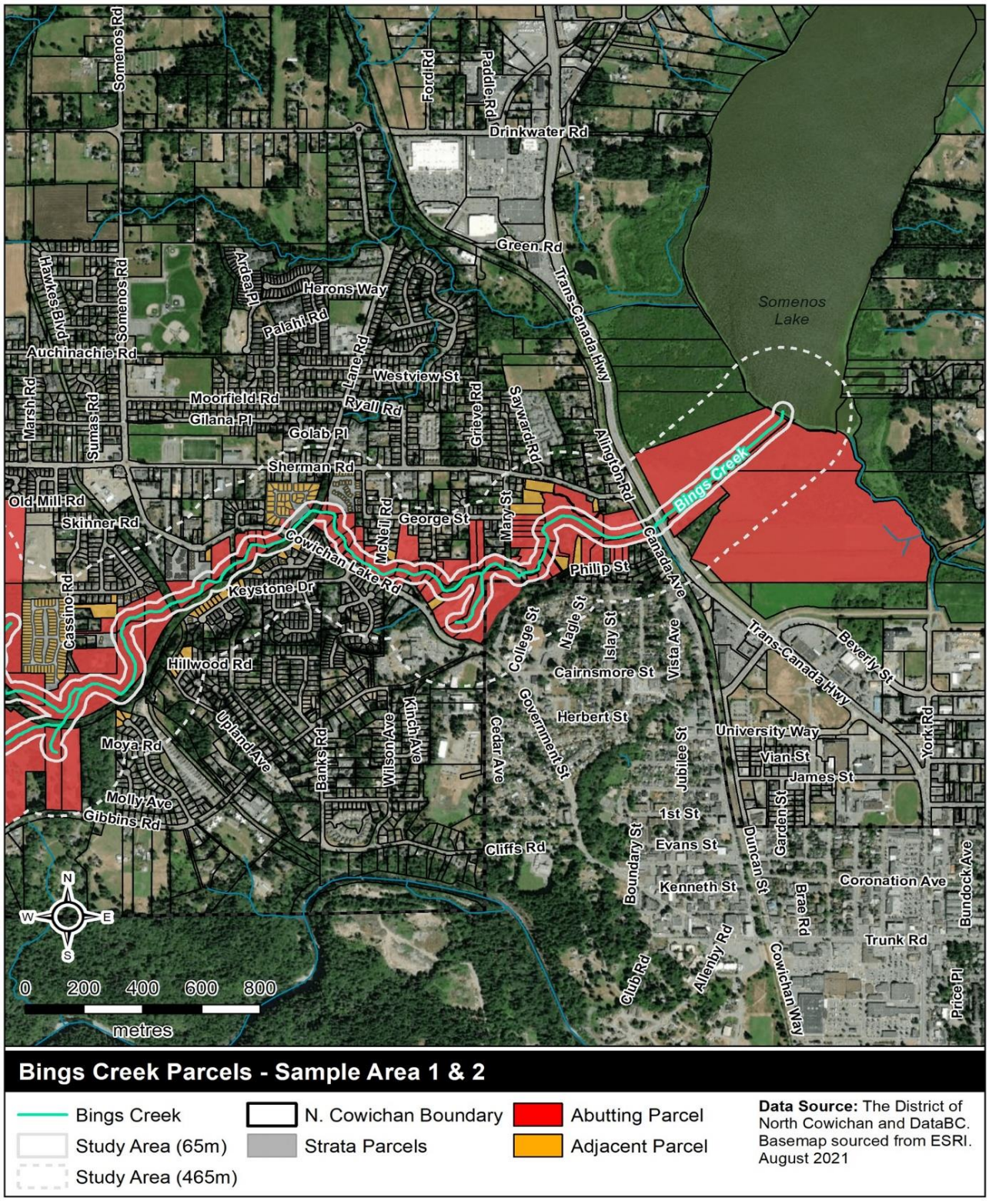
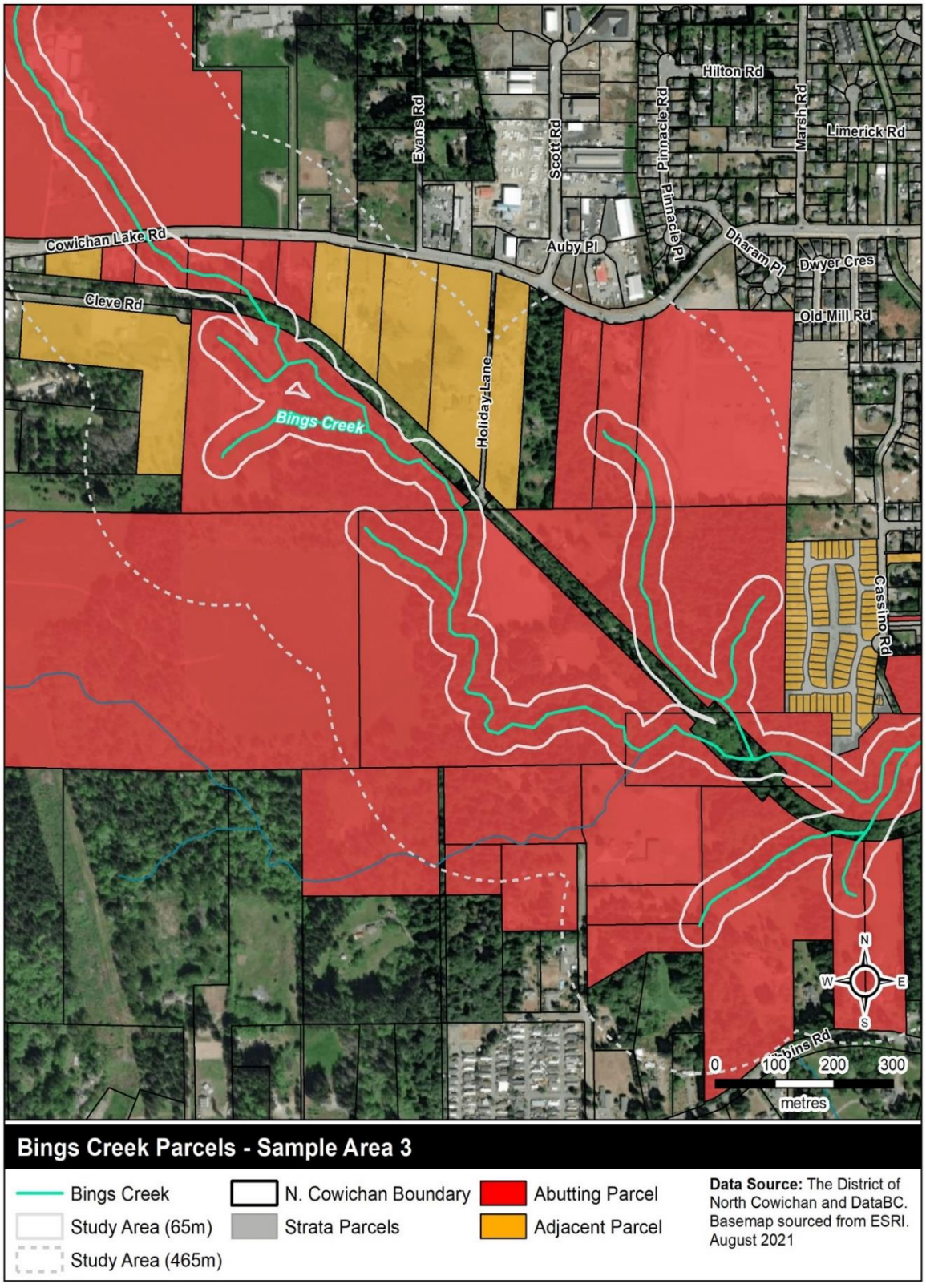


Figure C6 – Bings Creek Rural Area



NCA Analysis and Findings

Table C4 summarizes the results of the analysis of residential parcels in the two study areas of Bings/Menzies. For those interested in the derivation of the numbers, the supporting research is incorporated as Part D.

Compared to Other EAP Case Studies: Part B concluded with **Table B3** which included a listing of NCA values for all EAP projects. The NCA value of Bings Creek urban area is relatively low.

This suggests that the potential **riparian deficit** is also relatively low. This further suggests that a plan for improved maintenance and management in the Bings Creek corridor has a comparatively good ecological starting point.

Beneficial Impact of Riparian Area Regulation: Essentially MNC bylaws and enforcement have prevented subdivision of large parcels abutting the stream. These parcels are encumbered by DPA3 regulations. However, one should recognize that preserving the setback area does not confirm that it would be in good condition.

It should also be noted that topography also forestalled development on the steep slopes abutting the stream.

Comparison with Urban Development: Parcels abutting Bings Creek in the urban area are in a “good” condition because the riparian zone has mixed vegetation and extends 30m or more in most areas. The impervious area is less than 10%.

Between the 30m and 200m boundaries, however, the impervious proportion of the altered landscape increases to above 50% in the surrounding upland urban area.

Consequences for Stream Health: Two factors altering Stream Health in urban areas: Land use (impervious surfaces and engineered drainage) change water pathways and impede or prevent rainwater from reaching interflow and ground water. Gradually the stream will become dry. Strata subdivisions contribute to these negative impacts.

Table C4 –

Financial Value of Bings Creek Natural Commons Asset

A. Summary of Findings

EAP Study Areas		Stream Reach	Number of Parcels	NCA Value as determined from Table B
Designation	Reference for Study Area	Length		
Urban	Canada Ave, to Cassino Road	2740m	58	$10,401,236
Rural	Cassino Road to Cowichan Valley Hwy at Cleve Road	2000m	21	$915,000
Total		4740m	79	

B. Supporting Details

Area	NCA Value	$ per km	$ per m	$ per m²
Urban	$8,477,964	$1,803,822	$1804	$27
Urban Adjusted[1]	$10,401,236	$2,112,000	$2112	$32
Rural	$915,230	$183,000	$183	$2.80

[1] Adjusted to include 3 parks and Cowichan Valley Trail area that are situated within the Natural Commons Asset

Annual M&M Budget for the Stream Corridor
(Research Objective #3)

Research Objective #3 addresses the interaction of a constructed drainage infrastructure system with a stream system, and the reality that this interaction typically results in an "unfunded drainage infrastructure liability". This liability grows over time in the absence of a funding mechanism for M&M of both natural and constructed assets.

Asset management – A Working Definition

First, assess what you have; then, assess what condition it is in; and lastly, assess the financial reality to maintain it in a desired condition.

The NCA value is used to estimate an annual M&M budget that could then be included as a line item within the drainage and/or stream system component of an Asset Management Plan. A simple working definition of asset management is included as a sidebar for ease of reference and understanding.

Benchmark for Budget Planning: Based on established life-cycle practice for M&M of constructed assets – that is, buildings and buried infrastructure - future annual expenditures for ongoing M&M of the urban reach of the Bings Creek corridor could reasonably be set at 1% of the NCA value.

NCA Value	**Application of 1% Benchmark** to establish an Annual M&M Budget
~$2100 per lineal metre For 4900m total length of three sample areas	~$21 per lineal metre per year $103,000 per year

The 1% guideline establishes a benchmark for budget planning purposes. Because it uses the BC Assessment database, the NCA value is as real a number as the replacement costs for buildings and buried pipes.

The annual budget for natural asset M&M need not be 100% funded by local government. In addition to in-kind resources, the stewardship sector has access to other sources of grant funding that complement what local governments bring to the table. This underscores the benefit of collaboration to tackle the unfunded liability associated with M&M of stream corridors.

Life-Cycle Context for Urban Drainage: The financial burden and environmental impacts associated with 'pipe-and-convey' drainage infrastructure contrast with the benefits of 'green' infrastructure that restores creekshed hydrology: natural landscape-based assets reduce runoff volumes, have lower life-cycle costs, decrease stresses applied to creeks, and enhance urban liveability.

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5. Influence of the Stream on Parcel Values

Key Findings

RESEARCH OBJECTIVE 4:
Determine whether the stream influences the assessed values of parcels that abut or are adjacent to the stream.

In this section, we take a closer look at parcel values within the sample areas that we introduced under Research Objective 2. Analysis of the data shows that the stream system has a positive influence on parcel values. There are two dimensions to this positive influence:

- **ABUTTING THE STREAM:** Property owners effectively pay a premium to accommodate the 'green zone' when they purchase parcels situated alongside the stream.
- **ADJACENT OR DISTANT FROM THE STREAM:** Because there is a 'green zone' along the stream, it makes upland properties that can abut the 'green zone' desirable locations. This observation pertains to parcels located within 200m of the stream.

This two-fold influence reflects the long-term beneficial impact of Development Permit Area – Natural Environment (DPA3) which has created the 'green zone' for 30m on both sides of the stream.

What We Have Learned from Other EAP Projects: Previous research identified three common findings pertaining to proximity of parcels to the stream.

- Abutting parcels in urban reaches had assessed values that were 4% to 8% higher than non-abutting parcels where the aggregate area of parcels was about the same for each location relative to the stream.
- Differences were clear in urbanized areas, but not meaningful in rural areas where land use was agricultural and/or rural residential.
- Where a stream provided no ecological values – because it was either buried or development came to the edge of the stream such that there was no riparian area - there often was a negative influence on parcel values.

The other EAP analyses used aggregate numbers for 'like parcels' in the sample areas reviewed.

A Closer Look at the Numbers

For the three parcel sample groups introduced previously, the EAP analysis considers two metrics - aggregate assessed financial value and **$ value per m²**. It is the latter metric that is especially meaningful for the purposes of assessing stream influence on property values. Relevant data are tabulated below:

Location Type	Number of Parcels	Average Area	Average $ Value	$ Value per m²
Abutting	53	5830 m²	$337,107	$58[1]
Adjacent	11	2655 m²	$231,333	$87
Distant	50	2751 m²	$209,940	$76
Abutting Adjusted[2]	53	3739 m²	$337,107	**$90**

[1] *This is the Blended Financial Value*

[2] *The Abutting Adjusted calculation uses the aggregate area of parcels less the aggregate area in the setback zone. Thus, abutting parcels can be compared to other parcels based on "developable" area.*

For Adjacent and Distant Parcels:

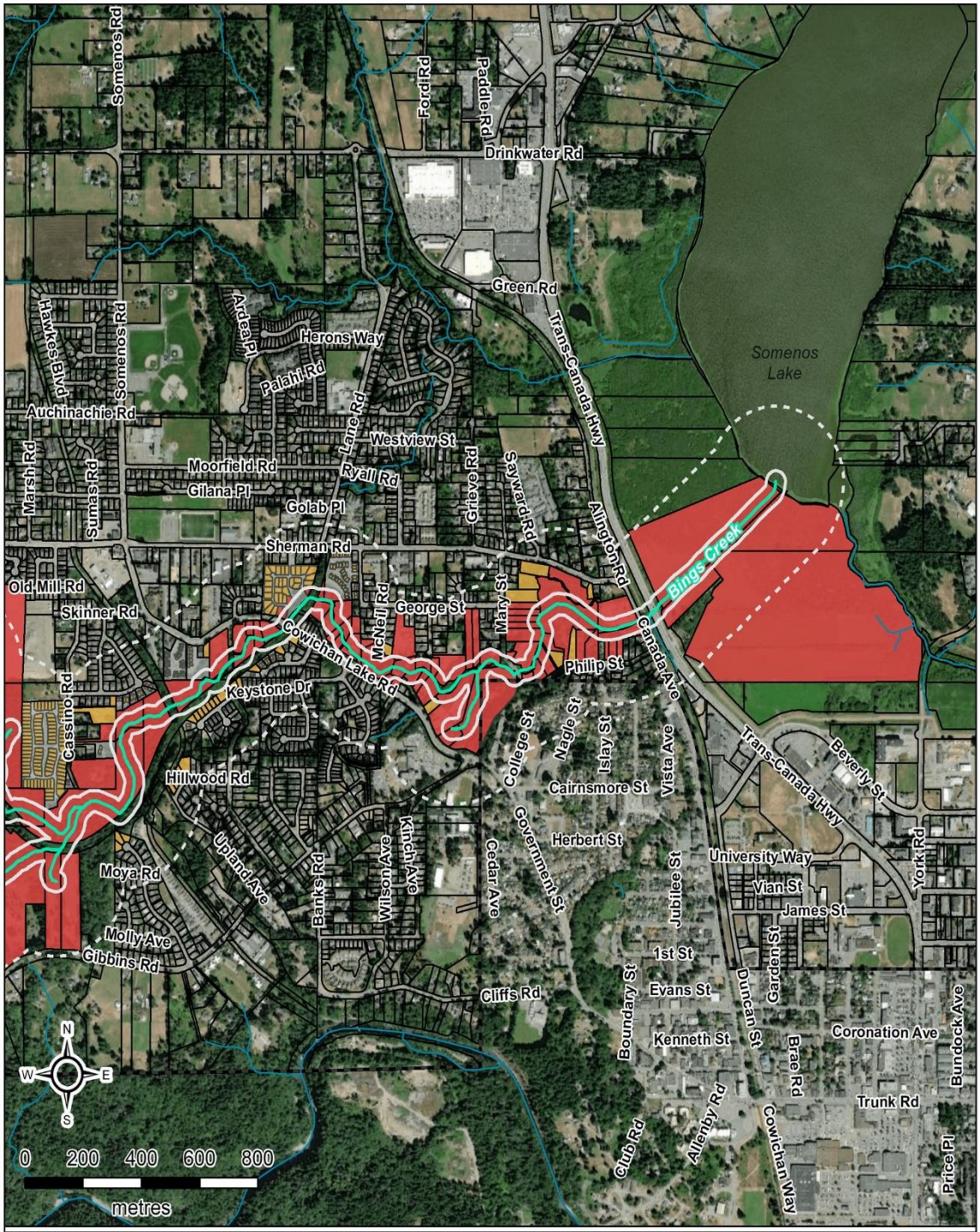
*With reference to **Figure C5,** introduced previously, the 'green zone' existing along the stream corridor probably makes a desirable boundary for upland development. This particularly seems to be the case with some strata parcels subdivided during the past two decades. Likely, there has been an uplift on potential lot values in part due to location next to (that is, within 200 m) a natural area and stream.*

Recognition of a Blended Financial Value: In the above table, a simple comparison of **$ value per m²** for "abutting" versus either the "adjacent" or "distant" types would lead to a misleading conclusion regarding relative value. At first glance, it would seem that being close to the stream has a negative influence on financial value. But closer examination yields a different conclusion.

Parcels abutting a stream exhibit a "blended financial value". We describe this as one value for the developable area of a parcel, and a lesser value for parcel area that cannot be developed due to streamside setback regulations. Thus, it is necessary to take a closer look at the numbers to determine what they really mean.

Considering Only the Developable Portion of Streamside Parcels: The objective is to understand the **$ value per m²** for the abutting parcels without and without the influence of the riparian area. Thus, we assign the financial value of the parcel to the developable portion to determine the **effective value per m²** for the unencumbered area - it is $90 rather than $58. The total value of the parcel does not change.

Figure C5


Somenos Rd
Ford Rd
Paddle Rd
Drinkwater Rd
Green Rd
Trans-Canada Hwy
Somenos Lake
Herons Way
Ardeal Pl
Palahi Rd
Lane Rd
Auchinachie Rd
Westview St
Moorfield Rd
Ryall Rd
Gilana Pl
Golab Pl
Grieve Rd
Sayward Rd
Allington Rd
Bings Creek
Sherman Rd
Old Mill Rd
Skinner Rd
McNeil Rd
George St
May St
Cowichan Lake Rd
Canada Ave
Philip St
Keystone Dr
Cassino Rd
Hillwood Rd
College St
Nagle St
Islay St
Vista Ave
Cairnsmore St
Herbert St
Government St
Cedar Ave
Jubilee St
University Way
Vian St
James St
York Rd
Beverly St
Moya Rd
Upland Ave
Banks Rd
Wilson Ave
Kinch Ave
Molly Ave
Gibbins Rd
Cliffs Rd
1st St
Evans St
Kenneth St
Boundary St
Duncan St
Craig St
Brae Rd
Coronation Ave
Bundock Ave
Trunk Rd
Club Rd
Allenby Rd
Cowichan Way
Price Pl
N
W
E
S
0 200 400 600 800
metres
Bings Creek Parcels - Sample Area 1 & 2
Bings Creek
Study Area (65m)
Study Area (465m)
N. Cowichan Boundary
Strata Parcels
Abutting Parcel
Adjacent Parcel
Data Source: The District of North Cowichan and DataBC. Basemap sourced from ESRI. August 2021

Interpreting the Data: What Metrics are Useful?

Figure C7 drills down to show details of the three parcel types. There are sufficient abutting and distant parcels to make useful comparisons. The limited number (11) of adjacent parcels means that only weak conclusions can be drawn.

The analysis of the imperviousness of abutting parcels found that only about 12% of the aggregate area of these parcels was impervious. In fact, nearly all of these parcels had intact or relatively intact riparian (< 25% impervious) area.

Condition of Riparian Area: The stream influences the general and financial value of parcels. In summary these influences are:

- The riparian setback zone restricts development and other land uses within 30m of the stream.
- The relatively good condition of the riparian area vegetation creates a natural area ('green zone') that may make nearby upland parcels a more desirable location for residential development.

Streamside protection policy and bylaws have been in force in MNC for two decades. A large amount of development within 200m of Bings Creek has occurred in that time and has been subject to regulation.

Development Permit Area 3 – Natural Environment (DPA3) is a MNC bylaw. It applies to Bings Creek and is influential in the urban portion of the stream. This is the length from Mary Street to Cassino Road. Where the stream passes through rural areas other regulatory regimes (Right to Farm, Resource Extraction, Municipal/Community Forests) supersede streamside setback regulations.

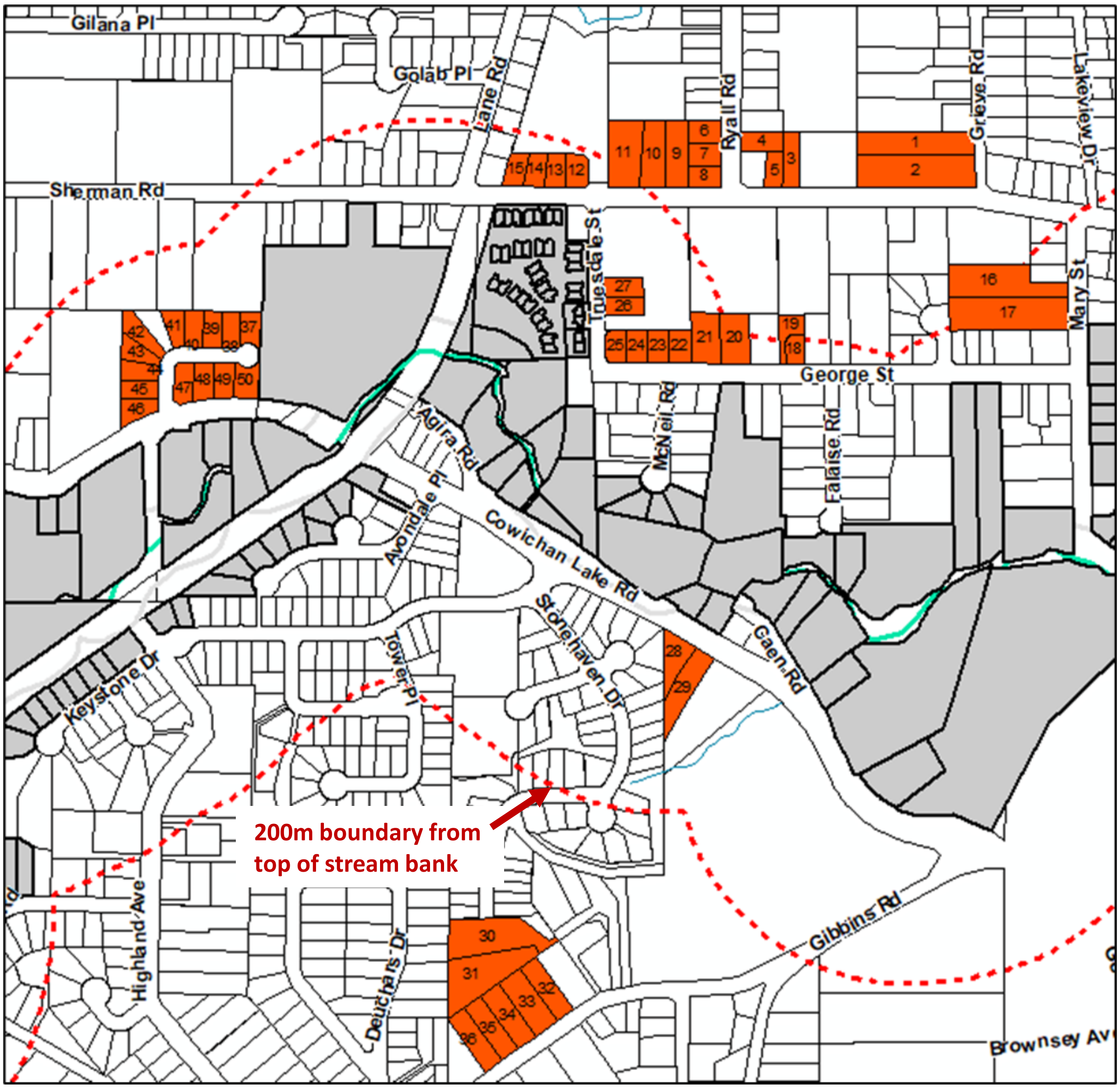
Development of land near (within 30m) the stream in the urban area has not been intensive in the past. During the last two decades, new residential development has occurred in the upland areas away from the setback zone. Likely, the *Riparian Areas Regulation Act* and the strength of DPA3 have encouraged this trend.

Influence of Stream on Parcel Values: Clearly the application of DPA3 to Bings Creek in the urban area restricts potential development of parcels abutting the stream. Parcels are encumbered by the setback zone. This condition suggests that owners and potential buyers accept the fact that some portion of a parcel is undevelopable.

The fact that abutting parcels have a lower **$ per m²** compared to distant parcels confirms that the stream influences value. In reality, the nature of the influence is to create a blended parcel value for those abutting the stream. If the setback area is removed from the aggregate area of abutting parcels, the value per m² increases from $58 to $90 and exceeds that of the adjacent and distant parcels.

Figure C7 - Bings Creek Urban Area – Sample Parcels

EXPLANATORY NOTE: *Abutting and Adjacent parcels are colour-coded in grey. Distant parcels are highlighted in red*



Closing Reflections on What We Learned

MNC has a robust bylaw in DPA3. It is protecting the riparian condition in the setback zone of Bings Creek in the urban area. Within the setback zone, only about 9% of the area is impervious. However, this situation does not mean that development away from the stream supports riparian areas adjacent to the stream.

Relative Influence of Strata Parcels on Hydrology

The land area occupied by strata parcel developments(about 183,000m^2) is almost the same area as for the entire setback zone, or Natural Commons Asset

Impact and Implications of Strata Development: Part B described the importance of hydrology (water pathways) and of sustaining the share of rainfall that infiltrates the soil to support interflow and groundwater flow, and thus ultimately maintain baseflow in the stream during dry-weather periods.

The review of 10 strata parcel developments (completed during the period1982 through 2021) described water pathways at risk. The area occupied by the strata parcels is about 207,500 m² compared to entire setback zone (178,200 m²) in the urban area. Thus, it is reasonable to conclude that the protection achieved for the setback zone is being influenced negatively by the upland development.

Water Pathways and Water Balance Distribution: How strata parcels are developed has implications for the integrity of water pathways and thus the water balance distribution. These include:

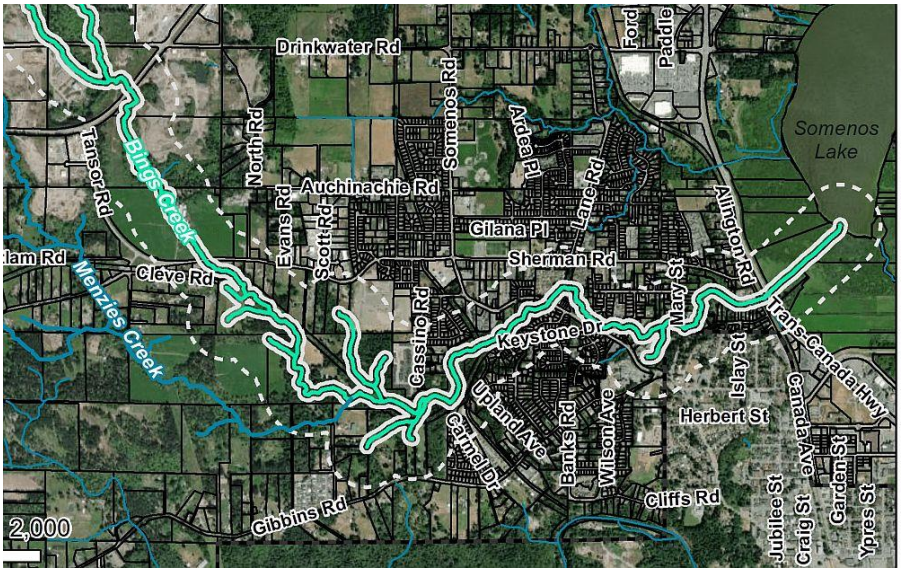
- For the 9 strata developments reviewed, the impervious coverage is about 57% of the parcels. The range is 49% to 75%.
- The rainwater that falls on those sites is collected and conveyed to outfalls – some go directly to Bings Creek; others go to parks or privately owned parcels for some form of infiltration.
- Other forms of recent (i.e., since 2001) urban residential and commercial development create areas with about >50% impervious area. Collected rainwater goes to Bings Creek or to ground in parks or wetland areas.

The community and MNC can further protect the stream by ensuring that the on-site designs of rainwater management systems serving upland developments maintain the natural volume proportions for each water pathway.

PART D

EAP Research

Supporting Analysis



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Analysis of Riparian Qualities of Parcels in Urban Sample Areas 1 and 2

(June 17,2021)

This analysis supports Research Objective 2 which is to report on the condition of the Bings / Menzies Creek riparian areas using qualitative and quantitative measures.

Parcel information in the pale mauve colour indicates parcels (more than 30 metres from the stream). These adjacent parcels have a boundary with an abutting parcel; thus, significant riparian areas may be continuous to the stream.

A. PARCELS IN SAMPLE AREA 1 – SINGLE FAMILY AND DUPLEX PARCELS

Order Number	Zone	Use	St. No.	Address	Parcel Area m²	Impervious Area	% Imp.	Riparian Quality	Vegetative Cover
4	PU	Public Bldg	6060	Canada Ave	11829.43309	6461.339117	54.6	Altered	Trees
5	R8	Residential	6046	Canada Ave	4580.200674	2733.249947	59.7	Altered	Trees
6	R3	Residential	2857	PHILIP ST	1472.842944	663.559814	45.1	Intact	Grass/trees
7	R3	Residential	2863	PHILIP ST	1790.950909	770.391716	43.0	Intact	Grass
8	R3	Residential	2871	PHILIP ST	922.843623	227.740455	24.7	Intact	Grass
9	R3	Residential	2879	PHILIP ST	3733.474797	946.943723	25.4	Intact	Trees/grass
10	R3	Residential	2889	PHILIP ST	3771.289094	881.13034	23.4	Intact	Trees/grass
11	R3	Residential	2897	PHILIP ST	2496.4933	929.83158	37.2	Intact	Grass/shrubs/trees
12	R3	Residential	2907	PHILIP ST	27619.9147	937.77766	3.4	Intact	Trees/shrubs/grass
13	R3	Residential	2909	PHILIP ST	2276.547517	212.489312	9.3	Altered	Trees
14	R3	Residential	2911	PHILIP ST	1945.960879	660.775296	34.0	Intact	Trees/grass
15	R3	Residential	2919	PHILIP ST	3331.505279	385.444403	11.6	Intact	Grass/trees
16	R3	Residential	2931	PHLIP ST	2335.48583	336.175223	14.4	Altered	Grass/trees
17	R3	Residential	2935	PHILIP ST	969.168133	569.943429	58.8	Altered	Shrubs
18		Deleted							
19	R3	Residential	2882	SHERMAN RD	946.461349	275.962648	29.2	Intact	Grass/trees
20	R3	Park	2886	SHERMAN RD	7596.195398	0.00	0.0	Intact	Trees/grass

Analysis of Riparian Qualities of Parcels in Urban Sample Areas 1 and 2

(June 17,2021)

21	R3	Residential	2936	SHERMAN RD	3791.683675	322.307548	8.5	Intact	Trees/shrubs/grass
22	R3	Residential	2942	SHERMAN RD	3610.138036	424.791706	11.8	Intact	Trees/shrubs/grass
23	R3	Residential	6061	MARY ST	4582.180394	389.701849	8.5	Intact	Shrubs/trees/grass
24	R3	Residential	6051	MARY ST	2374.826867	352.767464	14.9	Intact	Shrubs/trees/grass
25	R3	Residential	6047	MARY ST	2433.373415	397.45932	16.3	Intact	Shrubs/trees/grass
26	R3	Residential	6039	MARY ST	2300.256636	544.751506	23.7	Intact	Shrubs/trees/grass
27	R3	Residential	6037	MARY ST	2376.841999	471.795716	19.8	Intact	Shrubs/trees/grass
28	R3	Residential	6035	MARY ST	4956.831802	780.942266	15.8	Intact	Shrubs/trees/grass
29	R3	Residential	6009	MARY ST	5948.50532	1420.970706	23.9	Relatively Intact	Grass/trees/shrubs
30	R3	Residential	6011	MARY ST	669.840907	313.718157	46.8	Altered	Trees
31	R3	MNC/Duncan wetland	3021	Cow Lake Rd.	31771.03169	804.906123	2.5	Relatively Intact	Trees/grass/shrubs
N = 27									
		Totals			142434.2783	23216.86702	16%		

B. PARCELS IN SAMPLE AREA 2

74	R3	Residential	6020	MARY ST	3426.945789	472.531147	13.8	Altered	Trees
75	R3	Residential	2982	GEORGE ST	4483.278961	448.988657	10.0	Intact	Trees/shrubs/grass
76	R3	Residential	2986	GEORGE ST	4686.602055	380.466401	8.1	Intact	Trees/shrubs/grass
77	R3	Residential	6015	FALAISE RD	7696.895335	1080.874259	14.0	Intact	Trees/grass
78	R3	Residential	6011	FALAISE RD	1528.323816	786.682817	51.5	Altered	Trees/grass
98	R3	Residential	6019	MCNEIL RD	1227.619733	406.08664	33.1	Intact	Grass/trees
99	R3	Residential	6011	MCNEIL RD	665.372403	302.86521	45.5	Intact	Grass/trees
100	R3	Residential	6014	MCNEIL RD	892.115828	368.737515	41.3	Intact	Grass/trees
101	R3	Residential	6020	MCNEIL RD	1073.716256	448.552431	41.8	Intact	Grass/trees
102	R3	Residential	3103	AGIRA RD	3589.228105	953.501278	26.6	Altered	Trees/shrubs
103	R3	Residential	3091	AGIRA RD	1008.45612	425.449684	42.2	Altered	Trees
104	R3	Residential	3107	AGIRA RD	1070.641471	310.596467	29.0	Altered	Grass/shrubs/trees

Analysis of Riparian Qualities of Parcels in Urban Sample Areas 1 and 2

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105	R3	Residential	6048	TRUESDALE ST	1676.595483	705.837566	42.1	Intact	Grass/trees
106	R3	Residential	3111	AGIRA RD	2987.124692	557.27061	18.7	Relatively Intact	Trees/grass
107	R3	Residential	3115	AGIRA RD	6482.828275	403.69137	6.2	Altered	Trees/grass
108	R3	Residential	3135	AGIRA RD	4034.626149	1051.080457	26.1	Altered	Grass/trees
109	R6	Rec. Park		TRUESDALE	1564.255991	0	0.0	Intact	Trees
111	R6	Res. Dplex	6066	TRUESDALE					
112	R6	Res. Dplex	6068	TRUESDALE	480.2	129	26.8	Altered	Trees/shrubs
182	R3	Residential	3164	Cow. Lake Rd.	3381.163125	1083.71803	32.1	Altered	Trees/grass/shrubs
183	R3	Residential	3174	Cow. Lake Rd.	2465.701985	315.756247	12.8	Relatively Intact	Trees/grass/shrubs
184	R3	Residential	3180	Cow. Lake Rd.	1253.308859	371.858678	29.7	Altered	Trees/grass/shrubs
185	R7	Residential	n/a	Cow. Lake Rd.	6880.634809	0	0.0	Intact	Trees/shrubs
207	R3	Residential	3214	Cow. Lake Rd.	8195.8	0	0.0	Intact	Trees/grass/shrubs
278	R3	Residential	3208?	Cow. Lake Rd.	24,700.00	0	0.0	Intact	Trees/grass/shrubs
315	R3	Residential	n/a	?	7400	0	0.0	Intact	Trees
316	R3	Residential	5919	Cassino Rd	56,119.20	661.5	1.2	Altered	Trees/shrubs
317	R3	Residential	3296	Renita Rdg Rd	669.4	479.513119	71.6	Altered	Grass
318	R3	Residential	5969	Cassino	5,621.77	898.224007	16.0	Altered	Grass/trees/shrubs
319	R3	Residential	5941	Cassino	3684.6	510.6	13.9	Altered	GrassTrees Shrubs
320	R3	Res	5937-39	Cassino	4,425.00	1518	34.3	Altered	Trees shrubs
323	R3	Res	5925	Cassino	13558.8	1950.98	14.4	Altered	Trees shrubs
324	R3	Res	5920-22	Cassino	1,041.57	437.16	42.0	Altered	Trees shrubs
N = 33									
Total					**187971.7752**	**17459.52259**	**9.3**		

Analysis of Riparian Qualities of Parcels in Urban Sample Areas 1 and 2

(June 17,2021)

STRATA PARCELS IN SAMPLE AREA 2 – North Side of Bings Creek

3048 George St.	10,781 m² Bare Land Strata Parcel	11 lots
Impervious area 5282 m²	49% impervious	Area of lots is 7162 m² and average lot size is 651 m²
Common area of 3619 m² (34% of strata parcel)	1850 m² left as natural area	Riparian area is 17.2% of the parcel. Intact condition
Rainwater drainage from 11 strata lots goes to the natural area which abuts the stream. Drainage from Falaise Road also goes to this natural area. The remainder of the strata parcel has very limited pervious area. Correct.		

6078 Truesdale St. Common Name Creek Trail Properties	13,531 m² Building Strata Parcel	31 lots – since 2007
Impervious area 6100m²	57% impervious	Aggregate area of 31 lots is 4350 m² Avg. lot size is 130 - 150 m²
Common area of 9500 m² (70% of strata parcel)	1600 m² park dedicated from common area and left as natural	Riparian area is 12% of the strata parcel. Intact condition
Rainwater drainage from the common area and buildings goes to main on Sherman Road and then to an outlet to Bings Creek – follows the Cowichan Valley Trail alignment. From what I can tell it looks like that units 4-10 drain to 6110 Grieve Rd (private owned parcel) while the rest of the units drain directly into Bings Creek via two ditches.		

3144 Sherman Road. Common Name Holmes Creek Estates	26,000 m² Bare Land Strata Parcel	32 Lots – subdivision 1991 - 1992
Impervious area of 13,715 m²	50.84% impervious	Area of lots is 16,000 m² Avg. lot size is about 500 m²
Common Area of 9980 m² (34% of strata parcel)	Riparian area (remnant) is about 2600 m²	Riparian area is 10% of the parcel. Altered condition
Rainwater drainage goes to Sherman Road and then to Bings Creek – same stormwater main as 6078 Truesdale. Yes but Truesdale does not (see above).		

Stonewood Village – Cassino Road to Village Way and Edgewood Drive. CD4 zone	45,500 m² Bare Land Strata	89 lots – subdivision 2015, building 2016-2021, continuing
Impervious area of 34,270 m²	75.3% impervious	Area of lots is about 32,000 m² Avg. lot size is 360 m²
Common area of 13,300 m² (29% 0f the strata parcel)	No riparian area. Pervious area includes altered land and a constructed infiltration area of about 3000 m².	Infiltration area is 6.6% of the strata parcel area.
Rainwater drainage goes to the end of Village Way and into a drainage basin which abuts private parcels zoned R3 and A2 which are transected by Bings Creek. Distance of drainage basin from Bings Creek is about 90 metres. Correct.		

STRATA PARCELS IN SAMPLE AREA 2 – South Side of Bings Creek

3225 Cowichan Lake Road – Westwood Estates	15530 m² Building Strata	34 Townhome lots circa 1982
Impervious area of 7970 m²	51.3% impervious	Townhome footprint (30 lots) is 2020 m². Avg. lot is 56 m²
Common area of 7560 m²	Riparian area of about 5500 m² About 4500 m² is intact riparian area	Infiltration area is about 32% of the strata parcel area.
Rainwater drainage goes to the adjoining lot (3100 m²) to the south. Drainage flows about 230m through wetland area in this and another parcel, finally discharging into Bings Creek. This drainage also serves a main which comes from across Cowichan Lake Road and drains laterals for a potion of Keystone Drive, Stonehaven Dr., Manor Dr., Stonehaven Pl. and Cornerstone Pl. as well as Tower Ridge Rd., Tower Place and Baker Road. This drainage does discharge into Bings Creek on MNC property.		

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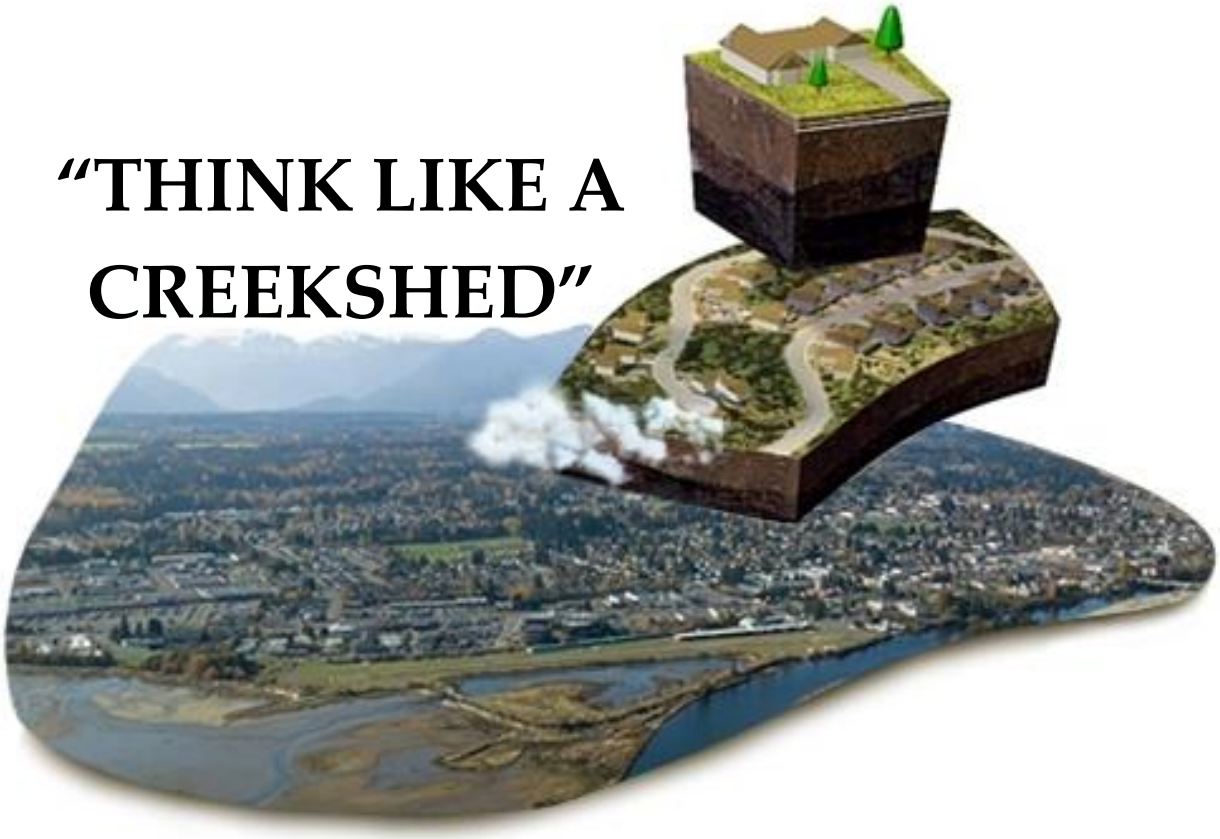
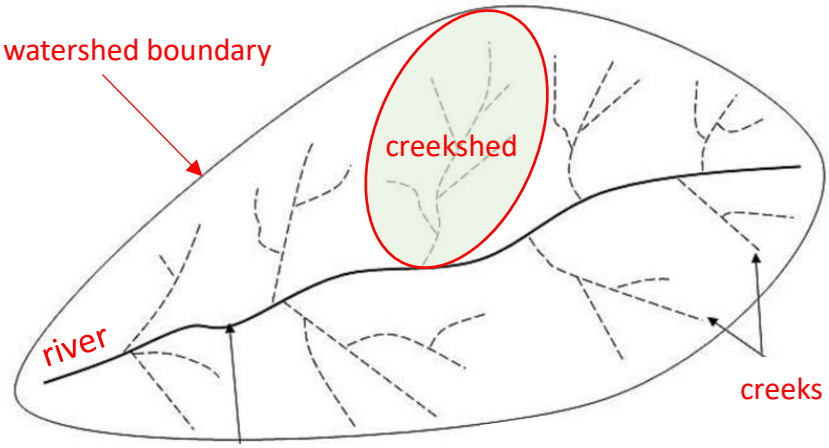
"THINK LIKE A CREEKSHED"



A creekshed is an integrated system:

The need to protect headwater streams and groundwater resources in BC requires that communities expand their view - from one that looks at a site in isolation - to one that considers HOW all sites, the creekshed landscape, streams and foreshores, groundwater aquifers…and PEOPLE….function as a **whole system**.



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