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Assessing the Value of a Park in a Rural-Urban Fringe Zone: A Case Study of Kenna Cartwright Nature Park in the Interior of British Columbia

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Abstract

This study estimates the value of green infrastructure and ecosystem services of the Kenna Cartwright Nature Park in Kamloops, British Columbia (B.C.). The 749 ha municipal park is considered the largest in the province of B.C. and the ninth-largest in Canada. The methodology allows for capturing natural, human, social, and built capital through an "opportunity cost" assessment of green infrastructure. It integrates the perceived benefits of urban parks found in numerous studies from stated preference methods and estimates the annual future growth rate of the value of ecosystem services. Kenna Cartwright Nature Park is estimated to be worth $2.96 billion and yields conservatively $45.7 million in annual ecosystem services or a 1.5% yield using a European transfer function, and $58.6 million per year or a 2% rate of return using the global transfer function. On a Kamloops per-capita basis, Kenna Cartwright's ecosystem services yield a minimum of $500 per year, and each person has $28.8 thousand worth of green infrastructure capital equally distributed. Kenna Cartwright Nature Park represents 20% of the value of all single-detached houses in Kamloops. For the lower, more conservative 1.5% yield, the annual ecosystem services are estimated to increase by 1.96% per year, similar to the long-run growth rate of Canada's standard of living of 2%, measured by GDP per capita.

Keywords: Benefit transfer, ecosystem services, equivalency principle, green infrastructure, public goods

Évaluation de la valeur d'un parc en zone périurbaine : une étude de cas du parc naturel Kenna Cartwright à l'intérieur de la Colombie-Britannique

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Résumé

Cette étude estime la valeur des infrastructures vertes et des services écosystémiques du parc naturel de Kenna Cartwright à Kamloops, en Colombie-Britannique (C.-B.). Le parc municipal de 749 ha est considéré comme le plus grand de la province de la C.-B. et le neuvième plus grand au Canada. La méthodologie permet de saisir le capital naturel, humain, social et bâti grâce à une évaluation du « coût d'opportunité » de l'infrastructure verte. Il intègre les avantages perçus des parcs urbains trouvés dans de nombreuses études à partir de méthodes de préférences déclarées et estime le taux de croissance annuel futur de la valeur des services écosystémiques. Le parc naturel de Kenna Cartwright est estimé à 2,96 milliards de dollars et produit de façon conservatrice 45,7 millions de dollars en services écosystémiques annuels ou un rendement de 1,5 % en utilisant une fonction de transfert européenne et 58,6 millions de dollars par an ou un taux de rendement de 2 % en utilisant la fonction de transfert globale. Sur une base par habitant à Kamloops, les services écosystémiques de Kenna Cartwright rapportent au moins 500 $ par an, et chaque personne dispose de 28 800 $ en capital d'infrastructure verte répartis également. Le parc naturel de Kenna Cartwright représente 20 % de la valeur de toutes les maisons individuelles à Kamloops. Pour le rendement inférieur et plus conservateur de 1,5 %, les services écosystémiques annuels devraient augmenter de 1,96 % par an, ce qui est similaire au taux de croissance à long terme du niveau de vie du Canada de 2 %, mesuré par le PIB par habitant.

Mots-clés : transfert de bénéfices, services écosystémiques, principe d'équivalence, infrastructure verte, biens publics

1.0 Introduction

It is challenging to envision cities in the absence of dedicated green space. However, as urbanization continues to intensify, pressure is mounting on the trade-off between two ecosystems, urban and nature, requiring further research to guide planners to "make cities more inclusive, safe, resilient, and sustainable" as per the United Nations sustainable development goal 11 (Grimm et al., 2008; Seto et al., 2012; Aronson et al. 2014; Ives et al., 2016; United Nations Department of Economic and Social Affairs [UN DESA], 2018).

According to the United Nations, 68% of the world's population will live in an urban area by 2050, up from 55% in 2018 (Huang & Seto, 2019, UN DESA, 2019). With the world population currently at 7.8 billion and expected to reach 9.7 billion in 2050, the urban population will increase by 2 - 3 billion (Seto et al., 2012). The most urbanized geographical region is North America, with 82% living in urban areas (UN DESA, 2019).

As cities grow, their footprint spills over into suburban areas, known as urban sprawl. This spillover creates friction between rural and populated urban areas. The result is a loss of natural capital and, consequently, a loss of wildlife habitat, declining biodiversity, and loss of carbon stored in vegetation biomass (McKinney, 2008; Seto et al., 2012, McDonald et al., 2020). Rising incomes and lower transportation costs can explain this suburban sprawl and lifestyle living. These lifestyle trends for urban sprawl can also be explained through sorting effects whereby people are pulled towards the suburbs for the attractive amenities it offers and pushing others out because of inner-city problems (Nechyba & Walsh, 2004).

In addition to the urban-suburban sprawl issues, concerns also arise between undeveloped and agricultural land with urban development, known as rural-urban fringe or peri-urban transitional zones (Simon, 2008; Sharp & Clark, 2008). Diagnosis, planning, and management of such zones are essential as cities extend and sprawl into the countryside (Gallent, 2006; Varkey & Manasi, 2019; Scott, 2019). For example, one way to block the urban sprawl is to allocate land space within that interface to "Greenbelts" (Taylor et al., 1995; Gant et al., 2011; Buxton & Goodman, 2003). A Greenbelt is a designated land use zone by jurisdictions to retain areas such as open spaces, nature parks, and agriculture to place a boundary to urban sprawl. An alternative proposal calls for area action plans which is a more holistic policy approach to land use (Gallent & Shaw, 2007).

The Kenna Cartwright Nature Park examined in this paper lies within this rural-urban transitional zone. The park was established in 1996 through an area action plan (Mt. Dufferin Land Use Plan, 1996). The plan was developed with input from multiple stakeholders. The plan was to request that the area be designated as a natural park to protect the wilderness features of Mt. Dufferin, for concerns of urban sprawl and consumption of valuable open space, and because of rezoning of private land due to development pressures in that area.

Green infrastructure (GI) within cities and rural-urban transitional zones has been receiving increased recognition to alleviate some of the problems of urban sprawl, and other problems cities are exposed to (Nechyba & Walsh, 2004; Tzoulas et al., 2007). Urban or nature parks, like the one examined in this paper, provide ecological benefits such as wildlife habitat, shading, carbon sequestration, climate regulation, and air quality improvements. They improve human health and wellbeing, both physically and mentally. Parks create an environment conducive to recreational, social, and cultural activities, such as a sense of place and space for social interactions. They also yield market-based benefits, increasing property values and attracting tourists, which benefits local businesses. According to Costanza et al. (2017), ecological services are "the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems." (p. 3). Future city planning, will need to consider protecting existing green space and expanding green infrastructure to accommodate growth (Pataki, 2015; Nilon et al., 2017; Seto et al., 2017; Vardoulakis & Kenney, 2019).

One way to assess the importance of green infrastructure within cities is to place a value on open space. The value does not imply commodification, a figure to assign a price tag to sell the land, but instead to use it to assess its significance due to scarcity and the ecosystem services it provides in a strained urban or rural-urban interface (Knetsch, 1962). It can be used as an accounting item to measure the city's natural capital, compute the genuine progress index, and policy formulation on infrastructure development and biodiversity conservation (Bockarjova et al., 2020). Various methods have been used in determining the value of annual ecosystem services of urban parks, such as contingency valuation, choice experiments, hedonic pricing, travel cost, and benefits transfer (McConnell & Walls, 2005; Brander & Koetse, 2011; Engström & Gren, 2017; Bockarjova et al., 2020). Constanza et al. (2014) used the benefit transfer method to determine the value of the world's ecosystem services arriving at a global value of ecosystem services estimated at US$125 trillion per year in 2007 $ U.S., significantly greater than the world's Gross Domestic Product. The study found a $4.3 to $20.2 trillion per year reduction attributed to the loss of biome land, relative to the earlier study by Costanza et al. (1997). The closest to assessing urban parks is within the urban systems biome, which was evaluated at US$6,661/ha/year for 2011. Bockarjova et al. (2020), in a recent meta-analysis of numerous existing studies, found parks as the most highly valued biomes within a city, with the most highly valued ecosystem service being aesthetics and cultural heritage. The ecosystem services provided by urban parks were valued between $12,000 and $31,100 per ha per year in USD 2016.

Sutton and Anderson (2016) offered a holistic approach to assess the value of New York City's iconic Central Park and the annual ecosystem services using a benefit transfer methodology. They used the Miller Samuel property appraisal firm's estimated real estate value of Central Park's 341 hectares. Central Park was found to be worth $528 billion. The land value reflects the urban park's value as it represents an *opportunity cost* for the real estate in which Central Park is situated. Sutton and Anderson (2016) assumed that the park yields a return just like any other form of capital (e.g., human, built, financial) in the form of ecosystem services. Historically, a well-diversified financial asset portfolio can yield a 5% return (e.g., S&P or Dow Jones Industrial Average).

Similarly, parks yield a return in the form of ecosystem services. With a 5% annual return generated from Central Park's ecosystem services, the study placed a value of $25 billion or $73 million per hectare per year. The opportunity cost approach is not new, Knetsch (1962) provided a theoretical foundation of land use and the valuation of parks in rural-urban fringe zones to reflect the opportunity cost of land not being developed.

This paper aims to use a similar approach to Sutton and Anderson (2016) to examine the value of the Kenna Cartwright vast park in Kamloops, a city of almost 100,000 population, in the interior of British Columbia. The park is located on Mt. Dufferin in a fringe rural-urban transitional zone. The following section provides a brief description of Kamloops and the park, followed by methodology and results, and ends with a discussion and concluding remarks.

2.0 Kamloops and Kenna Cartwright Park

Kamloops is a small city with a population of 97,902 (Statistics Canada, 2022) in the south-central of British Columbia at the confluence of the North Thompson and South Thompson Rivers. With beautiful natural surroundings, recreational activities are abundant throughout the year. Numerous parks are located all over the urban city. Smaller parks are within the urban area in densely populated areas, but the larger parks, for example, the 749 ha Kenna Cartwright Nature Park and the 15,712 ha Lac Du Bois Protected Provincial Park, are on the city's outskirts, creating a fringe between the urban and rural areas.

Kenna Cartwright Nature Park, named after a former mayor and long-time proponent of nature preservation, was established in 1996 (Mt. Dufferin Land Use Plan, 1996). Figure 1 exhibits a satellite image showcasing 749 hectares in size of Mount Dufferin—Kenna Cartwright on the city's western side. It is the largest municipal urban park in British Columbia and the ninth-largest municipal urban park in Canada (City of Kamloops, 2021; "10 Largest Urban Parks in Canada," n.d.).[1] Residential properties are located south of the park, while commercial properties are located on the northeast and north sides of the park. Finally, the undeveloped rural area is on the west and southwest sides, creating this rural-urban transitional zone.[2]

Figure 1: Kenna Cartwright Park, Kamloops, and British Columbia.

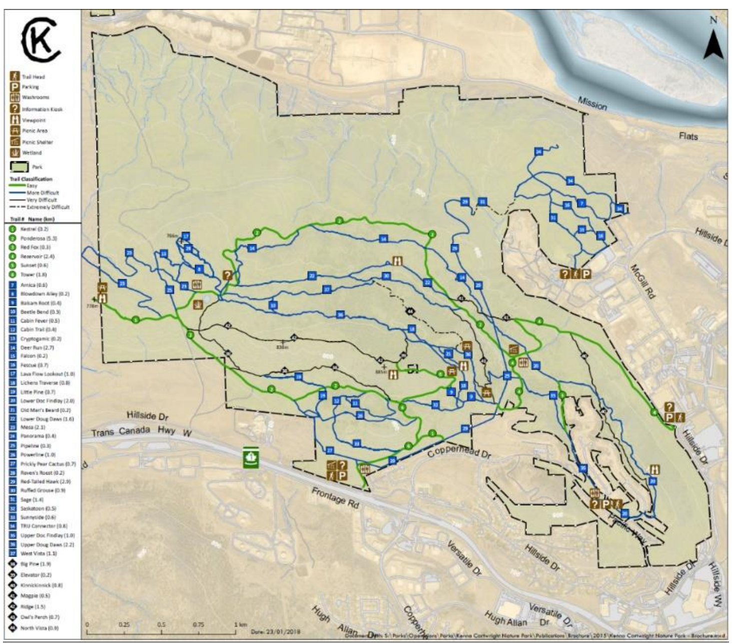
Source: Google, (n.d.). [Google Maps satellite image of B.C.] Alterations made by Jake Truscott.

[1] According to World Atlas (https://www.worldatlas.com/articles/largest-city-parks-in-canada.html) the park is 800 ha and not 749 ha. This would make the park smaller than the 10th largest park of Pacific Spirit Regional Park in Vancouver B.C. However, we use 749 ha as indicated in the Mt. Dufferin Land Use Plan, 1996.

[2] There is a correction centre northwest. Construction is currently taking place for the Kinder Morgan pipeline passing through the south side of the park towards the north end. See: https://www.kamloops.ca/sites/default/files/trail_construction_sign_36x48_v5.pdf

The ecosystem biome contains wetlands, hills, valleys, Ponderosa Pine and Douglas Fir forests, grasslands, and sagebrush. Wildlife is abundant, including numerous insects, birds, chipmunks, coyotes, deer, and black bears. The biome has been modified from its natural setting with walkways and numerous named hiking trails to accommodate recreational and cultural services provided by the park to visitors. The park's primary attraction is the vast 40 km network of gentle nature trails making this a desirable place for casual hikers, bikers, and individuals walking their dogs (see Figure 2).The scenic views are breathtaking at the top of Mount Dufferin or the northern part of the park. Numerous trails lead to lookout spots, some offering a 360-degree panoramic view of Kamloops and its surrounding nature, such as the south and north Thompson River Valleys, the astonishing beauty of Kamloops Lake, Mount Paul and Peter, and the Overlander bridge in downtown Kamloops close to the confluence of the North and South Thompson Rivers. There are no technical or extreme-rated trails throughout the site, making this park appealing to a wide range of individuals (City of Kamloops, 2021). The Mt. Dufferin Land Use Plan (1996) included 600 residential units in the Mt. Dufferin neighborhood area.[3] Population projections in the southwestern region of Kamloops, where Mt. Dufferin is located, are expected to have the highest growth, with a 43% increase by 2039, according to the updated Official Community Plan KAMPLAN 2018 section C.[4] Dufferin's population is expected to increase by 780, requiring an additional 200 single-family homes and 140 multi-family units.

Figure 2: Trails of the Kenna Cartwright Park.



Source: City of Kamloops Webpage: https://www.kamloops.ca/recreation-culture/parks-sports-fields/kenna-cartwright-nature-park

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[3] KAMPLAN is the Official Community Plan (OCP) providing direction to guide planning and land use management within the city of Kamloops with the 2018 updated version accessed at: https://www.kamloops.ca/homes-business/community-planning-zoning/official-community-plan-kamplan.

[4] The highest growth within the southwest region is in Aberdeen.

3.0 Methodology

3.1 Theory

In order to estimate the value of the park and the annual ecosystem services derived from Kenna Cartwright Park, a modified version of the *holistic* approach used by Sutton and Anderson (2016) is applied. First, the park's value is estimated using land values of built capital surrounding the park as per the equivalency principle advanced by Chiabai et al. (2013). The equivalency principle states, "based on the premise that the long-term value of a piece of undeveloped land ought to be at least the same as the value of an identical piece of land in the vicinity to which permission has been granted for development." (p. 535). The land values of residential houses in the park vicinity were converted to a per hectare basis and averaged to get a unit price. This unit price was then multiplied by the 749 hectares of park size to determine the park's estimated value.

$$V = price\ of\ land/ha * 749\ ha$$

Second, to be consistent with the empirical evidence on the value of ecosystem services provided by urban parks, we used the European and global value transfer function from the meta-analysis conducted by Bockarjova et al. (2020) to estimate the price of ecosystem services per hectare per year for the park. Even though these transfer functions are from other studies in other cities around the world, they can be applied to any park, including this park, but they require the input of Kamloops specific and study area data to make the assessment. The European transfer function was derived from 20 peer-reviewed studies yielding 81 US$ values per ha per year for various types of nature in cities, including parks. The price per hectare per year depends on spatial and study area variables (i.e., hectares, GDP per capita, population density), methodological variables (i.e., type of survey), and type of nature (i.e., park, rivers, ponds, forests). The global transfer function was derived from 60 peer-reviewed publications with 147 values. Bockarjova et al. (2020) argued that the global function yields better estimates than the European. Therefore, we report both values, but the European function gives a more conservative price.[5] Once the price is determined, the annual ecosystem services can be found by multiplying the price times 749 hectares. This method allows the integration of previous studies which assess the benefits people receive from ecosystem services parks provide.

$$ES/year = Price\ of\ \frac{ES}{ha}/year * 749\ ha$$

Where ES denotes annual ecosystem services.

Third, the yield of the park is the annual ecosystem services divided by the park's value. Sutton and Anderson assumed this yield to be 5%, but we can compute the annual rate of return as follows:

$$r = \frac{ES/year}{V}$$

[5] See note below Table 2 for the exact form of these transfer functions.

Finally, the simple Gordon dividend growth model (Gordon & Shapiro, 1956), which is used as a stock valuation method to price a stock's intrinsic value, is applied to find the future growth rate of the value of the park's ecosystem services. Analogically, the value of the park (the price of a stock) depends on all current and future ecosystem services (the dividend) discounted at the social discount rate (the cost of capital) net of the expected future growth rate of the ecosystem services (the growth rate of dividends) it provides.[6] The present value dividend growth model is, therefore:

$$V = \frac{ES\ in\ 2020}{\delta - g}$$

Where g is the annual growth rate of ecosystem services, and δ is the social discount rate accounting for the intertemporal opportunity cost for alternative social projects. It is assumed that $\delta > g$. The social discount rate is assumed to be equal to 3.5%, commonly used in cost-benefit studies for public projects such as health intervention and policies in high-income nations, including Canada (Boardman et al., 2010; Haacker et al., 2020). If the value of ecosystem services is not expected to grow over time, then the social discount rate can be used to find the park's value. However, if the value of ecosystem services is growing (declining) over time, then the effective discount rate is lower (higher) by $\delta - g$. However, in this case, the price of the park and the value of ecosystem services it provides are estimated, and thus the yield, r is determined a priori. As a result, the growth rate of ecosystem services can be found as a residual:

$$g = \delta - r$$

The growth rate of ecosystem services is equal to the social discount rate net of the yield of the park, r. Note that the yield of the park and the growth rate are inversely related and that the social discount rate will equal the yield of the park plus its growth rate. Next, the methodology for computing land values around the park's vicinity is explained.

3.2 Land Values Around the Vicinity of the Park

Land values surrounding Kenna Cartwright Nature Park were downloaded on May 5, 2021, from the British Columbia Assessment website. The British Columbia Assessment (2020) is a property assessment resource owned and managed by the British Columbia government. The Assessment Act is governed by the mandate to classify and assess the value of each land and improvements for property taxation and tax liability in British Columbia unless exempted.[7] However, its jurisdiction does not include urban parks or property owned by the various government levels, as they are exempted from property taxation. To determine the land's actual value, an assessor may consider the land's current use, location, cost and rental value, the

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[6] The dividend growth model although developed in 1956 is taught in undergraduate and graduate courses in Finance and Economics to price financial assets such as stocks which yield current and future dividends. More information can be found at:
https://corporatefinanceinstitute.com/resources/knowledge/valuation/gordon-growth-model/

[7] The assessment act can be found at:
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96020_01

selling price of the land and improvements, economic and function obsolescence, and other variables affecting the value of the land and improvements.

A total of 514 land values, the building values, the year the house was built, and the size of land in square feet of single-detached homes were collected. Land values were compared before and after 1996 to detect changes in land values, land size, and housing location. The park has 262 residential single detached housing units, on the southeastern side mainly, built before the park's establishment in 1996. After 1996 real estate developments took place adjacent to the west side of the park boundaries and established real estate zoning areas.[8] The park surrounds newer real estate properties, and there are still more real estate developments within this area as per KAMPLAN 2018 (see Figure 3). Figure 3 shows the distribution of the 514 houses. The red dots were built before 1996, and those with a green dot after 1996. The gray plots are undeveloped real estate.[9]

Figure 3: Houses built before and after 1996 with the establishment of the park.

Source: British Columbia Assessment (2020). [Property Locations: Kamloops, B.C.]. Alterations made by Jake Truscott. Retrieved from: https://www.bcassessment.ca/.

4.0 Results

4.1 Land Values Around the Park

Table 1 shows descriptive statistics of the variables of interest. The average land value is $264,535 for 514 single detached residential homes on an average lot size of 0.088 hectares. Land values range from a minimum of $208,000 to $434,000, but 75% of the values are less than $280,000. The size of the lot also ranges from 0.038 to 0.85

[8] The previous KAMPLAN 2004 indicates a first phase of construction development occurring adjacent to Dufferin Elementary School by Dufferin Park.

[9] Land not developed and also for commercial use close by the park were not incorporated into the analysis but a brief assessment is provided in the appendix to illustrate differences.

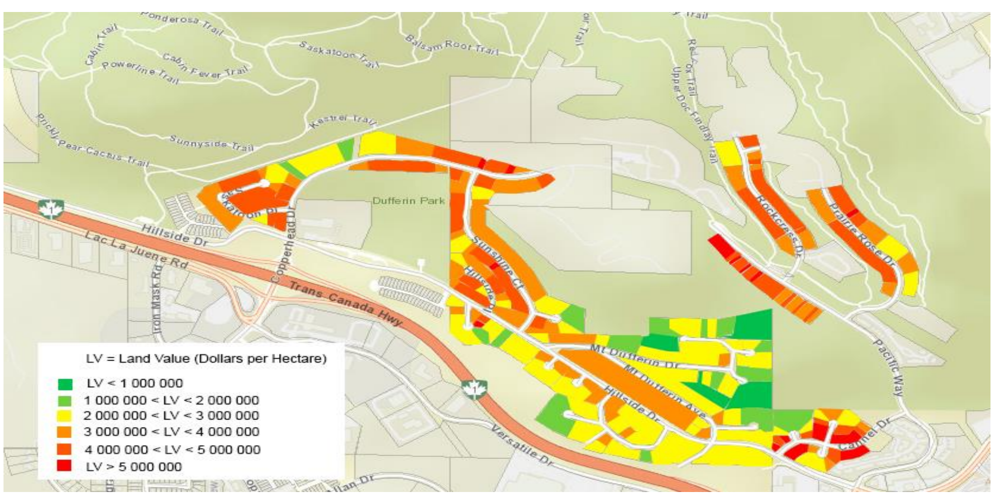
hectares. When the land values are converted on a per hectare basis, the mean land value is $3.5 million, ranging from as low as $407K to a maximum of $5.9 million.

Table 1: *Descriptive Statistics of 514 Residential Houses by Kenna Cartwright Park*

Variable	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Land Value	264,535	29,107	208,000	244,000	260,000	280,000	434,000
Building value	338,350	118,650	49,900	247,000	316,000	397,250	893,000
Year built	1994	16	1958	1976	1995	2006	2020
Size (ha)	0.088	0.058	0.038	0.057	0.072	0.098	0.850
Land value per ha	3,496,417	1,010,246	407,136	2,784,241	3,424,265	4,253,906	5,928,365

Figure 4 shows a heat map of land values per hectare. Land values south of Hillside Drive, a relatively busy street close to the Trans Canada Highway, are primarily in the $2 to $3 million per hectare range and are of a larger lot size. Likewise, land values across Hillside Drive towards northeast around Mt. Dufferin Avenue and Mt. Dufferin Drive are worth less than $3 million and are of relatively large lot sizes. The areas closer to the hiking trails of Kenna Cartwright Nature Park and around Dufferin Park, where an Elementary School is built, are primarily over the $3 range and up to $6 million with significantly smaller lot sizes.

Figure 4: Heat map of land values per hectare in and around Kenna Cartwright Park.



Source: British Columbia Assessment (2020). [Property Locations: Kamloops, B.C.]. Alterations made by Jake Truscott. Retrieved from https://www.bcassessment.ca/.

Figure 5 shows that this significant increase in land values on average per unit size has occurred after establishing the Kenna Cartwright Park in 1996, as assessed by the 2020 BC Assessment. Before establishing the park, the 2020 average land value per ha was assessed at $3.05 million. From 1996 onwards, the 2020 average land value per ha increased to $3.96 million (p-value < 0.00001) for a difference of 903K. This increase is an important finding as it states that the park's value is not diminished as more homes are built closer. However, more encroaching could lead to a reduction in value eventually. Also, before establishing the park, the average lot size was 0.1067 ha. However, after 1996 the average lot size was much smaller at 0.068 ha (p-value <0.00001).

After establishing the park, the more expensive land per ha is situated closer to the hiking trails and in the northeast area, whereby houses are surrounded by the park, with more real estate development planned. A clear, distinct pattern is observed in that the smaller the lot size, the greater the land value per unit of size, as indicated in Figure 5. Minor additions to lots that are small in size are valued highly by the market relative to small addition to lots already large in size. This result implies that it pays to subdivide the land and sell it. The yet-to-be-developed large lots shown in Figure 4 inside the park are priced significantly below the small lots per unit size. Same with the land on commercial property. The value of seven large undeveloped parcels of land inside the park was estimated at $452,000 per ha on average, and the value of the land on 12 commercial properties was estimated at 1.1 million per ha.

4.2 The Value of the Park and Ecosystem Services per Year

Table 2 shows the value of ecosystem services per ha per year at USD 50,951 derived from the European transfer function (ETF) by using the 749 ha, Canada's GDP per capita (2016 US$, PPP) of $47,567 and the City of Kamloops population density of 301.7 km² (Statistics Canada, 2017). The 2020 value of ecosystem services is estimated at CDN $45.7 million and the park's value at $2.96 billion from 1996 onwards for a yield of 1.5% and an implicit annual growth rate of ecosystem services of 2%, equaling the social discount rate of 3.5%. Using the global transfer function (GTF), the price per ha per year increases to USD 65,312, resulting in annual ecosystem services of CDN $58.6 million for a yield of 2% and a future growth rate of 1.5% per year.

Figure 5: Bid-rent curve. Year house was built on the lot, and number of properties for that year is listed beside the dots as labels. Green labels for lots built in 1996 and onwards, red labels before the establishment of Kenna Cartwright Park (1995 and before).

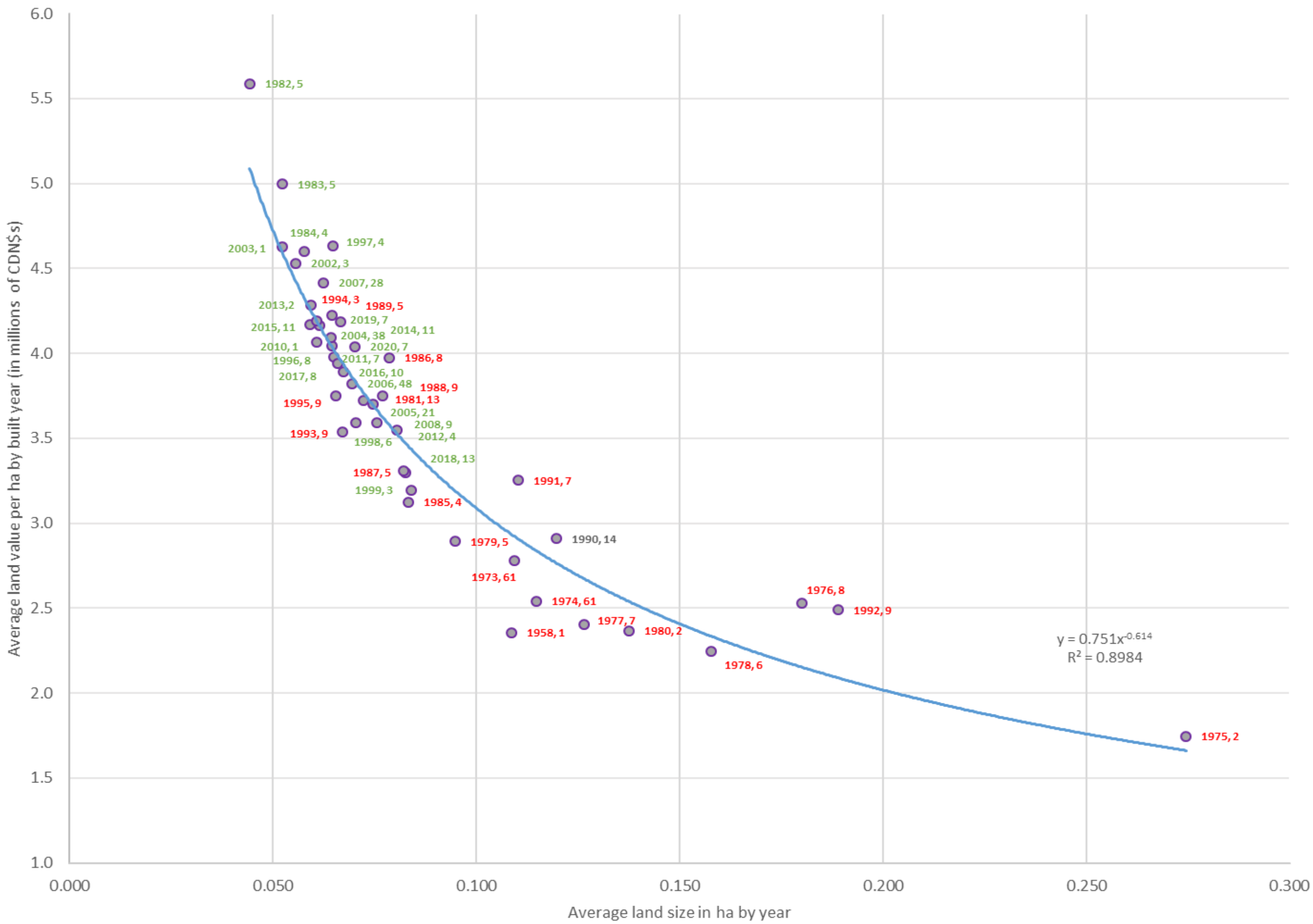


Table 2. *Value of Kenna Cartwright Park and its Ecosystem Services*[10]

Characteristics	**Kenna Cartwright Park**
Area (ha)	749
GDP per capita (2016 US$, PPP)	47,567
Population density of City of Kamloops (km^2)	301.7
European Transfer function	
Ecosystem services per ha per year (USD)	$50,951
Ecosystem services per year (CDN$, 2020 PPP)	$45.7 million
Yield from the park, r	1.5%
Growth rate of ecosystem services, g	2.0%
Global Transfer Function	
Ecosystem services per ha per year (USD)	$65,312
Ecosystem services per year (CDN$, 2020 PPP)	$58.6 million
Yield from the park, r	2.0%
Value of land per hectare – 1996 onwards ((CDN$)	$3.96 million
Value of the Park - 1996 onwards (CDN$)	$2.96 billion

Note: The 2020 Purchasing power parity CDN$ to USD exchange rate of 1.198 was obtained from https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm#indicator-chart https://data.oecd.org/conversion/purchasing-power-parities-ppp.htm - indicator-chart, *GDP per capita from the World Bank at https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD?locations=CA. Statistics Canada (2017). Census Profile, 2016 Census Kamloops, City [Census subdivision], British Columbia and Thompson-Nicola, Regional district [Census division], British Columbia. (Retrieved May 31, 2021).*

5.0 Discussion and Conclusion

Kenna Cartwright Nature Park's annual ecosystem services represent 1% of Kamloops' GDP.[11] On a per-capita basis, Kenna Cartwright's ecosystem services yield approximately $500, and each person has $28.8 thousand worth of green infrastructure capital equally distributed using the more conservative estimated value of ecosystem services of $45.7 million. Kenna Cartwright Park also represents a significant portion of Kamloops' built capital; the total number of single-detached houses in Kamloops is 23 thousand; the average price of a single-

[10] The European benefit transfer function is; $\ln\left(\frac{ES}{ha}/year\right) = 8.005 - 0.937(\ln(ha) - \ln(472)) + 1.496(\ln(GDP\ per\ capita) - \ln(28{,}007)) + 0.202(\ln(Density) - \ln(211)) + 2.402\ Park$. The global transfer function is: $\ln\left(\frac{ES}{ha}/year\right) = 7.718 - 0.964(\ln(ha) - \ln(1474)) + 1.527(\ln(GDP\ per\ capita) - \ln(23{,}026)) + 0.241(\ln(Density) - \ln(396) + 1.674\ Park$.

[11] Gross Domestic Product (GDP) was estimated to be 4.61 billion for Kamloops in 2020 (Venture Kamloops, 2018), and the population is growing with economic growth adding pressure to convert ecosystems into built capital. (Venture Kamloops economic impact 2018 report).

detached home in the first quarter of 2021 was $633 thousand (Statistics Canada, 2022). Therefore, the built capital from single-detached family homes is $14.46 billion. Consequently, Kenna Cartwright Park is 20% of the value of all single-detached houses in Kamloops.

The estimated conservative 45.7 million CDN$ per year from Kenna Cartwright Park's ecosystem services is substantially lower than that of assuming a 5% yield as per the assumption of Sutton and Anderson (2016). A 5% annual yield would be $148 million CDN$ annually instead of the $45.7 found in this study. However, in this study, the value of these annual ecosystem services is not constant but is estimated to increase at the rate of 1.96% per year, which is similar to the long-run growth rate of Canada's standard of living of 2% measured by GDP per capita. The park's low yield could be because it is highly valued as an asset and relatively riskless, not commanding a risk premium as with financial assets. Nevertheless, the yield is $58.6 million CDN$ or 2% using the global benefit transfer function. Furthermore, in order to verify if these valuations are reasonable, the Ecosystem Services Valuation database for the subset "Urban parks and forests" from the "Global Urban Green and Blue Infrastructure" biome assessed these at USD 100,225 per ha per year from 148 valuations which would yield an evaluation of this park at 90 million CDN$ or a 3% rate of return (Foundation for Sustainable Development, 2021).[12]

This study contributes to the literature on assessing the value of urban parks and their ecosystem services by using a modified version of the holistic approach taken by Sutton and Anderson (2016), following the equivalency principle developed by Chiabai et al. (2013) and using the benefit transfer functions from the meta-analysis of ecosystem services by Bockarjova et al. (2020). The approach allows for capturing natural, human, social, and built capital through an *opportunity cost* assessment of green infrastructure, integrate the perceived benefits of urban parks found in studies from stated preference methods, and provides their estimated future growth rate accounting for the intertemporal opportunity cost by discounting the flows at a reasonable social discount rate.

One of the purposes of this study was to show the value people place on Kenna Cartwright Park as a form of capital that is being preserved for its benefits. The park located in the rural-urban interface has public good characteristics in that it is nonrival, provided there is no congestion, and non-excludable, equally shared by all poor and affluent residents of Kamloops and visitors. Another purpose is to inform local administration to measure the value of its natural capital. Furthermore, policymakers should account for the market benefits and costs generated from private projects like residential or commercial forms of capital in a cost-benefit study and the environmental losses from removing nature in the area. The latter could be substantial since the social discount rate for public projects is much lower than for market-driven projects.

There are several limitations associated with the study. First, the valuation of the natural park using the equivalency principle is based on two assumptions that may not hold. First, it is assumed that previous administrative decisions were socially optimal in terms of development versus maintaining natural assets, and second, it is

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[12] The ESVD has over 6,700 value records obtained from over 950 studies out of a total of 5,000 and growing. The valuations are across all biomes, ecosystem services and countries. Information available at: https://www.esvd.info/

assumed that such decisions have considered the impact development will have on future generations (Chiabai et al., 2013). The social discount rate is assumed to be constant at 3.5%. The benefit transfer function may not be applicable, and a direct survey of visitors using valuation methods such as travel cost, hedonic pricing, or contingent valuation methods may yield different valuations that may be more representative. Kenna Cartwright is on Mt. Dufferin, and some sections are very steep and abrupt, resulting in a lower opportunity cost in terms of not being developed into a residential property. In addition, if Kenna Cartwright were to be fully open to residential development, land values might drop, not just due to encroaching and the loss of the parkland and the ecosystem services lost, but also due to the increased supply of land for housing development. Finally, the valuation of the park as green infrastructure may have been overestimated using the land value of housing units in the vicinity instead of using undeveloped land for which permission has been granted for development. Using undeveloped land would increase the yield and reduce the growth rate. However, the equivalency principle is based on a minimum valuation of undeveloped land, but the nature park is not completely undeveloped land as it has infrastructure to accommodate visitors and requires servicing. Hence, the park's land value should be at least the same as the value of an identical piece of land in the vicinity for which it has been developed (i.e., residential).[13] Finally, there are limitations with using the dividend growth model as it is based on assumptions such as a constant growth rate.

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[13] The equivalency principle states that undeveloped land "ought to be *at least* the same as the value of an identical piece of land in the vicinity to which permission has been granted for development." (*Italics* added for emphasis).

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