Ecologial Accounting Process

Report for French Creek

Year 1 0f 2

Report prepared by the Mount Arrowsmith Biosphere Region Research Institute for the Regional District of Nanaimo

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the partnership for water sustainability in bc

Regional District of Nanaimo

City of Nanaimo

Mount Arrowsmith Biosphere Region Research Institute

Municipality of North Cowichan

Vancouver Island University

Executive Summary

All communities have natural assets such as forests, wetlands, and streams; however, these natural assets are often overlooked in municipal asset management. Shared by the community, these ecological assets can be regarded as a 'natural commons', providing critical services and functions far exceeding simple aesthetic value to human and nonhuman life. To ensure current and future functionality, natural commons require a collective responsibility towards its maintenance and management. To address this need, the Ecological Accounting Process (EAP) was created to provide a standardized and rigorous approach to account for the value of natural assets, specifically stream corridor systems. The Partnership for Water Sustainability in BC (PWSBC) began development of the EAP methodology in 2016. Its framework emerged from green infrastructure ideas and practices dating from the late 1990s. To date, methodological testing has been undertaken through nine trial studies in partnership with Vancouver Island University's (VIU) Mount Arrowsmith Biosphere Region Research Institute (MABRRI). These trials have demonstrated the effectiveness of EAP methodology for integrating natural assets into municipal asset management. The PWSBC have determined that they wish to have the EAP methodology embedded into academia to teach and train EAP methodology to the next generation of municipal employees. As such, a transition to house the EAP method within MABRRI is currently underway in partnership with the Municipality of North Cowichan, Regional District of Nanaimo, and City of Nanaimo.

This report applies EAP methodology which uses GIS analysis to examine French Creek within the Regional District of Nanaimo. This analysis looks at the first three steps of the EAP process:

1) calculation of the Natural Capital Asset (NCA) financial value,
2) finding the annual investment at 1% of the NCA financial value required for maintenance and management of the stream system, and
3) stating the riparian deficit by providing a view of the extent of land use intrusions and alterations of the inner riparian zone (30m on each side of the stream).

Further, this analysis examined parcels based on types of land uses (zoning) and suggests a budget allocation for maintenance and management of the entire stream system or for sample sections or reaches. Mapping of impervious areas extending an additional 200m beyond the inner study areas was also completed, offering further insights into the riparian conditions surrounding French Creek. Total NCA value for French Creek is estimated to be between (CAD) $22.8 million and $33.5 million dollars. This indicates that each linear meter (m) of French Creek has at least (CAD) $333 of value to the community, though this number could be as high as $681 per m.

Based on these NCA values and their indication of French Creek's value to the community, it would be reasonable to spend between (CAD) $228,500 and $335,400 annually on the maintenance and management of the riparian areas abutting French Creek. This report provides baseline information about French Creek to be built upon with future work, including the formulation of a Technical Advisory Committee and research question.

Foreword

We respectfully acknowledge that French Creek is situated within Coast Salish territories, within the ancestral lands of the Snaw-naw-as and Qualicum First Nations. The cultural and spiritual values of these lands are of great significance, far beyond economic valuation. The intention of EAP is to provide one method to help incorporate ecological accounting into annual municipal budgeting, contributing to one piece of the working body of ecological stewardship.
EAP strives to bring stewardship and sound management of waterways to the forefront of planning processes. MABRRI and VIU appreciate that the significance of waterways addressed in this project far exceeds monetary value. However, it is our hope that by introducing a means to financially account for these systems in settled areas, we can ensure continued fiscal responsibility for their maintenance and management for years to come.

Stewardship and respectful management of water systems is a community driven process. We would like to acknowledge and give thanks to all those who made contributions to the EAP process, shared their knowledge, and assisted in the creation of this document. Just as waterways connect landscapes and ecological and social communities, we hope this process can play a role in connecting our waterways with a legacy of continued care.

We would like to thank our partners in this process, the PWSBC, the Municipality of North Cowichan, the Regional District of Nanaimo (RDN), and the City of Nanaimo for their ongoing support and trust as we work alongside them to improve the integration of natural assets into municipal asset management and to train emerging municipal planning and GIS professionals with locally relevant work experience and training.

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Introduction

Natural features within a community are of inherent value, much of which is difficult to equate in economic or financial terms. In municipal asset planning, financial value is generally assigned on an annual basis to maintain constructed assets which provide services to the community. Although this valuation is one among many metrics, it is an effective, relevant, and readily applicable means to delegate ongoing attention towards the sustainability of assets.

In a time of climate crisis and environmental change, it is pertinent to apply strategies that attempt to maintain and manage natural features. As these natural features are shared, humans hold collective responsibility towards the stewardship of natural commons, which service all forms of life. Within communities and beyond, human settlement activities typically occur to the detriment of the natural commons, resulting in the degradation or deficit of ecological features. On a community level, applications to mitigate this deficit are necessary in the interest of greater health of the environment and its inhabitants.

EAP is a methodology and metric aiming to provide local governments and communities with a relatively low-cost tool to integrate ecological assets into municipal asset management. EAP is grounded in a land-use perspective, which examines the ecological services offered by natural assets, and advocates for optimized health of these assets. Assuming land use and land conservation to be of equal value, EAP advocates for the same budgeting considerations towards maintenance and management of municipal infrastructure to be applied to stream corridor systems (the stream itself plus 30m setback on each side of the stream). Viewing these riparian corridors as natural assets and natural commons, EAP values these areas on a dollar per square metre basis, providing a metric to be used by municipal governments. EAP analyses then enable local governments to apply annual budgeting for natural assets, have a baseline figure for landowner compensation for riparian restoration, and more. Furthermore, EAP analyzes the value of the land occupied by the natural commons, areas where the riparian setback area and stream channel fall, as well as the maintenance and management investments put into the stream by property owners, the local government, and stewardship groups. The level of riparian deficit is then communicated, to be remediated collectively through a shared responsibility of stewardship towards the natural commons.

Recognizing the critical importance of our natural commons and the pressing need to address riparian deficits, this project brings together collaborative partnerships that prioritize the sustainable management of natural assets. By fostering inclusive alliances between governmental bodies, communities, and environmental organizations, EAP aims to collectively enhance the health and resilience of our shared ecosystems, ensuring the equitable distribution and responsible stewardship of precious natural resources for the benefit of current and future generations.

Limitations

EAP intends to provide defendable valuations that can be referred to in natural asset management, budgeting, and capital planning; however, we recognize that EAP assessed valuations of streams do not directly engage in an in-depth consideration of social, cultural, ecological, or intrinsic value of streams. While these measures of value are certainly important and should be acknowledged, EAP valuations may be viewed as a conservative approach. The true value of a stream (with the consideration of social, cultural, ecological, and intrinsic value) may be higher than the figures presented, and it is recognized that social and cultural worth of land should or cannot be presented as a monetary value. EAP aims to provide one tool to begin the process of accounting for ecological assets within municipalities, and initiate investment in stream restoration, maintenance, and management. The intention is for EAP to be used as one aspect of an intricate framework within a larger management plan, which should be accounting for values beyond the quantitative and fiscal.

Within the field of natural asset management, there is an approach that works to quantify natural assets through an evaluation of their ecological services. This looks at a range of human-specific services that a natural asset may provide (such as drainage, carbon sequestration, water filtration, air quality, and more) and works to ascribe a value to the natural asset that would approximate what replacing it with built infrastructure would cost. Several municipalities across BC have begun engaging with the Municipal Natural Assets Initiative (MNAI), including creating inventories and identifying and ascribing a value to their natural assets. It should be clarified that EAP is situated within a different, but complementary, framework.

It is also important to note that EAP limits its scope to the land parcels directly adjacent to the stream channel. It provides some limited opportunity to look at rainwater pathways leading to the stream and adjacent impervious surfaces to infer water quality impacts, but the EAP analysis is not an approach that encapsulates the full watershed surrounding the stream. EAP sees the stream channel and its supporting riparian area as the backbone of the watershed but does not extend its analysis to parcels beyond that concentrated area. This framework is based on the "streamside protection and enhancement area" (SPEA) defined in the Riparian Areas Protection Regulation (RAPR)[1].

EAP aims to reframe the financial, social, and ecological value of stream corridor systems (natural assets) by synthesizing a single Natural Capital Asset (NCA) value that makes a financial case for natural assets in an accessible format. EAP metrics for the NCA primarily concern the target SPEA (30 metres on each side of the stream) set out in the RAPR. EAP focuses specifically on stream corridor systems (including ephemeral and seasonal water assets, flood plain areas, and constructed waterways such as ditches and impoundments providing habitat for fish) with particular attention to the riparian areas abutting streams. It does not provide direct recommendations on funding or policy approaches. EAP should be considered alongside recommendations from qualified environmental professionals and relevant ecological and riparian protection frameworks.

One core strength of EAP is its transferrable nature as a methodology to help municipalities exercise oversight and account for continued care and upkeep of waterways to ensure long-term watershed health and sustainability. However, this methodology produces relatively consistent and unbiased amounts for this maintenance and management, that are inherently limited. While EAP uses British Columbia (BC) Assessment data to quantify allocations for maintenance and management, the

1 **Ministry of Forests. (2022, June 14). Riparian Areas Protection Regulation (RAPR). Province of British Columbia. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/fish/aquatic-habitat-management/riparian-areas-regulation**

methodology does not have built-in strategies that can account for fluctuations in parcel value year to year. It is a framework that depends on parcels maintaining relatively consistent value or necessitates recalculation of the NCA value at regular intervals to accurately reflect current market prices. However, this may not be a considerable issue as management plans for specific areas are often made in 5–10-year increments, so the budget for maintenance and management would be estimated and allocated for that time span regardless of changes in market pricing.

Another limitation with BC Assessment data is that the framework reflects market value of a parcel and is primarily influenced by the sales history of other parcels in the area. This introduces space for misrepresentation of the true value of parcels due to boom-and-bust cycles where values are inflated or underestimated. Finally, the EAP methodology relies heavily on up-to-date GIS data, and accurate estimations may be limited in cases where this data is not available.

Ultimately, the EAP methodology provides a transferrable metric to allocate annual budgeting and valuation of stream corridors. This metric provides an educated estimation of this worth and determines baseline figures for annual budgeting of natural asset maintenance and management and is designed to act as one tool amongst many towards the mobilization of natural asset management now and in the future.

French Creek Background

French Creek drains a watershed of approximately 68km^2 and flows through RDN Electoral areas G, F, and C, with bordering municipalities of the Town of Qualicum Beach to the north and the City of Parksville to the south. The stream is approximately 24km in length, with the main stems braiding out into several channels in the upper watershed. The French Creek watershed is made up of steep forested headlands that drain from the mountains at 1080 m above sea level into the Salish Sea. The inland lowlands of French Creek are comprised of mostly rural residential and agricultural land, including some industrial and commercial use[2]. The coastal area surrounding the mouth of French Creek contains the highest level of urban development. The designated water uses in French Creek include drinking water, irrigation, livestock watering, wildlife, and aquatic life. EPCOR Water, a private utility company supplying water to a community service area in French Creek, is licensed under the Water Protection Act to withdraw drinking water from groundwater aquifers in the area[3], and adheres to the provincial Water Sustainability Act in this endeavor[4]. Logging roads provide recreational access to the upper watershed where hunting, ATV use, and hiking occurs. These activities, as well as forestry, urban and residential development, light industrial development, agriculture, and wildlife, all potentially alter water quality in French Creek[5].

French Creek has been selected for this analysis as it is considered an at-risk catchment. It is identified as a sensitive stream under the Water Sustainability Act[6] and is a designated community watershed. The areas that surround the creek are experiencing rapid development, which results in degrading riparian integrity. According to the RDN Area F Water Quality and Quantity Risk Assessment released in 2020, surrounding areas of French Creek's headwaters have undergone extensive tree loss over the past two decades, which may incur negative impacts to the creek's water flow and water quality[7] both onsite and downstream. French Creek also has complex hydrology and has experienced severe droughts and floods in recent years, as well as water quality concerns. The creek's riparian corridor is an asset providing the community with ecological services including stormwater conveyance, water filtration, aquifer recharge, fish habitat, green space, and aesthetic values for the communities adjacent to the creek.

In an RDN report analyzing surface water quality data collected from 2011-2020 by the Community Watershed Monitoring Network, it was suggested that French Creek may be experiencing "degrading

2 Northwest Hydraulic Consultants Ltd (2021). Watershed performance targets for rainwater management-French creek water region: Phase 1- Hydrologic modelling and performance targets. **https://www.rdn.bc.ca/sites/default/files/inline-files/20211020%203006259%20NHC%20French%20Cr%20Watershed%20Targets%20Final%20R0.pdf** (Accessed November 10, 2023).

3 EPCOR (2023). French creek, bc. **https://www.epcor.com/about/who-we-are-what-we-do/about-our-company/where-we-operate/Pages/french-creek.aspx** (Accessed November 10, 2023).

4 EPCOR (2020) 2020 french creek performance report.**https://www.epcor.com/products-services/water/water-quality/wqreportscanada/wq-french-creek-2020.pdf** (Accessed November 10, 2023).

5 British Columbia Ministry of Environment (2014). Water quality assessment and objectives for the French creek community watershed: Technical report. **https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo_tech_french_creek.pdf** (Accessed November 10, 2023).

6 Water Sustainability Regulation, BC Reg 36/2016. **https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/36_2016#section17** (Accessed November 10, 2023).

7 GW Solutions Inc. (2020). Water quality and quantity risk assessment for rdn electoral area f. **https://www.rdn.bc.ca/sites/default/files/inline-files/GWS_RDN%20Area%20F_RevJune15_2020.pdf** (Accessed November 10, 2023).

water quality conditions" (p. 15)[8]. In 2022, the RDN conducted a Watershed Performance Targets study which modeled the hydrological water balance for the French Creek watershed, and recommended targets for infiltration to groundwater, reducing run off into the creek, and baseflow maintenance[9]. This report recommended site development considerations that incorporate rainwater management best practices, as well as the implementation of a comprehensive and long-term hydrometric monitoring program and continued water quality monitoring at several locations along the creek. In 2023, the RDN completed a comprehensive numerical Water Budget study of the French Creek Water Region[10] to assess water supply and demand. This area was prioritized through a region-wide conceptual water budget project completed in 2013 which identified French Creek as a stream of significant complexity, at-risk hydrological function, potential diminishing water balance, and at-risk from growth pressures within the watershed[11]. The 2023 Water Budget study built a numerical model that looked at both surface and groundwater and then ran scenarios to observe the impacts of climate change, land cover change, and water demand on water levels and aquifer stress (E. Forssman, personal communications, 2023).

Though by no means exhaustive, social ascriptions of worth of French Creek is represented in community advocacy for ecological services and functioning primarily championed by the Friends of French Creek Conservation Society (FFCCS). This stewardship organization undertakes and funds fish and wildlife habitat restoration processes, works to acquire and preserve ecologically important sites, and educates the public about the ecology of the French Creek watershed. More than 90 community members are part of the FFCCS and work to mitigate reduced flow, lower water quality, and damaged natural habitats observed in French Creek[12]. These community-level efforts reflect thousands of volunteer hours committed to maintaining the integrity of the creek, showcasing one facet of the collective responsibility towards maintaining the natural commons.

8 Ecoscape Environmental Consultants Ltd. (2021). Community watershed monitoring network data analysis (2011-2020). **https://rdn.bc.ca/sites/default/files/2021-06/cwmn_data_analysis_2011-2020_reduced_file_sz.pdf** (Accessed January 9, 2024).

9 Northwest Hydraulic Consultants Ltd (2023). Watershed performance targets for rainwater management-French creek water region: Phase 2-Implementation, monitoring and adaptive management. **https://www.rdn.bc.ca/sites/default/files/inline-files/20230222%203006259%20NHC%20French%20Creek%20Watershed%20Targets%20Ph%202%20Implementation%20Final%20Report%20R1.pdf** (Accessed November 10, 2023).

10 Regional District of Nanaimo. (Accessed November 10, 2023). Rdn water budget project. **https://www.rdn.bc.ca/water-budget**

11 Waterline Resources Inc. (2013). Water region #3-French creek. In **Water budget project: Rdn phase one (vancouver island).** **https://www.mvihes.bc.ca/images/pdfs/Waterline2014.pdf** (Accessed November 10, 2023).

12 Friends of French Creek Conservation Society (Accessed November 10, 2023). **https://ffccs.ca**

Figure 1: Map of French Creek Water Region

French Creek Water Region

French Creek Main Stream

French Creek Tributaries

Watercourse

Waterbodies

French Creek Water Region

Inner Study Area (34m from Midline)

Outer Study Area (234m from Midline)

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Methodology

In this study of French Creek, EAP Steps 1-3 were conducted, in addition to mapping impervious surfaces in the Outer Study Area (OSA) extending an additional 200m on either side of the riparian corridor. More information about EAP Steps 1-3 can be found below.

Step 1: **The calculation of Natural Capital Asset (NCA) financial value.**
Streams are natural assets that occupy physical space on the landscape. This land has a financial value and can represent what the community is willing to pay for the stream and the benefits it offers. To find the NCA value, we calculate the value of a strip of land 30m wide on either side French Creek measured from the centre of the stream itself. This calculation of the riparian area differs slightly from the definition in the Riparian Area Protection Regulation. The land value amount comes from BC Assessment, which is the provincial agency responsible for standardized land valuation in BC. The total value of all land within 30m on each side of the stream is added together. This is considered the combined value of the stream and its riparian area.

Because maintenance budgets are suggested based on the NCA value (see Step 2 below), the combined value of land within 30m of the stream is divided by two to emphasize a shared responsibility between private landowners and the local government/larger community. The result is the total NCA value for the stream, indicating the value that French Creek brings to the community.

Step 2**: The calculation of a suggested Maintenance and Management (M&M) budget.**
This step suggests what local government / the community could spend on maintenance and management of French Creek to sustain the stream's capacity to function as an asset for the community. To start, we use 1% of the NCA value to calculate the annual Maintenance and Management (M&M) budget for French Creek. 1% is a standard proportion of total asset value allocated to maintenance in built infrastructure projects such as recreational facilities or roads. Because the stream provides so much value to the community, EAP recommends spending 1% to maintain its health and function.

Step 3**: Investigate the Riparian Deficit.**
NCA values can inform a Riparian Deficit, which indicates areas where increased spending on restoration or enhancement can be justified. This is a similar concept to built infrastructure deficits, where a lack of spending can result in the deterioration of an asset.

It makes sense that areas with denser development generally have higher land values. If more development intrudes into the 30m riparian setback, this means that higher NCA values could indicate that riparian condition is at a higher risk of degradation. Increased spending in areas with higher NCA values would be justified because the riparian area may need more M&M and the community may be deriving more value from the stream in these areas. The Riparian Deficit concept indicates order of magnitude: how much spending on the riparian area may be needed to maintain the capacity of French Creek as an asset. In densely developed areas abutting a stream, green infrastructure works may be a part of a M&M strategy to protect it.

The reverse can also be true as low NCA values might indicate that streamside protection has been relatively effective, and the riparian area may be in better condition. These areas may have smaller Riparian Deficits and might not require as much maintenance.

In any case, streams are a social and natural commons, in which upstream parcel owners have a social and ecological responsibility to protect the SPEA to avoid degradation of downstream conditions.

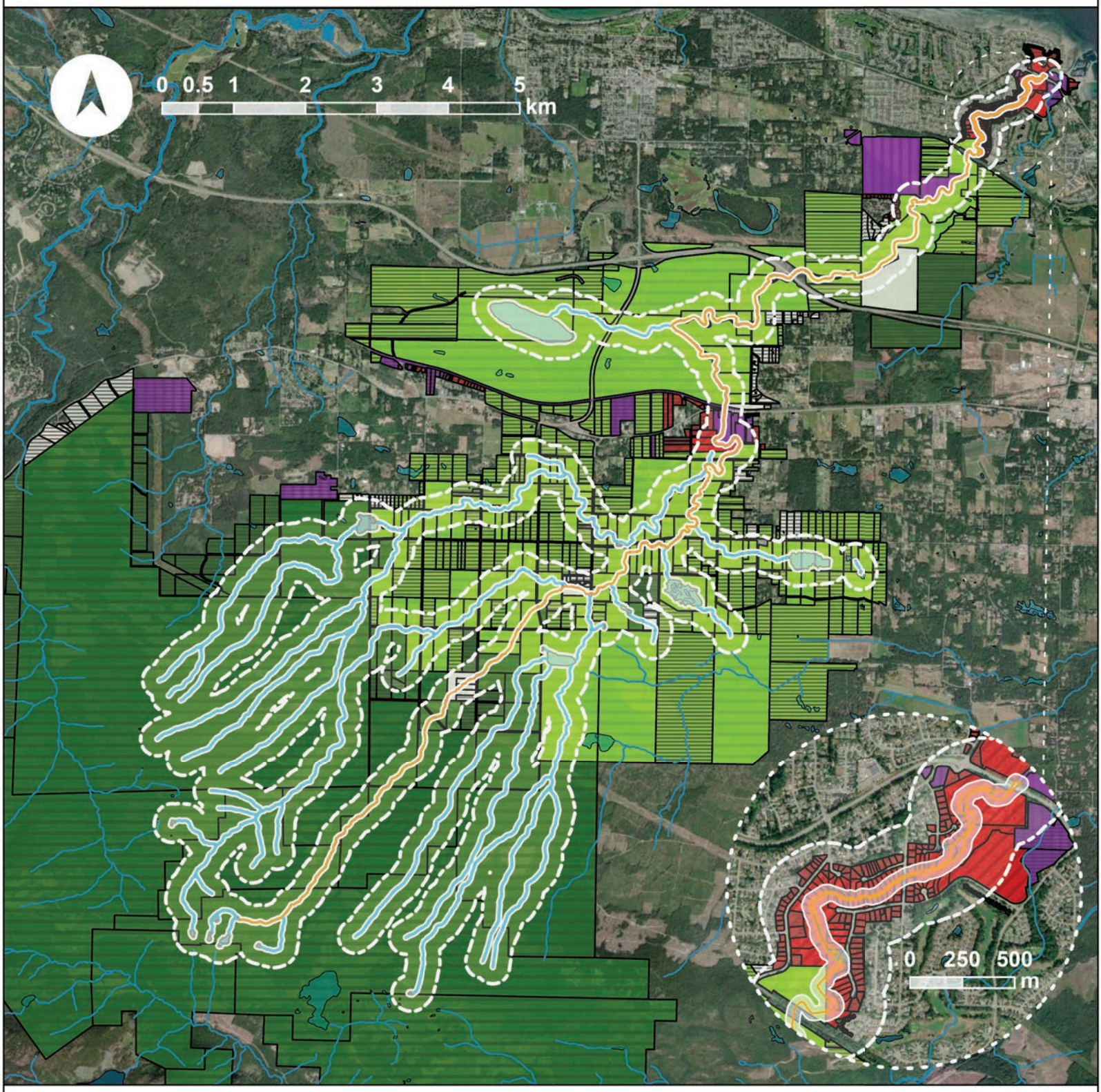
Where community plans concentrate development and reduce riparian conditions, offsetting M&M may be pursued in other stream reaches where restoration may be most effectively invested.

It should be noted that comparisons with actual measures of ecosystem health are needed to reinforce this concept. This is ongoing work that will be included in the next phase of research on French Creek. Local governments are also encouraged to bring in additional complimentary data sources and studies about riparian condition that may exist to further develop the Riparian Deficit concept.

In this study, abutting parcels were grouped into 5 land use categories based on a classification of municipal zoning information (see Appendix C) to allow comparisons between land uses. The zoning information used to create land use categories does not reflect actual land use in all instances and introduces potential for misinterpretation of results. The most notable of these discrepancies is in the inclusion of Managed Forest Land and Cut Timber parcels (as designated by BC Assessment) into the agricultural and rural residential land use categories. As these Managed Forest Land and Cut Timber parcels are generally large parcels with low land values and differing characteristics to the respective agricultural, rural residential, and forestry/resource parcels, Managed Forest Land and Cut Timber parcels have been segmented within reporting to better demonstrate the EAP metrics within each land use category. Managed Forest Land and Cut Timber parcels were also segmented in this analysis because the RDN does not have jurisdiction over these parcels, impacting the application of EAP metrics, including NCA and M&M values. The Results section below reviews these comparisons.

Figure 2: Study Parcels by Zoning Groups

Study Parcels by Zoning Groups



French Creek Main Stream
French Creek Tributaries
Watercourse
Waterbodies
Inner Study Area (34m from Midline)
Outer Study Area (234m from Midline)

Study Parcels
Abutting
Adjacent

Study Parcel Zoning Groups
Agriculture
Commercial/Industrial/Institutional
Forestry/Resource
Residential Rural
Residential Suburban

January 2023

Results

Of all 827 parcels used in the analysis, 267 (32%) are abutting parcels used in the main NCA calculations and the remaining 560 (68%) are adjacent parcels used to provide context and inform the impervious surface coverage analysis (Table 1). Agricultural and Residential Suburban uses contain the largest number of parcels (309 and 335, respectively; Table 1). Residential Rural uses and Commercial/Industrial/Institutional uses contribute relatively few parcels to the total (79 and 41 respectively; Table 1). Forestry uses also contribute a small proportion of total number of parcels to the analysis (63) but make up a large proportion of the area the stream abuts- about 57km of a total 100km abutting French Creek (Table 1). In comparison to Forestry as a dominant but low-density use, the relatively small area of the stream that the Suburban Residential land use abuts (3.8km) and the high number of parcels (335) indicates Suburban Residential use as a compact, high density land use along the stream.

When we only consider abutting parcels, the most extensive land uses along French Creek remain Agricultural and Forestry/Resource uses, with the combination of the two uses making up 65% of the stream frontage abutting the stream (Table 1). Proportionally, the Forestry/ Resource use makes up a larger percentage of the area abutting the stream (57%) than Agriculture (37%) and other uses (combined for ~6%). The Forestry parcels are larger on average (301ha compared to less than 15ha for all other land uses; Table 1), with only 33 Forestry/Resource parcels (out of a total 267 total abutting parcels) making up near 60% of the abutting stream area. One of the reasons for this large contribution of Forestry land use is the braided stream network that makes up the upper watershed in French Creek (Figure 2). Each large Resource/Forestry parcel may have multiple streamways running through it which explains the relatively large contribution of the Forestry land use to stream frontage area (Figure 1; Table 1). Residential parcels have a small contribution to abutting area with only ~4% of stream length abutting the higher density suburban residential use and ~1.5% of stream length abutting lower density rural residential uses.

Generally speaking, land use categories like the Forestry/Resource with larger average parcel areas have lower land value per m^2, while land use categories such as Suburban Residential with smaller average parcel areas have higher land value per m^2. This is an expected characteristic of the parcels used in the analysis and underscores the relative impact of smaller, higher value parcels on calculated NCA and M&M values (Table 2,3,4,5).

Table 1. Parcel Summary (Including Managed Forest and Cut Timber)

	Agriculture	Commercial/ Industrial/ Institutional	Forestry/ Resource	Residential Rural	Residential Suburban	Total
Total Number	309	41	63	79	335	827
Abutting	141	8	33	11	74	267
Adjacent	168	33	30	68	261	560
In ALR	128	1	3	2	1	135
Not in ALR	181	40	60	77	334	692
Farm Designated	50	0	1	1	0	52
Stream Length thru Parcel Area (km)	37.6	0.5	57.2	1.5	3.9	100.5

	Agriculture	Commercial/ Industrial/ Institutional	Forestry/ Resource	Residential Rural	Residential Suburban	Weighted Average of Abutting Parcels
Weighted Average Parcel Area of Abutting Parcels (ha)	14.9*	12.8	301.9	7.5*	0.7	67.5
Weighted Average Parcel Value per m^2 of Abutting Parcels ($ CAD)	11.31**	10.90	1.56	20.87**	94.09	27.75
*Average parcel sizes without inclusion of Managed Forest and Cut Timber are 7.8ha and 2.4ha for Agriculture and Residential Rural uses, respectively. ** Average parcel value per m^2 without inclusion of Managed Forest and Cut Timber are $13.23 and $25.45 for Agriculture and Residential Rural uses, respectively.						

Table 2. NCA Summary Table (Including Managed Forest Land and Cut Timber)

Group	Stream Length (m)	Parcels	Natural Capital Asset Values		
			Total $	$ per m	$ per m^2
Agriculture	37,614.44	141	18,973,689	504	7
Commercial/Industrial/ Institutional	493.68	8	374,884	759	5
Forestry/Resource	57,150.96	33	5,378,477	94	1
Residential Rural	1,460.58	11	1,238,768	848	13
Residential Suburban	3,851.63	71	7,577,337	1,967	47
Weighted Averages				**334**	**3**
*All financial values have been rounded to the closest dollar.					

Table 3. NCA Summary Table (Excluding Managed Forest Land and Cut Timber)

Group	Stream Length (m)	Parcels	Natural Capital Asset Values		
			Total $	$ per m	$ per m^2
Agriculture	26,285.40	120	13,516,137	514	7
Commercial/Industrial/ Institutional	493.68	8	374,884	759	5
Forestry/Resource	1,884.80	8	511,422	271	3
Residential Rural	1,020.94	9	875,201	857	13
Residential Suburban	3,851.63	71	7,577,337	1,967	47
Weighted Averages				**682**	**9**
***All financial values have been rounded to the closest dollar.**					

Table 4. Maintenance and Management Budget (including Managed Forest Land and Cut Timber)

Group	NCA Total ($)	M&M ($)
Agriculture	18,973,689	189,737
Commercial/Industrial/Institutional	374,884	3,749
Forestry/Resource	5,378,477	53,785
Residential Rural	1,238,768	12,388
Residential Suburban	7,577,337	75,773
Total	33,543,154	**335,432**
*All financial values have been rounded to the closest dollar.		

Table 5. Maintenance and Management Budget (Excluding Managed Forest Land and Cut Timber)

Group	NCA Total ($)	M&M ($)
Agriculture	13,516,137	135,161
Commercial/Industrial/Institutional	374,884	3,749
Forestry/Resource	511,422	5,114
Residential Rural	875,201	8,752
Residential Suburban	7,577,337	75,773
Total	22,854,980	**228,550**
*All financial values have been rounded to the closest dollar.		

Table 6. Impervious Surface Summary (Including Managed Forest and Cut Timber)

Row Labels	Count of Reference #	Sum of Area (m2)	Sum of Area Within Study Area (m2)	Sum of Impervious Area (m2)	Percent of Study Area (OSA)	Sum of Area (m2) within the 30m Study Area
Agriculture	309	34,791,818.58	14,194,176.36	385,372.90	2.715007094	2,608,870.39
Commercial/ Industrial/ Institutional	41	1,971,022.47	394,741.54	60,553.91	15.34014164	64,568.19
Forestry/ Resource	63	106,273,240.46	21,306,697.43	389,723.23	1.829111373	3,830,334.30
Residential Rural	79	2,066,886.06	633,320.45	26,530.61	4.189128697	93,940.41
Residential Suburban	335	1,166,214.53	682,393.26	109,758.67	16.08437204	148,019.36
Remaining Study Area	N/A	N/A	2,648,661.57	337,479.06	12.74149438	800,512.45
Total	**827**	**146,269,182.09**	**39,859,990.62**	**1,309,418.38**	**3.29**	**7,546,245.10**

The total NCA value of French Creek is (CAD) $22.8 million on the low end and could be as high as (CAD) $33.5 million with the inclusion of Managed Forest and Cut Timber lands (Table 4, 5). This indicates that each linear meter of French Creek has at least (CAD) $333 of value to the community (though this ratio could be almost double—$681—if Managed Forest and Cut Timber Lands are excluded from the calculation; Table 2, 3). Based on these NCA values and their indication of French Creek's value to the community, it would be reasonable to allocate between (CAD) $228,500 and $335,400 annually on the maintenance and management of French Creek (Table 5, 6).

Of the land use categories, Agricultural parcels are the largest contributor to total value of the stream, comprising $13.5 million of $22.8 million (59%) total NCA value, whereas $7.5 million (33%) is attributed to Suburban Residential parcels, and $1.6 million (7%) is linked to Rural Residential and Commercial/Industrial/Institutional parcels (Table 3, 5). Even though the Forestry/Resource use makes up almost 60% of the abutting stream area, when Managed Forest and Cut Timber parcels are excluded, it contributes only $0.5 million in total NCA value and is less than 1% of the abutting stream area. Exclusion of Managed Forest and Cut Timber parcels subsequently accounts for 8 forestry/resource parcels (Table 3) rather than the original 33 parcels accounted for in Table 2 with inclusion of Managed Forest and Cut Timber parcels. Although there is strong rationale for removing Managed Forest and Cut Timber parcels from the analysis on the basis that local government lacks jurisdiction, it makes sense to include them when interpreting the factors influencing the land use categories of French Creek and its NCA value. When included, the Forestry/Resource use contributes about $5.4 million total NCA value and a much larger 16% of the adjusted total (Table 2, 4).

A main takeaway from the NCA results is that the Suburban Residential use has a very small physical footprint on the area abutting French Creek (3.9km of 100.5km linear km), but it is one of the largest contributors to NCA value (between 22% and 32% of total NCA value depending on inclusion of Managed Forest and Cut Timber parcels; Table 1, 4, 5). This is reflected in a proportional per/m and per/m^2 measure of NCA value in Suburban Residential areas that is 200-400% higher than the next highest land use category (Rural Residential). When seen through the Riparian Deficit lens, this may indicate that the Suburban Residential area imposes more encroachment of development in the riparian area of French Creek than other land uses. This may suggest that riparian health is under more stress in these areas and could benefit from a higher proportion of M&M spending.

Impervious surface coverage is the area within the OSA (up to 230m from the stream's edge) made up of hard surfaces that shed rainwater. As one might expect, the highest proportion of impervious surface coverage exists in the Residential Suburban category with 16% of the study area delineated as impervious (Table 6). Similar results are found in the Commercial/Industrial/Institutional category with 15% impervious area, followed by Residential Rural, Agricultural and Forestry/Resource uses with 4%, 2.7%, and 1.8%, respectively (Table 6).

Land uses typically considered higher intensity such as Commercial/Industrial/Institutional and Residential Suburban have higher proportions of impervious surface coverage when compared to land uses typically considered lower intensity such as Residential Rural, Agricultural, and Forestry/Resource uses (Table 4). Though this is perhaps not a surprising result, it is interesting to compare impervious surface coverage to calculated NCA value. The high impervious surface coverage in Suburban Residential uses indicates more development is closer to the stream, raising its NCA value when compared to Rural Residential uses (Table 2, 3). This finding supports the concept of the Riparian Deficit in that the higher NCA values may indicate more disturbed riparian areas.

Directions for Future Research

The results of this EAP analysis summarized an overall NCA value of French Creek to be $22,800,000 without inclusion of Managed Forest and Cut Timber lands, and $33,500,000 with this inclusion. The overall M&M calculation based on these numbers ranges between $228,500 - $335,400, depending on whether Managed Forest and Cut Timber lands are accounted for. As these numbers have been divided in half prior to these calculations to indicate a shared responsibility between the community and its local government, it would be pertinent for community stewardship efforts and fundraising initiatives to match these funds to ensure sufficient and ongoing maintenance and management of French Creek.

Analysis of the Riparian Deficit in accordance with the NCA calculation yielded that the Suburban Residential land use category comprised disproportionate land value to physical footprint, indicating more dramatic development in this zone. These findings warrant further research within the Suburban Residential land use zone, as the context of Riparian Deficit suggests a greater impact upon these natural commons. This finding may also indicate purchaser willingness to pay more for land parcels in higher density suburban areas with proximity to French Creek than Agricultural or Rural Residential parcels with similar streamside proximity. This finding warrants future research into values associated with the natural commons, especially when they are situated amongst a higher density of constructed assets.

As the lower French Creek watershed continues to experience suburban development pressures from the nearby communities of Parksville and Qualicum Beach, understanding the conditions of the stream and its value as a natural asset to the community is important information to guide further development. A pertinent first step for future research would be to complete EAP Steps 4 and 5, which would provide a deeper understanding of the riparian conditions, including loss of forest/woodland cover within the study area (which is a likely by-product of development density). According to the Official Community Plan (OCP) for RDN electoral area G[13] and the draft OCP for RDN electoral area F[14], French Creek intersects with the Growth Containment Boundary in multiple locations along the lower watershed, indicating a shared interest in development and riparian protection along these reaches. We can compare the metrics EAP produces (such as NCA value and measures of ecosystem health) in the lower watershed to the rest of the stream system to inform understanding of the costs and benefits of future land use decisions. Future research such as this may inform policy and funding decisions to support the health of the stream in these areas. Given recent changes in proposed provincial land use legislation and a greater need for housing, integrating natural assets into the Electoral Area F OCP update may be a strategic decision to safeguard ecological areas.

A second consideration for future research in the French Creek watershed could place greater focus on upstream uses. Because Forestry land use areas make up a significant portion of the upper French Creek watershed and the watershed as a whole (50-80%), jurisdiction over these lands has a large influence on the condition and value of the stream to the downstream community. Future work could examine these Forestry areas and seek to quantify changes to stream condition (for example, changes in proportional tree cover versus other areas of the stream). As well, literature and legislation (for example, the Riparian Areas Protection Regulation) could be examined to better understand how riparian areas in Forestry lands are managed.

13 Regional District of Nanaimo (2008). Electoral area ‘g’ official community plan. https://www.rdn.bc.ca/dms/documents/planning/electoral-area-g---san-pareil,-french-creek-&-dashwood/official-community-plan/area_g_official_community_plan_complete_text_document.pdf

14 Regional District of Nanaimo (2023). Electoral area f draft official community plan. https://www.getinvolved.rdn.ca/11348/widgets/47067/documents/108178

We acknowledge some challenges with this inquiry as it may be difficult for the RDN to establish a natural asset management scheme to improve riparian health in privately managed forest lands outside local government jurisdiction. However, there is value in quantifying the extent of degradation due to forestry because if policy recommendations on natural asset management are to be made, there must be local, case specific, and defendable justification for doing so. This inquiry could highlight, with numbers specific to French Creek, the impact that forestry use has had on French Creek as a natural asset in comparison to agricultural or residential uses. Given the value that agricultural and residential landowners place on the stream (NCA value) there could be justification for incentivizing forestry use to change practice and add value to the riparian areas, and thus the community.

Finally, it may be pertinent to focus further research into the feasibility of providing compensation and/or incentivization to private landowners for streamside protection within their properties. As many parcels abutting and adjacent to riparian corridors are owned by private landowners, governing bodies have somewhat limited jurisdictions over these areas. By providing incentives to private landowners to restore and maintain the natural commons on their property, and with ongoing available and relevant education about its required care, this is an area of opportunity to further encourage multi-level community stewardship. Further research is required to determine the nature of this compensation (tax breaks or covenants may be pertinent areas of investigation), as well as investigations into cases elsewhere with similar contexts. The figures deduced in this report may provide an educated starting point in determining baseline investment funds, which also merits further research into relevant funding sources, and the financial advantages of restoration work made possible by such sources.