ATTACHMENT 1

Ecological Accounting Process Report for Richards Creek

Report prepared by the Mount Arrowsmith Biosphere Region Research Institute for the Municipality of North Cowichan

January 2024

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Executive Summary

Natural assets, including riparian corridors, woodlands, and wetlands possess inherent value to surrounding forms of life. When coexisting with built infrastructure, prioritization of natural asset maintenance and management equal to that of constructed assets is necessary to ensure continuation of its optimized and ongoing health. Shared by the community and surrounding ecosystems, natural commons deliver essential services and functions that require oversight through shared responsibility from municipal asset management and community stewardship. The Ecological Accounting Process (EAP) was formulated to provide communities with baseline financial allocations to meet this requirement, focusing specifically on-stream corridor systems.

EAP was created in 2016 by the Partnership for Water Sustainability in British Columbia and refined through a series of demonstration applications in municipalities within British Columbia (BC). Utilizing BC Assessment data and GIS analysis, EAP offers a standardized and rigorous approach to appraising the value of natural assets. EAP is now being integrated into the Mount

Arrowsmith Biosphere Region Research Institute (MABRRI) at Vancouver Island University (VIU) through a three-year transition strategy to house this methodology in an environment that can train the next generation of municipal professionals. Three regional municipalities, the Regional District of Nanaimo, the City of Nanaimo, and the Municipality of North Cowichan (MNC) have committed to completing one study per municipality per year. The following report applies EAP to Richards Creek in MNC, produced in Year 1 of this partnership. An analysis of the creek's entirety was conducted, and a focus area of agricultural land parcels between Richards Trail and Herd Road received detailed review. This report suggests an overall budget allocation to pursue the research objective of providing payment to agricultural landowners for ecological services involving creekside maintenance and restoration. Mapping of tributaries and impervious areas extending an additional 200m beyond the Inner Study Area was also completed, offering further insight into the riparian condition surrounding Richards Creek.

The key takeaways from this report are that Richards Creek may be worth as much as $31.5million to the community, and an annual maintenance budget of $28,379 would be a reasonable amount to spend on riparian maintenance and management of agriculturally developed lands abutting Richards Creek.

Acknowledgements

We, the research team at MABRRI and VIU, extend gratitude to our partners for their unwavering support and trust as we work to integrate natural assets into municipal asset management and provide training for emerging professionals with locally relevant expertise.

EAP represents an intention to bring stewardship and sound management of waterways to the forefront of planning processes. We appreciate that the significance of natural assets addressed in this project far exceeds monetary value. By introducing a means to account for these systems in settled areas, communities can ensure continued fiscal responsibility for maintenance and management of stream systems for years to come. With that, we respectfully acknowledge that Richards Creek is situated within the ancestral lands of Cowichan Tribes. 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.

Stewardship and respectful management of water systems is community-driven. We would like to acknowledge and thank all those who made contributions to the EAP process, shared their knowledge, and assisted in the creation of this document. Local waterways connect our landscapes, natural commons, and communities. EAP is one tool that can be utilized in building a legacy of continued care.

Introduction

Natural assets possess inherent value, yet determining the magnitude of this value is subjective and multifaceted. From a financial and municipal asset management perspective, placing monetary value onto natural assets within communities allows allocation of baseline budgeting for their ongoing maintenance and management. EAP enables such calculation by recognizing a stream system as a land use and finding the financial value of the area of the stream system.

Communities track the financial value of constructed assets within municipal asset planning on an annual basis to maintain these assets which support quality of life and property enjoyment. During a time of climate crisis and environmental change, it is increasingly pertinent to apply strategies to maintain and manage natural assets within communities to ensure their current and long-term health, thereby servicing all elements of the ecosystem that benefit from it. While it is recognized that financial valuation of natural assets is not compatible with all perspectives, it is one method to apply ongoing attention to natural assets within communities. Further, this attention toward the maintenance and management of natural assets aids in combating further environmental degradation or deficit resulting from human development, allowing these natural commons to be enjoyed by all communities within the surrounding environment.

EAP provides municipal governments and communities with a methodology and metrics to integrate ecological assets into municipal asset management. Regarding land use and conservation to be of equal value, EAP advocates for the same budgeting considerations towards maintenance and management of stream corridor systems (and 30m beyond on either side of the stream) as is placed on municipal infrastructure. Valuing these areas on a specified dollar per square metre basis informed primarily by BC Assessment data, EAP provides accessible baseline figures to be addressed by municipal governments and communities. Because these natural assets are shared by the public, EAP views these areas as a natural commons, requiring a shared responsibility to maintain and manage. While primarily prepared for municipal governments, EAP analyses benefit all of society by providing a baseline figure for annual budgeting for natural asset management, allowing for operationalization of ecological accounting and landowner compensation in riparian restoration. EAP analyses can be tailored to community needs and can analyze the condition and value of the land underlying the natural commons up to 230m on each side of the stream, and previous investments put into the stream by property owners, the local government, and stewardship groups. The analyses can indicate the level of riparian deficit resulting from alteration of the stream corridor by land use (subdivision and development). The community may use the indicated riparian deficit to consider shared responsibility for stewardship of the natural commons.

Recognizing the critical importance of our natural commons and the pressing need to address riparian deficits, EAP provides baseline information to foster collaborative partnerships and prioritize the ongoing management of natural assets. Opportunities for these partnerships are far-reaching, including potential for alliances between governmental bodies, communities, environmental organizations, and landowners with a shared goal of enhancing ecosystem health and resilience, and shared enjoyment of natural commons now and in the future. For more information about EAP, please refer to Appendix A.

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, 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 financial 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 (30m 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. The methodology produces relatively consistent and unbiased results. While EAP uses British Columbia (BC) Assessment data to quantify allocations for maintenance and management, the 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

[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

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 for mobilization of natural asset management now and in the future.

Richards Creek Background

Located in North Cowichan and the Somenos Basin, Richards Creek spans from the Crofton Lake Reservoir to Somenos Lake. While the primary water flow of Richards Creek is from the Crofton Lake Reservoir, it also receives flow from several springs and serves as catchment for Mount Richards and Maple Mountain.[2,3] Richards Creek is comprised of a varying degree of ecological health, with upper reaches proving relatively intact, and lower stretches encountering flooding despite ditching in the 1970s[3] and dredging in 1983.[4] Regardless, Richards Creek is a fish-bearing stream, and supports small populations of juvenile coho salmon, cutthroat trout, chum salmon, steelhead trout, and rainbow trout.[5,6] Some of these populations relocate to Richards Creek from Somenos Lake during the summer months as an escape from an agriculturally developed habitat, however, Richards Creek lacks optimal conditions to support healthy populations.[7] One observed location of viable salmon habitat is in the upper reaches of Richards Creek near Richards Creek Trail.[8] However, this is somewhat of an anomaly as many

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[2] Demers, E. (2016). *Water quality and stream invertebrate assessments for Richards Creek North Cowichan, BC, 2008-2015*. Vancouver Island University. https://www.viurrspace.ca /server/api/core/bitstreams/4c0c94f5-bb8b-4757-9035-75fa07bd3bbc/content

[3] Burns, T. (1999). *The Somenos - Quamichan Basin, watershed atlas and fish production plan*. Lanarc Consultants Ltd. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/27449.pdf

[4] Sluys, C. (1986). Agricultural land drainage in British Columbia: the Richards Creek - Somenos Creek example [Unpublished master's thesis]. Simon Fraser University. https://summit.sfu.ca/_flysystem/fedora/sfu_migrate /6035/b15324138.pdf

[5] Burns, T. (2002). *A salmonid production plan for the Cowichan valley regional district*. Cowichan valley regional district. https://a100.gov.bc.ca/pub/acat/documents/r8457/cvrd_ 1166129937987_0869bfaec5f44733ba 1d9e68890f6dcb.pdf

[6] Guimond, E. & Sheng, M. (2005). *A summary of water quality monitoring in the Somenos Basin Pacific Salmon Commission*.

[7] Preikshot, D., Willmott, T., & Lange, J. (2015). Somenos basin Coho Salmon summer habitat assessment. Madrone Environmental Services, Duncan BC. https://static1.squarespace com/static/5bf5e80b4eddecf99a694748/t/5c193c0acd8366c34717d91e/1545157646313/Somenos+Basin+Coho+Salmon+Habitat+Assessment+-+Preikshot+2015.pdf

[8] Demers, E. (2016). *Water quality and stream invertebrate assessments for Richards Creek North Cowichan, BC, 2008-2015*. Vancouver Island University. https://www.viurrspace.ca /server/api/core/bitstreams/4c0c94f5-bb8b-4757-9035-75fa07bd3bbc/content

areas along Richards Creek lack sufficient area of healthy riparian zones and vegetative cover that support fish habitat.[3,5]

Segments of Richards Creek encountering challenges primarily lie downstream of Richards Creek Trail. These lower stretches are neighbored by agricultural land before the Creek reduces to a lower flow around and downstream of Herd Road Bridge. Challenges associated with this lower flow and low gradient lead to dissolved oxygen levels in the areas of Richards Creek spanning from Herd Road Bridge to Somenos Lake,[9,10,5] confirmed by consistent sampling by VIU students between 2008-2015.[8] These factors, coupled with regional flooding during winter and early spring,[11] ongoing challenges with invasive vegetation,[12] climate change,[13,14] and toxic algal blooms in Somenos Lake downstream are some challenges associated with Richards Creek. The Municipality of North Cowichan requested an EAP analysis of the entirety of Richards Creek, with specific focus on the agricultural area between Richards Trail and Herd Road, in order to gather a baseline figure for maintenance and management of these areas. In this study, the agricultural focus area has been calculated with intent to provide MNC a baseline figure to support consideration of payment to agricultural landowners for ecological services. For a full review of Richards Creek please refer to Appendix C.

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[9] Craig, J.D.C. (2008). *Crofton Lake/Richards Creek habitat study - final report May 2008*. Habitat conservation trust foundation. https://static1.squarespace.com/static/5bf5e8 0b4eddecf99a694748/t/5c101be2c2241b9b67355990/1544559600357/Richards+Ck+habitat+study+-+BCCF+2008.pdf

[10] Craig, J.D.C. (2009). *Crofton Lake-Richards Creek flow augmentation - HCTF final report 2008-2009*. BC conservation foundation. Habitat conservation trust foundation. Publication No. (23735). https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=23735

[11] M. Miles and Associates Ltd. (2005). Hydrological assessment of flooding in upper Richards Creek Pastula v District of North Cowichan. https://static1.squarespace.com/static/ 5bf5e80b4eddecf99a694748/t/5c1948a6898583b2f4af2055/1545160913413/Richards+Creek+flood+assessment+-+Miles+2005.pdf

[12] Dewar, A. (2021). 2021 *Somenos Creek parrot's feather report*. Somenos Marsh Wildlife Society.

[13] Barron, R. (2023). *Lack of water licenses have many Cowichan farmers worrying about the future*. Cowichan Valley Citizen. https://www.cowichanvalleycitizen.com/local-news/lack-of-water-licences-have-many-cowichan-farmers-worrying-about-the-future-3118007

[14] Cowichan Valley Regional District. (2020). *Cowichan Valley Regional District drinking water and watershed protection strategy (2020-2030)*. https://cvrd.ca/DocumentCenter/View/1020 39/FINAL-CVRD -DWWP-Full-Strategy-2020

Figure 1: Map of Richards Creek Watershed

Figure 1: Map of Richards Creek Watershed

Research Question

In this study, the entirety of Richards Creek has been analyzed through GIS software and site visits. One area of focus lies between Richards Trail and Herd Road Bridge, where agricultural properties abut the creek. The research question of this study is: What is the feasibility of payment to agricultural landowners for ecological services on parcels abutting Richards Creek, as one method to apply riparian stewardship? The EAP process determines the value (NCA) of sample reaches of the riparian corridor and suggests an annual budget for its maintenance and management. This budget can indicate a compensation amount that might be paid to agricultural landowners with parcel area abutting Richards Creek for engagement in restoration activities, maintenance, and enhancement. The research focused on maintenance and management in a sample portion of the creek, targeting areas directly upstream from and within 'problem areas', and downstream from areas of established riparian health. Works undertaken will serve to further enhance the entire stream system. This strategy ties into the concept that restoration in one area positively impacts the entire community, and that these riparian areas are part of a natural commons of shared responsibility.

A similar research question has been explored in a previous EAP analysis: Bertrand Creek in the Township of Langley, in which they looked to a project named the Langley Ecological Services Initiative to perform maintenance and management activities on Bertrand Creek's riparian corridor. Recommendations from this study included advising the Township of Langley to allocate an annual maintenance and management parcel fee to the creek, and work with parcel owners to find and secure funding sources in instances requiring more costly intervention. The Bertrand Creek report also suggested exploring tools and titles such as covenants to protect the riparian areas at risk, and to use EAP's tailored NCA per parcel as a "unit ceiling rate" for compensating parcel owners. If adopted, the report stipulated that this ceiling rate can be scaled up on a case-by-case basis depending on intervention required to the agricultural parcels.[15] These recommendations from the Bertrand Creek report can be transferred to the context of Richards Creek, by deducing the NCA 1% calculation for agricultural land parcels between Herd Road and Richards Trail, and proposing this as a "unit ceiling rate" per square metre to compensate parcel owners. Strategies to secure this funding and execute will require further investigation, however, this report can propose this initial figure.

[15] The Partnership for Water Sustainability in BC (2022). Bertrand creek- A natural commons in the township of Langley: Use of the ecological accounting process to establish the 'financial case for the stream system'. Author.

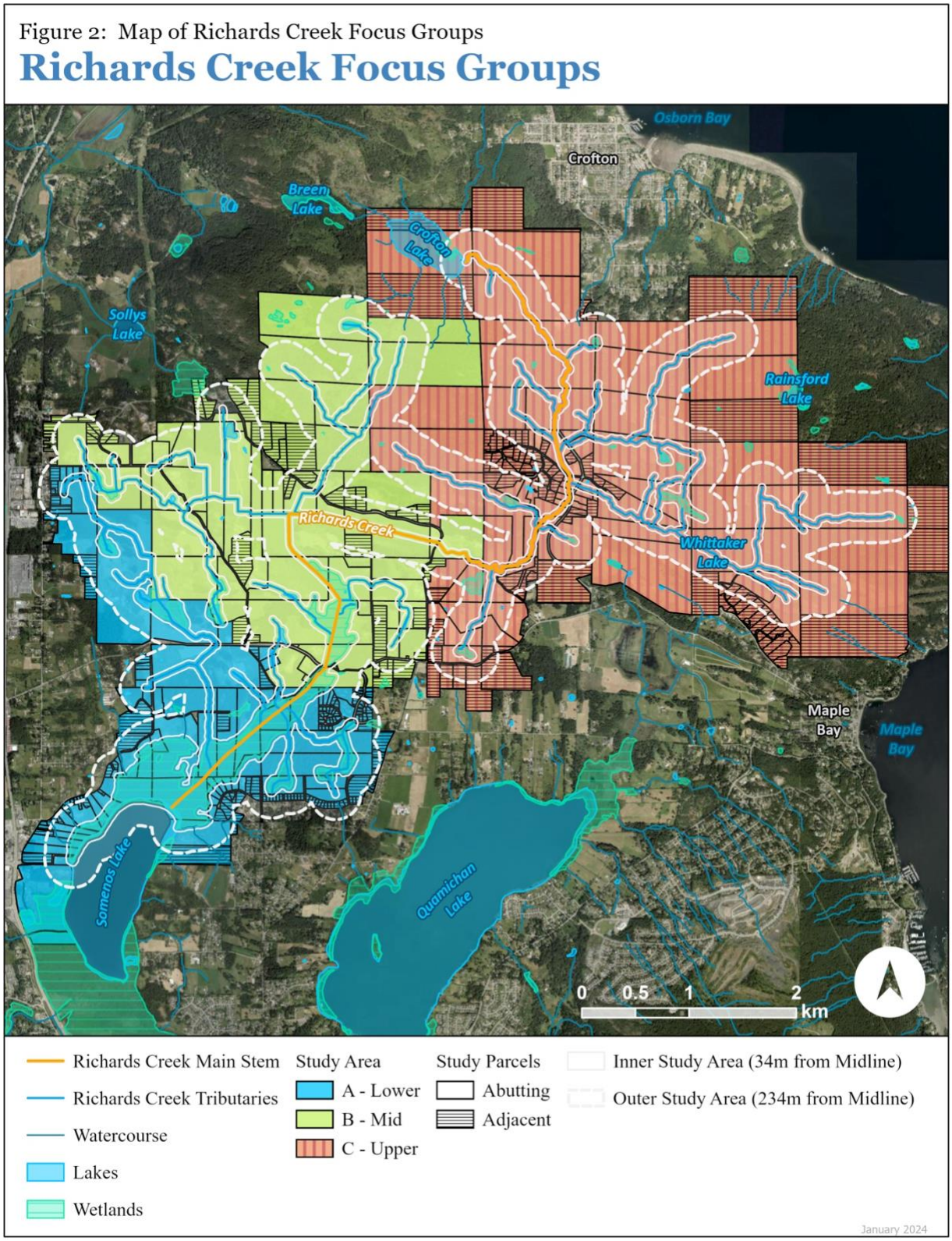

Figure 2: Map of Richards Creek Focus Groups

Methodology

This study drew upon EAP Steps 1-3, with the addition of GIS mapping of impervious surfaces in the Outer Study Area (OSA) of the entire creekshed. To allow comparison between different land use along Richards Creek, the stream was segmented into sample areas that represent the lower, mid, and upper sections of the stream. These areas are referred to in this report as Subset A, B, and C, respectively. The upper reach begins at the headwaters of Richards Creek at Crofton Lake and continues downstream to Richards Trail. Compared to downstream sections, this section is more forested than sites downstream, is home to a few residential subdivisions, and displays overall higher levels of riparian health. The mid section accounts for the areas between Richards Trail and Herd Road, reflecting primarily abutting agricultural parcels. The mid-section includes four main tributaries that feed into the main stem of Richards Creek. To isolate agricultural parcels deemed important for the overall ecological function of Richards Creek, the mid section of the stream is further parsed out to reflect a subset of farm designated parcels along the main stem. The intent of this subset is to help answer the research question of the study by offering informed baseline EAP metrics for some of the parcels most influenced by agriculture along the stream. Finally, the lower section continues past Herd Road and ends at Somenos Lake, reflecting a more degraded section of creek according to the literature review. Throughout all sections of the stream, farm designated parcels were identified by cross-referencing addresses with Farm Credit Canada data, in which active farms were identified. These farm designated parcels were separated from non-farm designated parcels for comparison and analysis.

Step 1: The calculation of the Natural Capital Asset (NCA) financial value

Streams as natural assets 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. The NCA calculation finds the value of a strip of land 30m wide on either side of Richards Creek, which generally aligns with the Riparian Assessment Area as defined in the Riparian Area Protection Regulation. Notably, the Riparian Area Protection Regulation also considers areas abutting ravines (10-30m from the top of bank depending on the size of ravine) as part of the Riparian Assessment Area. EAP analysis only considers the 30m of land directly abutting a stream as the Inner Study Area (ISA), and only this area is considered for NCA calculations.

The land value assessment of the ISA comes primarily from BC Assessment, which is the provincial agency responsible for standardized land valuation in BC. Farmland values are not captured reliably by BC Assessment so the value of Farm Designated parcels comes from Farm Credit Canada, which provides an accurate summation of farmland before subsidies as reflected in BC Assessment data. The total value of all land within the ISA, from both BC Assessment and Farm Credit Canda, is added together. This is considered the combined NCA value of the area occupied by 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 the ISA 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 Richards Creek brings to the community. In this case, there are two NCA values: one reflecting the entirety of Richards Creek, and one reflecting the focus area indicated in the research question above, which is from Richards Trail to Herd Road Bridge.

Step 2: The calculation of a suggested Maintenance and Management budget

This step suggests what MNC could spend on maintenance and management on the entirety of Richards Creek to maintain the stream's capacity to function as an asset for the community. The NCA value derives from the aggregate assessed value (m^2), or Farm Credit Canada value, of parcels in the sample area. The target for annual maintenance and management is based on 1% of the NCA value for a section or entirety of a stream. Allocating 1% of an asset's value to its maintenance is standard practice in constructed asset management such as residential construction[16] and local government budgets[17,18]. EAP assumes that built assets, such as roads or recreational facilities, and natural assets, such as riparian corridors, each deserve a fair share of a community's resources. As such, 1% of the stream's NCA value is suggested to be allocated to the maintenance and management of the riparian corridor.

The method to find the NCA amount requires establishing the financial value of a sample of parcels based on area (m^2). The value per m^2 could be used to establish a ceiling rate for compensation to parcel owners who allow a portion of their land to be committed to maintenance and management works.

Step 3: Investigate the Riparian Deficit

NCA values can inform a Riparian Deficit, which indicates area where more spending on riparian maintenance in areas of the stream system 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 more dense development generally have higher land values. If more development is present in the 30m riparian setback, this means that higher NCA values could indicate that riparian condition is at a higher risk of degradation. We could justify spending more on maintenance in these areas with higher NCA values both because the riparian area may need more M&M, and because the community may be deriving more value from the stream in these areas. These are areas with a Riparian Deficit: more spending on the riparian area is needed to maintain the capacity of Richards Creek as an asset.

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

Note: comparisons with actual measures of ecosystem health are needed to reinforce this concept, and it is recommended that this information will spur further investigation. While this study drew from publicly available data and field visits, it is recommended for local governments

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[16] Scotiabank (2021). How much should I budget for home maintenance costs? https://www.scotiabank.com/ca/en/personal/advice-plus/features/posts.how-much-should-i-budget-for-home-maintenance-costs.html#:~:text=Learn%20more-,1%25%20rule,%245%2C000%20per%20year%20for%20maintenance

[17] City of Vancouver (2023). 2023 Budget and Five-Year Financial Plan. https://vancouver.ca/files/cov/2023-budget-final.pdf

[18] City of Nanaimo (2023). 20 Year Investment Plan and Asset Management Plan Update. https://www.nanaimo.ca/docs/departments/finance/20-year-investment-plan-and-asset-management-plan-update-june-2023.pdf

to cross-check results with internal data sources about riparian condition that might be integrated with the Riparian Deficit concept.

Results

Of the 425 parcels considered in the analysis of Richards Creek, 182 (43%) are abutting parcels used in the main NCA calculations and the remaining 243 (57%) parcels are used to provide context and inform impervious surface coverage analysis (Table 1). To allow comparisons between different reaches of the stream, these parcels are divided into upper stream, mid stream, and lower stream groups. While all three stream segments are roughly equivalent in stream length, the lower watershed has the lowest proportion of abutting farm designated parcels (13.7%). In comparison the highest proportion of abutting farm designated parcels are in the mid section which contains 44.2%, which is more than the lower and upper regions combined (13.7% and 17.5% respectively). The fewest parcels with Agricultural Land Reserve (ALR) designation were found in the upper stream (21.5%), followed by the lower stream (44.8%); the highest proportion was in the mid stream (71.4%).

The lower number of ALR designations in the upper watershed is supported by observations of large, low value parcels predominately covered by forest. The findings in Table 1 also indicate the higher number of agricultural parcels observed in the mid stream area, as it has the most abutting farm designated parcels and parcels in the ALR. Parcels in the upper section are 63% larger and have assessed values that are 19% lower than the average of abutting parcels along Richards Creek (Table 1). In comparison, parcels in the mid section are 20% larger in area and have assessed values that are 8% lower than the average of abutting parcels (Table 1). Lastly, the lower section of the stream is more heavily influenced by residential uses as parcels here are about 21% more valuable and 44% smaller than the average parcel along Richards Creek (Figure 1).

Table 1. Parcel Summary

Parcel Group	A - Lower	B - Mid	C - Upper	Total
Total Number	192	98	135	425
Abutting	73	52	57	182
Adjacent	119	46	78	243
In ALR	86	70	29	185
Not in ALR	106	28	106	240
Abutting Farm Designated	10	23	10	43
Stream Length thru Parcel Area (km)	23.66	25.07	24.14	72.87
Average Abutting Parcel Value ($) per m^2	14.51	11.10	9.77	12.03
Average Abutting Parcel Size (ha)	6.21	13.44	18.18	11.18

Ecosystem Valuation

Results of this EAP study indicate that the value of Richards Creek to the community is approximately (CAD) $31.5 million, meaning that each linear metre of the stream is worth (CAD) $433. (Table 2). Based on these values, it may be reasonable to spend about (CAD) $ 315,450 annually on the maintenance and management of Richards Creek and its tributaries (Table 3). A useful place to begin might be in the agriculturally developed lands in the mid-section of this analysis, which was a focus area in this review. If beginning here, results indicate that $28,328 is a reasonable amount to allocate towards maintenance and management in this area.

Though differences between stream segments are relatively small when compared to other EAP studies of streams on Vancouver Island, there are sightly higher per area NCA values in the lower watershed compared to mid and upper sections. In the lower watershed, NCA values are (CAD) $7.18 per m^2 which is 9% to 35% higher than in the mid and upper reaches respectively. The likely reason for this is likely the contribution of higher value residential parcels in the lower watershed which may place a higher value on the benefits of the stream and related NCA amounts. This result generally supports the riparian deficit concept as the upper section of the stream has less development near the stream which results in lower NCA values. This reduced development near the stream may also translate to improved riparian health in these areas with low NCA values. The reverse may also be true where higher NCA values in lower sections of the stream correspond with higher levels of development (thus increasing land value) and potentially greater infringement on the riparian area.

Table 2: NCA Summary Table

Group	Stream Length (km)	Parcels	Natural Commons Asset Values		
			Total $	$ per m	$ per m^2
A – Lower	23.66	73	12,463,094.98	526.78	7.18
B – Mid	25.07	52	10,003,036.49	398.95	6.60
C – Upper	24.14	57	9,078,682.27	376.05	5.30
Weighted Averages				**432.87**	**6.34**

Table 3: Maintenance and Management Budget

Group	NCA Total ($)	M&M ($)
A – Lower	12,463,094.98	124,630.95
B – Mid	10,003,036.49	100,030.36
C – Upper	9,078,682.27	90,786.82
Total	**31,544,813.74**	**315,448.14**

Ecosystem Influence

Table 4. Impervious Area Summary for Group A, B, and C

Row Labels	Parcels	OSA Total Area (m^2)	OSA Impervious Area (m^2)	Percent of OSA (%)	ISA Total Area (m^2)	ISA Impervious Area (m^2)	Percent of ISA (%)
A - Lower	192	4,513,783.63	205,441.56	4.55	1,683,436.35	13,504.42	0.80
B - Mid	98	6,430,115.88	266,240.87	4.14	1,462,513.28	27,986.47	1.91
C - Upper	135	7,835,725.37	161,372.95	2.06	1,490,001.47	22,379.08	1.50
Total	**425**	**18,779,624.88**	**633,055.38**	**3.37***	**4,635,951.10**	**63,869.97**	**1.38***
							***Total percent of OSA and ISA have been averaged.**

When referring to Table 4, it is evident that the lower reaches Outer Study Area (OSA) have the highest proportion of impervious surface (approximately 5%) when compared to the OSA of the mid and upper reaches (with approximately 4% and 2%, respectively). However, the lower reach also has the lowest amount of impervious surface coverage in the Inner Study Area (ISA) of approximately 1%, compared to approximately 2% in the mid reach, and 1.5% in the upper reach. Further, the ISA in the lower reach of Richards Creek also amounted to the largest size (m^2). When looking at the sizes of the ISA and OSA in the lower study area, it reflected that there was fifteen times more impervious areas in the OSA than the ISA (Table 4). While this finding might seem to contradict the riparian deficit theory of high impervious surface coverage leading to lower ecological health, it might be reasonable to argue that, based on aerial imagery and research conveyed in the literature review attached in Appendix C, denser development within the ISA of the Creek may not be possible due to stagnant, slough-like conditions.

Table 5: Subset Area B and C Parcel Comparison: Richards Creek Main Stem

	Main Stream – Farm Designated	Main Stream – not Farm Designated	All Tributaries – Combined Land use (Same as Table 1,2,3)
Subset B – Mid – Herd Road Bridge to Richards Trail			
Number of Parcels*	7	5	52
Average Parcel Size (ha)	18.7	14.3	12.9
NCA Total Values ($)	2,837,864	1,063,008	10,003,036.49
NCA ($) per m^2	7.88**	4.28	6.60
ISA Impervious Area (%)	0.31	1.39	1.91
Subset C – Upper – Richards Trail to Crofton Lake			
Number of Parcels*	3	19	57
Average Parcel Size (ha)	13.6	14.1	18.9
NCA Total Values ($)	1,072,873	1,681,695	9,078,682.27
NCA ($) per m^2	7.88**	3.63	5.30

ISA Impervious Area (%)	0.80	2.62	1.50
*All values are abutting parcels only. **Farm designated parcel values are drawn from Farm Credit Canada and are allocated by region.			

Based on lower riparian quality in the lower study area, Table 5 reflects the differences between the mid and upper reaches of Richards Creek, labeled as Subset B and C, respectively. As greater riparian health in Subset B and C have been observed, a comparison analysis of the two subsets was then completed. As outlined previously, Subset B contains a larger concentration of farm designated and ALR land parcels abutting the main stem of Richards Creek (Table 1). While Subset C has three farm designated parcels, they are of smaller size than the seven listed in Subset B. Meanwhile, Subset C has a higher average parcel size when all tributaries were combined when compared to Subset B, which may account for the higher density of forested parcels noted (Figure 2). The combined NCA value of parcels in Subset B is also higher than that of Subset C, supporting the deduction that Subset B contains more densely populated parcels, and while they are agricultural, this subset does have a slightly higher percentage of impervious surfaces than Subset C, which is the only section to still house viable salmon habitat.[5]

As there is strong evidence in previous EAP studies that high NCA values correlate with a high level of riparian deficit, or ecosystem degradation, it would make sense to target Subset B as a site for restoration, especially if presented with an opportunity to collaborate with willing landowners. In this case, and to provide a baseline figure in response to the research question, the combined NCA value of the farm designated parcels abutting Subset B is $2,837,864, equating to a baseline allocation of $28,378.64 for annual maintenance and management in this area, and offering a baseline compensation of $7.88 to agricultural landowners for each m^2 undergoing maintenance and restoration ($78,800 per hectare).

Practical Applications

To address the research objective of this study and provide justification for a payment for ecological services program on agricultural lands abutting Richards Creek, this study finds that an annual baseline maintenance and management figure of $28,378.64 is required to engage in effective restoration (Table 5). This figure is based on farm designated parcels as designated by Farm Credit Canada and, when engaging with agricultural landowners, suggests a baseline compensation of $7.88 per m^2 or $78,800.00 per hectare for those willing to engage in ecological restoration initiatives upon their land abutting Richards Creek. When NCA value is combined across the entirety of Richards Creek and its tributaries, a larger $315,488.14 maintenance budget is suggested, with $100,030.36 (Table 3) attributed to the section of stream between Herd Road and Richards Trail (subset B).

To mobilize these concepts, it is necessary to implement funding pathways to ensure annual investment into maintenance and management of stream systems. It is also necessary to track all maintenance and management investment of regional creeksheds to compare to EAP analyses. As Richards Creek is facing significant degradation to the lower portions of the creek and retains a fair level of ecological integrity in the reaches upstream of Richards Trail, enhancing quality of

abutting agricultural parcels in the thirty-metre riparian area is likely to positively impact stream quality in these areas and downstream.

As illustrated in the literature review in Appendix C, despite fair health of the upper reaches of Richards Creek, the lower reaches are of poorer quality. This reduced quality can be attributed to several factors, all relating to forms of development encroaching on the riparian area. Due to the RAPR allowing agricultural areas to develop right to the stream bank, it is not unlikely that higher levels of phosphorous, nitrogen, and fecal coliforms consistently recorded downstream these agricultural parcels from 2008-2016 may be a result of this lack of riparian buffer. It would be pertinent to examine whether ecological services along agricultural land parcels within the ISA might reduce these levels of phosphorous, nitrogen, and fecal coliforms, as well as increase vegetative cover and riparian zone. Decreasing the level of nutrient loading into Somenos Lake could play a role in minimizing its toxic algal blooms, which is only one issue the area faces as it encounters climate change and invasive species. However, it is recognized that agricultural lands provide viable income for those farming it, and every square metre counts. Therefore, offering payment for ecological services to participating landowners may be a viable option. One suggestion for this is Farmland Advantage, a program to aid in ecological service management of riparian areas on farmland parcels. Recent developments have made it now possible for Farmland Advantage to receive applications for stewardship, which is an evolution from previous cases in which areas were approached based on mapping and matching criteria. While it can be challenging to secure ongoing funding for these necessary services, gathering a baseline number for maintenance and management is a first step. EAP provides baseline information to begin addressing these issues through its maintenance and management calculation for the entirety of Richards Creek, as well as by section, including the agricultural area of focus. As the NCA represents a figure of shared responsibility due to the creekshed being a natural commons, it is pertinent to seek out equal support to that provided by the municipal government. By providing a financial case for the stream, with recognition that it is based on one method of evaluation (being parcel data and defended by environmental observations), EAP provides a starting point towards informed annual budgeting towards the stewardship of riparian areas.