Parksville Wetlands Education and Outreach Program

Final Report

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Prepared by: Vancouver Island University Geography 452 students

Prepared for: The City of Parksville

Acknowledgements

The 2019 Geography 452 class through the guidance of local experts were able to experience the process of hands on consulting work involving collaboration and field work. The report was produced in conjunction with expertise of the City of Parksville, MABRRI staff, and Vancouver Island University professor Matt Bowes. This project involved the dedicated work of the following Geography 452 students: Linda Bracken, Allison Brand, Christos Doukakis, Jeffery Fontaine, Geoffrey Genge, Stephen Hextall, Aleesha Jones, Sarah Kerman, Tor Lundgren, Linden MacNeill, Colby Mahood, Caleb McIntrye, Rosalea Pagani, Alexis Smith, Sam Smith, Harry Tassell, Avery Warren and Megan White.

We would like to acknowledge and thank Snaw-naw-as First Nation for welcoming us to their traditional unceded territory where we had the opportunity to learn, research, and enjoy the beauty of nature at the Parksville Wetlands.

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Finally, we would like to acknowledge and thank the participants and citizen scientists, who eagerly attended the BioBlitz and the Parksville Open House, for their time, feedback, and interest in the project. We also acknowledge and thank the park visitors, neighbourhood citizens, and fellow trail walkers for their valuable input into our project.

Executive Summary

With the guidance of local experts, the 2019 Geography 452 (Applications in Natural Resource Management) class was able to gain hands-on experience with field work and collaboration through consultation work. The Parksville Wetlands Education and Outreach Program final report was produced in conjunction with expertise of the City of Parksville, MABRRI staff, and VIU professor Dr. Matt Bowes.

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1.0 Project Introduction

Parksville Wetlands is a unique area, being the largest city park and one of the only wetlands in Parksville (iVault Moblie, n.d.). Specifically located just inside of the west boundary of the City of Parksville, the property covers approximately 35.27 hectares. In proximity to the Parksville Wetlands are rural neighborhoods, a dog park, Springwood Elementary School, and the Inland Island Highway (Figure 1). The property is comprised of a network of trails that are accessible from Renz Road, Despard Avenue, and Coldwater Road. Parksville Wetlands is popular for walkers, children from the neighboring elementary school, dog walkers, and bikers.

Figure 1: The location of the Parksville Wetlands within the City of Parksville and Vancouver Island (map created by MABRRI)

Classified as a swampy marsh, the Parksville Wetlands have a diverse range of hydrophytic plant species and migratory birds that rely on the complex ecosystem to provide nesting grounds and food. The area is home to the Oregon fairy shrimp (*Eubranchipus oregonus*), an extremely rare species only found throughout a few locations in British Columbia and Oregon. Oregon fairy shrimp are one of the sources of food for the Virginia rail (*Rallus limicola*), whose numbers are currently decreasing due to habitat loss. Since the Parksville Wetlands contains one of the only wetlands within the City of Parksville boundaries, it provides the unique opportunity for the public to learn about the ecological value and enjoy the beauty of the land.

To portray the significance of the park, Vancouver Island University (VIU) Geography students have completed comprehensive research about the Parksville Wetlands under the guidance of VIU Geography Professor, Dr. Matt Bowes, and the Mount Arrowsmith Biosphere Region Research Institute's (MABRRI) Research and Community Engagement Coordinator, Graham Sakaki. This report outlines the ecological significance of the area, history of the land, users of the park, and history of previous landowners, such as the Ermineskin Cree First Nation. To introduce and raise awareness of the Education and Outreach proposal for the Parksville Wetlands to the public, students of VIU and the City of Parksville hosted a BioBlitz, detailed below as an integral part of the community involvement component of this report.

2.0 Community of Parksville

Census data from the 2001, 2011, and 2016 census profiles by Statistics Canada were used to analyze the current demographics of Parksville and surrounding areas, and to extrapolate potential changes to the community in the near future.

2.1 Demographic Analysis

The population of Parksville increased 4.8% from 2011 to 2016 (well below the provincial average of 5.6%), from a population of 22,493 to 23,574 people in just five years. Despite being below the provincial average, Parksville is experiencing growth faster than most of Canada, and at a rate that has been increasing since 1996. This would suggest that the population growth rate will continue to increase steadily above the national average.

It is important to note that the average age of Parksville citizens is amongst the highest in Canada at 56.2 years, compared to the national average of 41 years. This trend appears to be continuing upwards, with all age categories from 55+ increasing the fastest. However, despite the change in proportion, there is still a similar overall number of families and younger residents in 2016 as there was in 2011. This shows that while most new residents to Parksville are above the age of 55, there remains a steady influx of younger residents.

Citizens of Parksville tend to live in two person households without children, higher than the national average. This is likely due to the high rate of married and common-law residents, many of which are aged 55+.

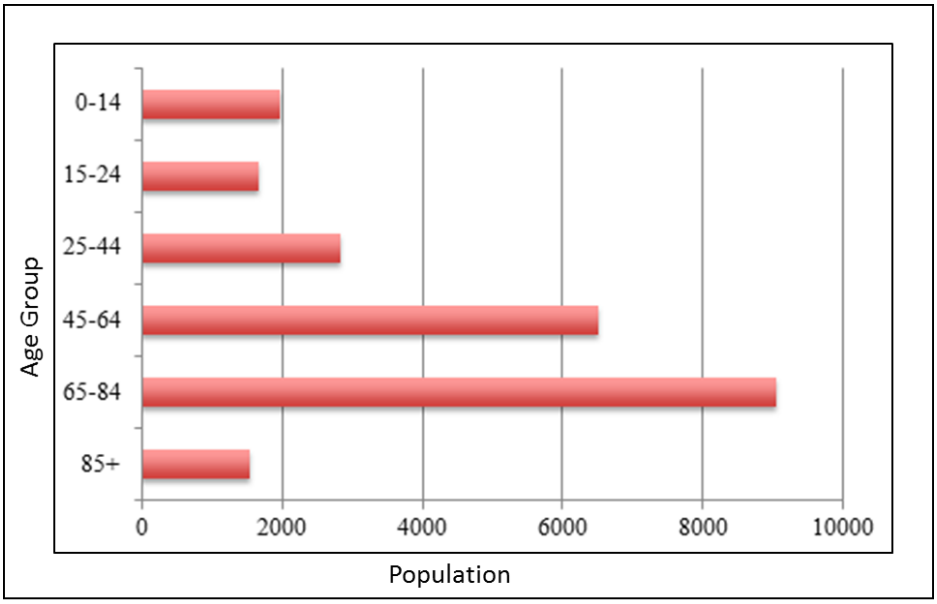

Figure 2: Population of Parksville by Age Group (Statistics Canada, 2017)

The average income of Parksville citizens is $31,918, which is slightly lower than the provincial average of $33,012. However, due to the unusually high percentage of retirees, we can consider that number to be above average for working individuals. Overall, income increased by approximately 4.7% from 2011 to 2016. This would suggest a rising annual income for the average household in the future. Additionally, it is worth noting that a majority of Parksville residents do not participate in the labour force.

2.2 Summary

The residents of Parksville and surrounding areas are amongst the oldest in Canada, the majority of which are retirees. Most of these residents live in two-person dwellings, many of which are composed of a married or common-law couple. The average household income is slightly below the provincial average, though that figure does not account for the high degree of retirees. These demographics suggest that Parksville citizens have more time for recreational activities than almost any other city in Canada.

3.0 Site Introduction

The community of Parksville utilizes the Wetlands for multiple purposes: a commuter network, water storage resource, wildlife sanctuary, and community park.

The size and position of the parkland has been critical in facilitating the development of a wildlife pathway for southern Parksville residents. The parcel is bordered by residential communities to its east and north, and is straddled by Coldwater Road to the south (Figure 1). The site is accessible from Despard Road, Coldwater Road, and Lodgepole Drive, serving as a trail pathway connecting Despard and Lodgepole. This location has resulted in the park becoming a focal point in many commuter's transit experiences, namely to students traveling to and from Springwood Elementary School and Ballenas Secondary School. The development of this wetland will be of critical importance for residents who rely on this park for daily use and service.

The Wetlands are situated on aquifer 216 near the City's water wells. The unique location and structure of the soils as a combination of sand and silt allow for the storage of one of Parksville's few water resources. Unfortunately, the aquifer has been declining at a rapid rate as of 2017, potentially due to over extraction of water resources. Recognizing and communicating the value and importance of this aquifer and its wetland manifestations will be necessary in maintaining Parksville's water system in the coming years.

The site exists, despite the aforementioned disturbances, as a region of high bioactivity, allowing for the development of many important plant and animal species. Intrinsically, wetland ecosystems carry varied and special forms of biodiversity due to their unequal distribution throughout the province and world. However, the Parksville Wetlands serves as an especially unique purpose due to its closeness to beach resources. This position allows the Wetlands to not only house species familiar to BC forests, including white tail deer, cedars, and a plethora of songbirds, but also to board several shorebirds who feast in the wetland for additional nutrients. For the sake of the many forms of life that depend on this region, it is of extreme importance that this wetland be acknowledged for its natural value.

Before its acquisition by the City of Parksville, the park was previously used as an unrecognized community park, a service which continues to pull the attention of many community members. This development was facilitated in no small part by the abundant proximity of local Parksville residents. It has been noted that the Wetlands has attracted members of bordering municipalities, such as Errington, due to its relative ease of accessibility from the highway. This pull is understandable as the area serves as an excellent location for recreational purposes of dog walking, biking, and wildlife engagement. This experiential understanding of the park could also be developed to serve as an educational tool for Parksville's educational district. By nature of its locale, it exists as a prime location for community engagement and environmental outreach.

It can be seen through this report that the Parksville Wetlands is an extremely unique and valuable resource to the community of Parksville due to its geographic position. By utilizing this parcel to facilitate the development of trail networks, in accompaniment to signage and learning opportunities, this locale could serve to benefit the Parksville community excellently.

4.0 Parksville Wetlands Site History

The Parksville Wetlands and surrounding area is unique on Vancouver Island as a shallow and transitional wetland. Being a transitional wetland, it plays an important part in managing the Parksville watershed, as well as being an important habitat for birds. It has been a major part of Parksville's watershed by helping to mitigate flooding and acting as the current site of many test wells for the City of Parksville's drinking water (City of Parksville, 2019).

Historically, the area was used first by both Indigenous peoples and then by early settlers as a hunting and foraging ground, due to an abundance of wildlife and birds in the area (Leffler, 2014). According to Marjorie Leffler (2014), a local historian who has catalogued many stories about the early settlers to the area, the Parksville Wetlands area and nearby Errington were settled in 1885 by Duncan McMillan. This was shortly after the first European settler to the Parksville area, John Hirst, bought land in the Englishmen River area in 1873. The area was first used for trapping and a limited amount of farming, which used the abundant freshwater in the area (Leffler, 2014). McMillan's cabin was also used as a stop on the stage coach route between Nanaimo and Port Alberni (Leffler, 2014).

In the last 30 years, there have been a few major changes to the area. In the 1980's, the area was slated for development and the trees cleared to make way for either farming or residential purposes (Stephens, 2015). However, the proposed development was never fully realized, and the land was sold to the City and then fell into the Agricultural Land Reserve (ALR). In 2005, Parksville City Council voted to keep the Parksville Wetlands area in the ALR, thus saving the area from further development (Stephens, 2015). In 2015, the Parksville Wetlands were mapped and assessed in a 35-page report titled "Lower Englishman River Watershed Wetlands Study" along with several other wetlands by Christopher M. Stephens Consulting & Writing (Stephens, 2017). This report mapped and chronicled the Wetlands and its importance to the local ecosystem, spurring the City of Parksville into eventually purchasing the 35.27 hectare parcel of land from Ermineskin First Nation in 2017 (Stephens, 2017).

This leads us to 2019, where the City of Parksville is now working on and finalizing a park plan for the Parksville Wetlands with help from MABRRI and VIU.

5.0 Ermineskin Cree First Nation

Ermineskin First Nation originate from Alberta, Canada. Their traditional territories originally stretched down into Montana, but their reserve today occupies 10,000 hectares of land approximately 80 km south of Edmonton (Ermineskin Cree Nation, 2019). The Ermineskin reserve is part of the larger Montana reserve that is made up of four different Ojibway First Nations in Alberta (Anishinabe History, 2019). Based off a 2016 census, the Nation numbers around 2500 individuals (Anishinabe History, 2019). The Nation has oil and gas reserves, a large agricultural lands base, and further commercial income from tourism initiatives at popular lakes in their territory (Ermineskin Cree Nation, 2019).

The Parksville Wetlands were purchased by Ermineskin First Nation in 1987 (Maureen, 2017; Rardon, 2017). It was initially purchased as an investment property, with the intention of using it for development purposes (Maureen, 2017). The desire was to develop the property into housing, but due to its ALR designation, the Nation was unable to build on the property (Maureen, 2017). In 2005, the Nation applied to have the lands withdrawn from the ALR, but the Parksville City Council voted to recommend against this to the Agricultural Land Commission. The recommendation was to keep the land within the ALR as it was recognized as an environmentally sensitive area with financial and ecological benefits to the City of Parksville (Maureen, 2017). Over the 30 year period of their ownership, the Ermineskin First Nation property was used as a popular dog walking spot, and was considered an important area for the sustained biodiversity for the Parksville region, containing over 87 animal species and a series of city wells (Maureen, 2017; Rardon, 2017).

With no success to develop the parcel of land, Ermineskin First Nation entered into prolonged negotiations with the City of Parksville (City of Parksville, 2017; Maureen, 2017). These negotiations concluded in 2017, with the City of Parksville paying 1.3 million dollars for the property (City of Parksville, 2017). This purchase came with the condition that the land stays within the ALR and is maintained as a park in perpetuity (City of Parksville, 2017). These conditions were agreed upon by Ermineskin First Nation and the City of Parksville to ensure the parkland stays accessible to all residents of Parksville, and the environmental integrity of the Wetlands is maintained for the ecological health of the region (City of Parksville, 2017; Maureen, 2017).

6.0 Snaw-naw-as First Nation

The Parksville Wetlands are located on the traditional unceded territory of the Snaw-naw-as First Nation. The Snaw-naw-as reserve land is 62.6 hectares (or approximately 155 acres) located nearly 30 minutes north of the City of Nanaimo, on the east coast of Vancouver Island (Indigenous and Northern Affairs Canada, 2019; British Columbia Assembly of First Nations, 2019). Snaw-naw-as First Nation are a Coast Salish people, who have occupied Vancouver Island since time immemorial (Snaw-naw-as First Nation, 2016). Their traditional language is Hul'q'umi'num, which is one of the three sub-languages of Halkomelum (Nanoose Economic Development Corporation, n.d.). This dialect is spoken by many First Nation groups, reaching from Nanoose all the way south to the American state of Oregon (Nanoose Economic Development Corporation, n.d.). The Coast Salish people of British Columbia are a geographically diverse group; their collective region in Canada spans from Vancouver Island all the way east to the Lower Mainland or Fraser Valley (Kennedy & Bouchard, 2017).

Coast Salish people are well-known for placing a high value on kinship, as well as being active and vocal in their political and often environmentally-focused engagements (Kennedy & Bouchard, 2017). Many Coast Salish Nations are engaging in treaty and land claims with both the provincial and federal governments, this in itself being an active pursuit of self-determination through self-governance (Kennedy & Bouchard, 2017). The Snaw-naw-as people are an example of this movement towards self-determination for the benefit of their community. Their goal is to socially, culturally, and economically improve their community, as well as better the collective health and well-being of the Snaw-naw-as community (Snaw-naw-as First Nation, 2016).

The Coast Salish people are presently and historically considered to have very close relationships with the land and water. Their location on the coast of the Pacific Northwest of Canada means that their surrounding environment is thoroughly water-based; this is reflected in their culture since relationships with the land and water are deeply entrenched and respected in their values and beliefs (Royal BC Museum, 2009; Kennedy & Bouchard, 2017). Not only does their culture tie heavily into their physical environment, but also their economy both historically and in contemporary contexts (Kennedy & Bouchard, 2017). Traditionally, Coast Salish people created and built their communities with materials that the land had to offer. They lived through subsistence, which meant a holistic and natural approach to survival.

7.0 Community Engagement

Within the four-month partnership beginning on January 5, 2019, the role of public engagement and input is paramount in producing an effective Parksville Wetlands Education and Outreach Master Plan. Multiple community outreach events were hosted by the City of Parksville, VIU, and MABRRI, including the BioBlitz and the Parksville Open House. During these events, student facilitators recorded and incorporated the community's input to build an enhanced master plan that is reflective of the values and recommendations of the Parksville community.

7.1 BioBlitz Event and Wetlands Walking Tours

On Friday, March 8, 2019, in collaboration with the City of Parksville, fourth-year VIU Geography 452 students hosted a BioBlitz and walking tour of the Parksville Wetlands Park. A total of 37 participants attended the event. The BioBlitz event accomplished various objectives, including a rapid survey for the community to find, identify, and record the local flora and fauna that reside in the park. The BioBlitz

provided an overview of the level of biodiversity within the area. The VIU students were given the opportunity to highlight and share with the participants new and intriguing information related to the Wetlands while the tour walked the new trail system and spoke of the importance of wetland ecosystems.

During the BioBlitz, community members also provided feedback regarding future interpretive signage in the park. The feedback included what information should be on the signs and where they should be located. Booths were set up at the main trailhead with posters presenting the current status of operations on the Parksville Wetlands timeline and the further phases in operation, a map displaying the new trail section of the park, a template of the features proposed to be used in the signage, and the general overview of the Parksville Wetlands Education and Outreach Project. While the BioBlitz and walking tour were the main objectives of the event, it was also intended to build relationships with the community while addressing any general questions, concerns, and suggestions.

7.2 Parksville Open House

On March 29, 2019, an Open House was hosted for the final stages of the Education and Outreach Plan. Hosted in the Parksville Civic & Technology Center, the Open House was split into morning and afternoon sessions to best accommodate varying schedules of community members. The earlier of the two, running from 9:30 am to 11:00 am, hosted twenty-four participants. The latter, operating from 4:00 pm to 5:30 pm, received nine participants. The VIU students used the knowledge they gathered at the BioBlitz event to create interpretive signage to be placed within the park.

The signage on display at the Open House included a timeline for the project, proposed trail names, potential sign locations, and more specialized interpretive signage. The specialized signage included information on the wetland's recovery, food chain, biodiversity, and a site overview of the project. The community then had the opportunity to be shown each sign by the students, who gave a detailed explanation of the information on the topic or design choices and answered any questions. To further obtain participant feedback, it was encouraged to write any thoughts, questions, or concerns on a sticky-note and place it on the corresponding signage; allowing for direct communication between the local community and those involved in the creation.

8.0 Trail Counter Data

In order to gain a greater understanding of which parts of the trail were most heavily trafficked, trail counters were placed at specific locations in the property between the dates of January 20 and April 4, 2019. Three trail counters (A, B, and C) were each placed at a separate location and then were moved after approximately one month. The first location that the counters were placed at was given the identification number "1", and each trail counter name was therefore A.1, B.1, and C.1 (Figure 3). The counters were at this location for a total of 33 days, after which they were moved to their second location, thereby gaining the new names of A.2, B.2, and C.2. The counters were at this new location for 29 days and then were moved to their third and final location where they stayed for just 14 days. Counter C was severely damaged in its second location and could not be used in the third location, so only A.3 and B.3 were used. In addition, B.3 was stolen from its third location, leaving only the data from A.3 available for this study – this is why only A.3 is shown in Figure 3. With three locations and two counters not being used in the third, a total of 7 locations with resulting data could be used in this study.

The counters were placed at hip height (approximately 2.5 to 3.0 feet off the ground) to avoid recording dogs or other animals. They were also arranged in a concealed fashion to reduce the chances of drawing attention from passersby, who might be recorded multiple times if they were to stand in front of the camera too long.

Figure 3: Locations of trail counters within Parksville Wetlands Area

One interesting trend in the data was a decrease in the average number of counts during the first period of data collected (Figures 4-6) and an increase during the second period (Figures 7-9). This could be explained by the colder than average weather experienced during the month of February, which caused many of the trails to ice over and would pose a greater risk of injury to community members. Unlike the

others, the counter for A.3 saw no major increase or decrease in the average number of counts (Figure 10).

Of the data collected for all locations, location B.2 had the highest total count at 2994 over the course of the 29 days (Figure 8). This could easily be explained by the counter being located at the main entrance to the park, however this data shows an anomaly in that the number of counts dramatically increased from a period between March 7 and March 12. One possible explanation for this could be the BioBlitz, which occurred on March 8. However, it could be due to other factors as the counts appear to peak on March 11.

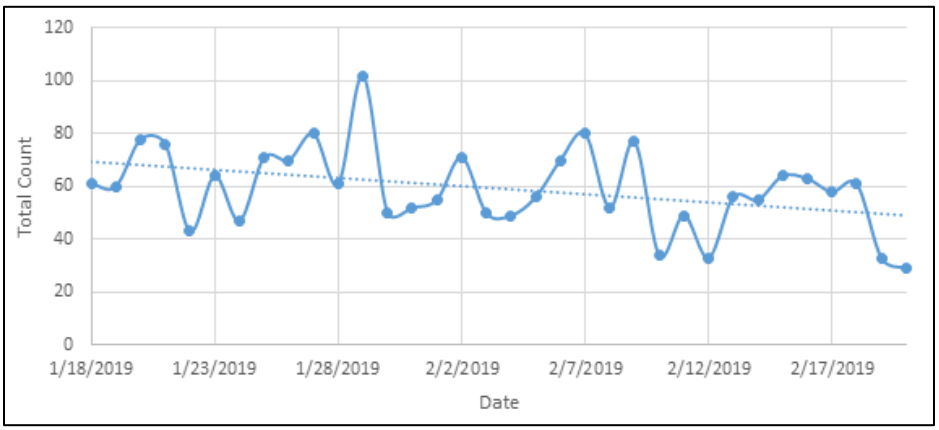

Figure 4: Trail counter data for location A.1 from January 18 to February 20

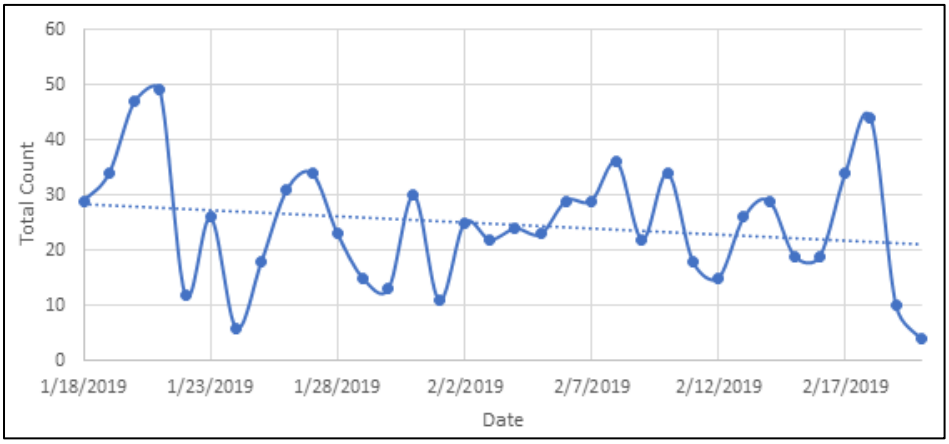

Figure 5: Trail counter data for location B.1 from January 18 to February 20

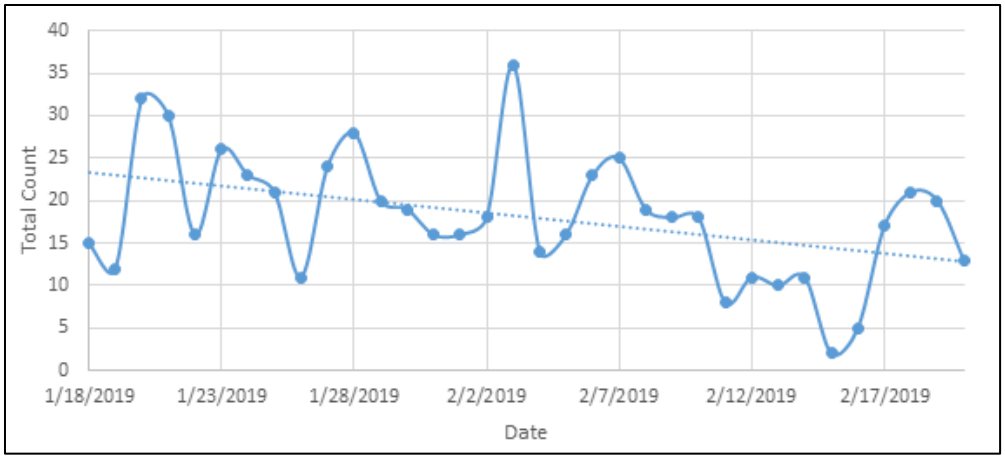

Figure 6: Trail counter data for location C.1 from January 18 to February 20

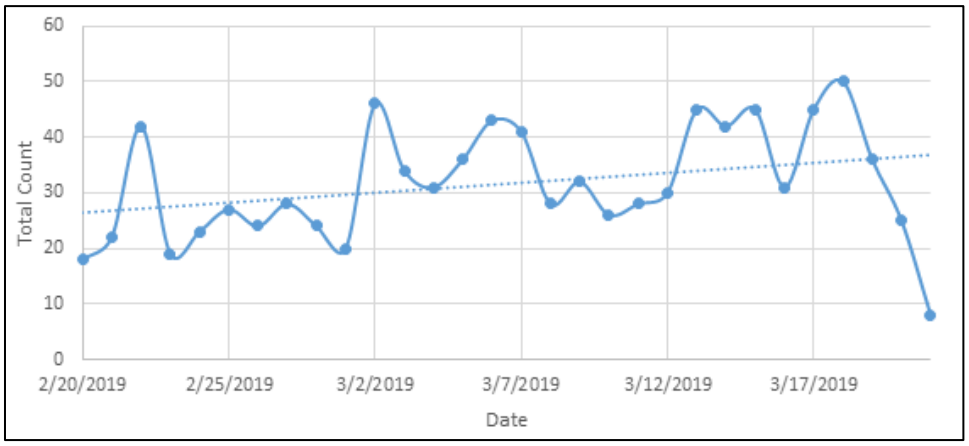

Figure 7: Trail counter data for location A.2 from February 20 to March 21

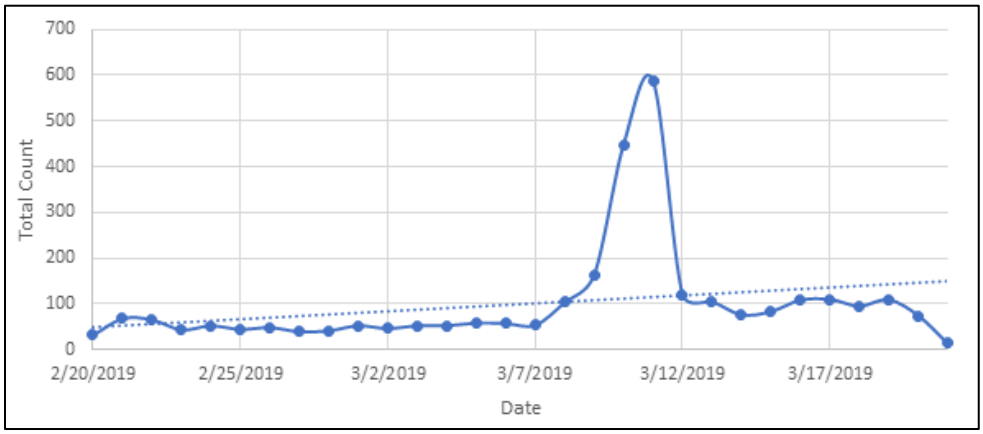

Figure 8: Trail counter data for location B.2 from February 20 to March 21

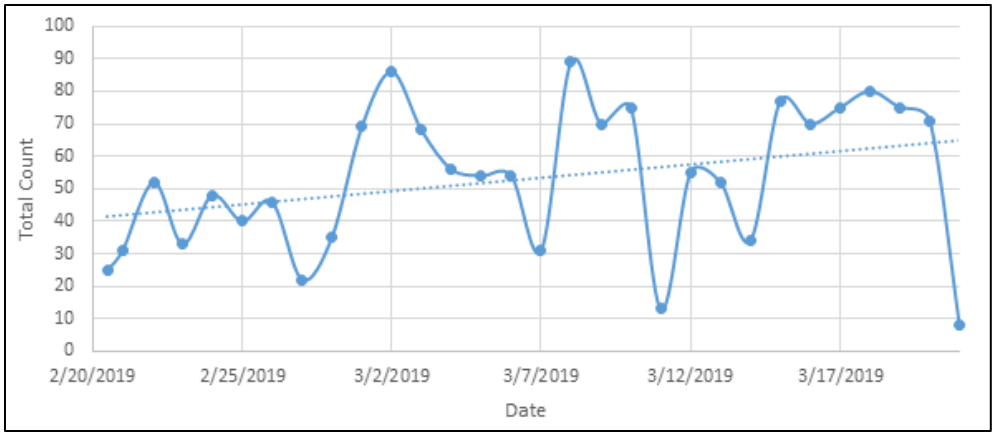

Figure 9: Trail counter data for location C.2 from February 20 to March 21

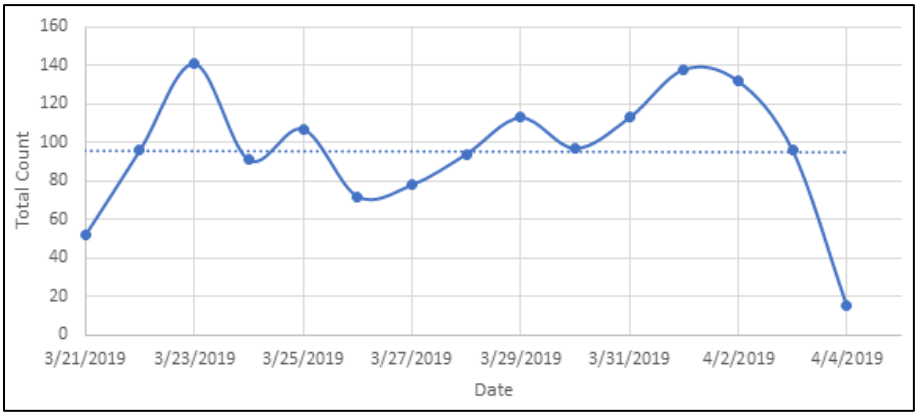

Figure 10: Trail counter data for location A.3 from March 21 to April 4

The highest total counts after B.2 were A.1 at 2010 (Figure 11), C.2 at 1594 (Figure 12), followed by A.3 at 1435 (Figure 13). C.1, with 640 counts (Figure 11), was the lowest, likely because the trail counter was placed on a trail that is not part of the main loop around the Wetland. A.2, having the next lowest recordings, 949 (Figure 12), of all the counters placed near an entrance is also not surprising as the only access point to this entrance is off the highway, making it less noticeable and accessible than the other entrances, which are closer to the residential areas.

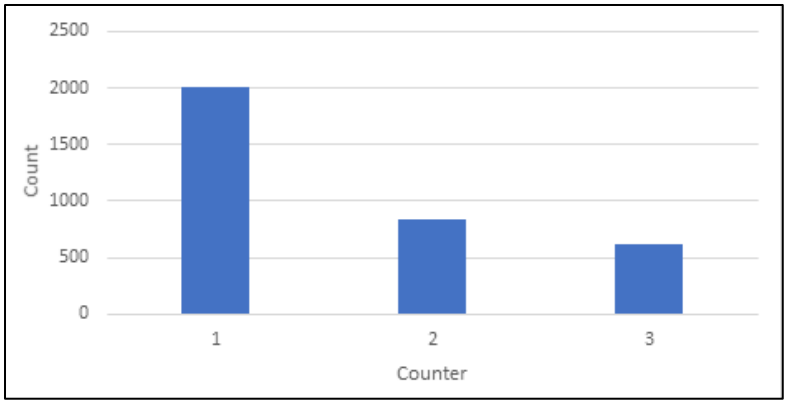

Figure 11: Total count for locations A.1, B.1, C.1

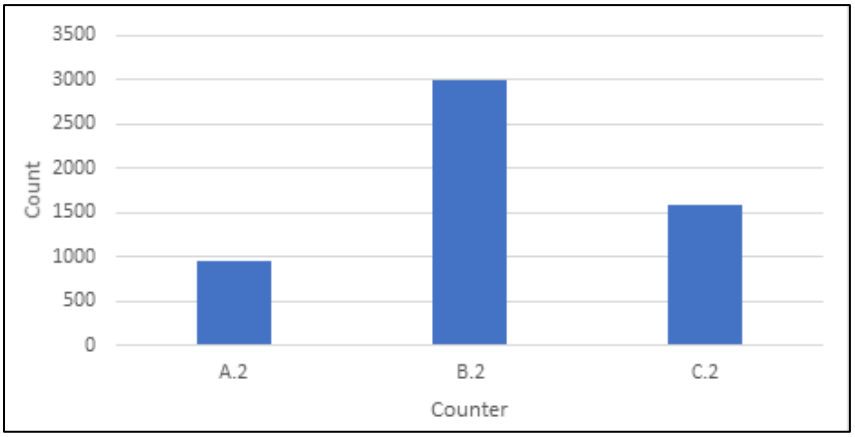

Figure 12: Total count for locations A.2, B.2, C.2

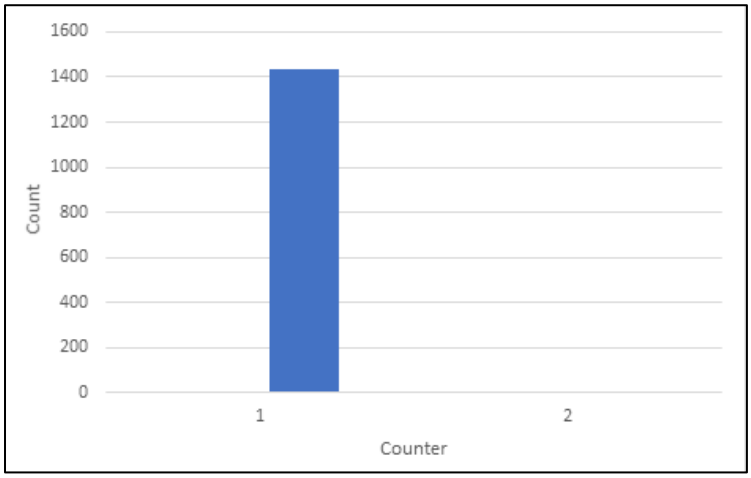

Figure 13: Total count for location A.3, B.3 (data unrecorded)

9.0 Trail Network and Connectivity

The Parksville Wetlands has many trails within its boundary and with connectivity to other areas of Parksville. Connectivity and trail networks plays a key role in improving community wellness. Studies have shown that increased physical activity that occurs due to increased access to trail networks improves the health of individuals (Bere, 2011). For example, Bere (2011) concluded a longitudinal study illustrating that continued cycling in adolescence reduced obesity and promoted sustained cycling behaviour.

There is currently 1.5 km of trails throughout the Wetlands, with plans to add an additional 800 m. The Wetlands has two main loop trails with shorter trails linking these loops together (Figure 1). The existing main loop west of the train tracks guides visitors through second-growth riparian forest. A new trail starting at the junction of Magnolia Drive and Chestnut Street will run the length of the property, connecting to Renz Road. This trail will allow visitors to walk closely to the wetland and observe the local wildlife. Additionally, the new Wetlands trail functions as a connector with other key trails in the region such as Springwood, the Coombs trail, and the Parksville Qualicum cycling route. On a smaller scale, the park connects to Ballenas Secondary School and Springwood Elementary School providing students with a relatively traffic-free cycling or walking path to get from the surrounding residential areas to school. There are also five main entrance points with an additional one being proposed. These entrance points are located at Renz Road to the northeast, Despard Avenue to the southwest, and two at Coldwater Road to the west (Figure 1). The last entrance can be accessed at the junction of Magnolia Drive and Chestnut Street.

There is an off-leash dog park about 150 m to the south of the Parksville Wetlands on Despard Avenue. Individuals are also able to walk to Englishmen River and Rathtrevor Beach Provincial parks via existing trail networks. This connectivity to other natural areas is important for community members to have a sense of continuous natural area that can be explored. It is positive for tourism if visitors know they have access to natural areas near where they are staying.

This wetland is not a true wildlife corridor, but some connectivity exists. Located between the estuary of the Englishman River and French Creek, and also close to Hamilton Marsh, the Parksville Wetlands has been identified as a key site for nesting, feeding, and breeding migratory birds within the region (Stephens, 2015). Some bird species that populate this wetland may alternate between this wetland and others in the surrounding area. This wetland has a high population of birds, amphibians, and small to medium sized mammals that could lead to potential Human-Wildlife conflicts. There is also some evidence of ungulates using this wetland as habitat. This wetland is adjacent to some agricultural land to the north, residential neighborhoods to the east, south and southwest. The Island Highway 19 creates the western border; because of this, ungulate are most likely to be coming from the agricultural land that connects to the wetland.

Cougars have also been sighted in the property. Since this area is popular with dog walkers and families, extra precaution needs to be taken while visiting the site. All members of the public should be aware of this risk if visiting this park and should take precautions to avoid human wildlife conflicts, such as keeping dogs on leash (Government of Alberta, 2019).

10.0 Climate and Environment

Located on the western edge of the City of Parksville, the property shares the same mild, temperate climate characteristics as the rest of the surrounding region. These conditions allow many residents of the area to take part in outdoor recreation and experiential educational activities in all four seasons, making this area a valuable public resource for year-round enjoyment and management.

With yearly average temperatures hovering around 10°C and less than 40 mm of precipitation during its warmest summer months the Parksville region falls into the 'warm-summer Mediterranean climate' (Csb) category of the Köppen climate classification system (Climate-Data.org, 2019; Christopherson, 2007). Other regions in this category include San Francisco, USA, and Cape Town, South Africa (although annual temperatures and precipitation averages in these regions do vary slightly from those of Parksville, BC). While precipitation is plentiful in the fall, winter, and spring, the occasional emergence of high-pressure weather systems allows residents of such climates to enjoy many clear and sunny days during colder months (Christopherson, 2007).

Parksville's climate conditions are primarily driven by the upwelling of cool ocean currents in the nearby Pacific Ocean and the adjacent Salish Sea. This helps to keep average summer temperatures below 22°C between mid-June and early September. The effects of ocean currents are also responsible for driving Parksville's wet but mild winters, during which residents rarely experience temperatures below -3°C (Statistics Canada, 2019). As such, snow is possible but not common in the area immediately surrounding the parkland. The greatest seasonal change in temperature here is typically less than 15°C, making the area an ideal home for people and wildlife who are sensitive to the drastic seasonal fluctuations witnessed in most parts of continental Canada (Climate-Data,org, 2019). High humidity levels, often over 100%, are another reason that many people choose Parksville over drier parts of the country, however this is also known to contribute to unexpectedly chilly or 'wet cold' conditions caused by latent cooling, especially in the presence of coastal wind (Christopherson, 2007).

Anthropogenic climate change is already causing significant alterations to long-standing climate norms throughout the world, including on central Vancouver Island. In recent years, Parksville residents have witnessed the gradual lengthening of summer dry spells and a further reduction in seasonal temperature fluctuations as winters become even milder (Floyd, 2011). With climate scientists recognizing 2018 as the warmest year on record, it is likely that these trends will continue, with change being the only constant in the decades to come.

While this might appear as 'good news' for local residents – especially retirees who intentionally moved to the regional for its mild climate – the reality is that many native flora and fauna are likely to be negatively affected by the effects of climate change, as seen in other regions around the world (Strachan, Chester & Robson, 2016). While the nearby ocean is known to regulate the temperature of Parksville's climate throughout each year, warming ocean temperatures are expected to change this dynamic in the future. Resulting increases to evapotranspiration may lead to unpredictable new weather patterns, and climate change will also exacerbate the proliferation of invasive species and other ecological threats that thrive in warm, wet conditions.

Furthermore, while there is evidence that Parksville and its surrounding regions will continue to receive considerable precipitation in the winter months, local climate scientists are predicting that much less of this precipitation will fall as snow or ice compared to historical levels (Floyd, 2011). This will contribute

to a reduction in the amount of long-term snowpack that is added to Vancouver Island's central mountain ranges each winter, which Vancouver Island communities have historically relied on to store and release melt water during the dry summer months. With considerably less snowmelt flowing downstream in the drier spring and summer months, coastal communities like Parksville are bound to face increasing water shortages and restrictions in years to come (Trubilowicz, Floyd, D'Amore, Bidlack, 2016). Longer summer dry spells are also leading to increased range and frequency of wildfires on Vancouver Island, posing significant risks to Parksville residents, their ways of life, methods of income and recreation, and the surrounding ecosystems of Vancouver Island as a whole.

Such knowledge should prompt local citizens and resource managers to recognize the irreplaceable value of wetlands in terms of their ability to retain and purify watershed runoff, replenish local aquifers, sequester carbon dioxide, and maintain a water table necessary for the long-term functioning of human settlements (see section 13.0 below) (Armendariz, Cortese, Rodriguez, Capitulo, 2017). Without these precious ecological assets and the services they provide, citizens of Parksville may find themselves importing or redirecting drinking water from unsustainable sources in the imminent future.

11.0 Forest Ecology

The parkland is located within the Coastal Douglas Fir (CDF), biogeoclimatic (BEC) zone as seen in Figure 14. The main zones displayed in Figure 14 are: Coastal Douglas-fir (CDF), Coastal Western Hemlock (CWH), Mountain Hemlock (MH) and Coastal Mountain-heather Alpine (CMA). This zone primarily contains Douglas-fir (*Pseudotsuga menziesii*), Grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), western flowering dogwood (*Cornus nuttallii*), and bigleaf maple (*Acer macrophyllum*) trees, in conjunction with understory plants, such as salmonberry (*Rubus spectabilis*), sword fern (*Polystichum munitum*), and trillium (*Trillium grandiflorum*) (Egan, 1999). In wet, swampy areas there is a higher percentage of red alder (*Alnus rubra*), salmonberry, and red elderberry (*Sambucus racemose*), all of which is present in the Parksville Wetland (Egan, 1999). The CDF zone is one of the smallest BEC zones in BC, as it covers only 0.3% of the province (University of British Columbia, 2019). It is located along the southeastern coast of Vancouver Island, parts of the mainland coast, and the Gulf Islands, located on low elevations from 0 to 260 m (University of British Columbia, 2019). Due to its low elevation the climate of the CDF zone is strongly influenced by the Pacific Ocean, giving it warm, dry summers and mild, wet winters (Nuszdorfer, Klinka & Demarchi, n.d).

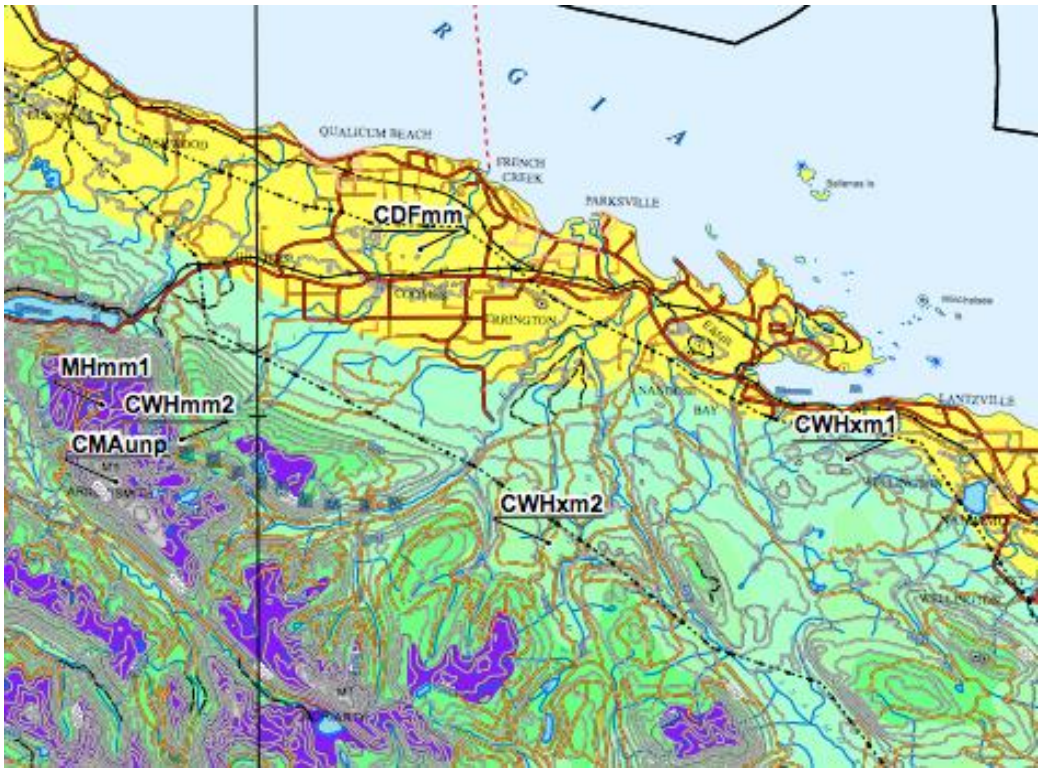

Figure 14: Biogeoclimatic zone of Parksville (Ministry of Forests Lands, Natural Resource Operations and Rural Development, 2016).

Parksville Wetlands is located within the podzolic soil monolith according to a map produced by the University of British Columbia (Figure 15) (Soil Sciences, n.d). Podzolic soils are forested soils that are found primarily on sandy parent materials in areas underlain by igneous rock, but they can also be found on sandy glacio-fluvial deposits (University of Saskatchewan, n.d). They are found mainly in boreal and temperate regions in the Northern Hemisphere, occupying approximately 4% of the Earth's total land surface (Sanborn, Lamontagne & Hendershot, 2011). These soils are also found in ecozones where the mean annual precipitation is above 700 mm; this is true for the Parksville Wetlands, as it receives a mean annual precipitation of 1000 mm (University of Saskatchewan, n.d). Podzolic soils typically have an acidic pH because of their mineralogical composition derived from igneous rocks (University of Saskatchewan, n.d). In addition, conifer leaf litter decomposition further amplifies the acidity in the upper soil, creating an intense chemical weathering zone in the upper soil (University of Saskatchewan, n.d). According to Jungen (1989), all podzolic soils in this area belong to the Humo-Ferric great group. This means that the soils are characterized by a boron monofluoride horizon where aluminum and iron are present, but there is little organic matter present (Jungen, 1989).

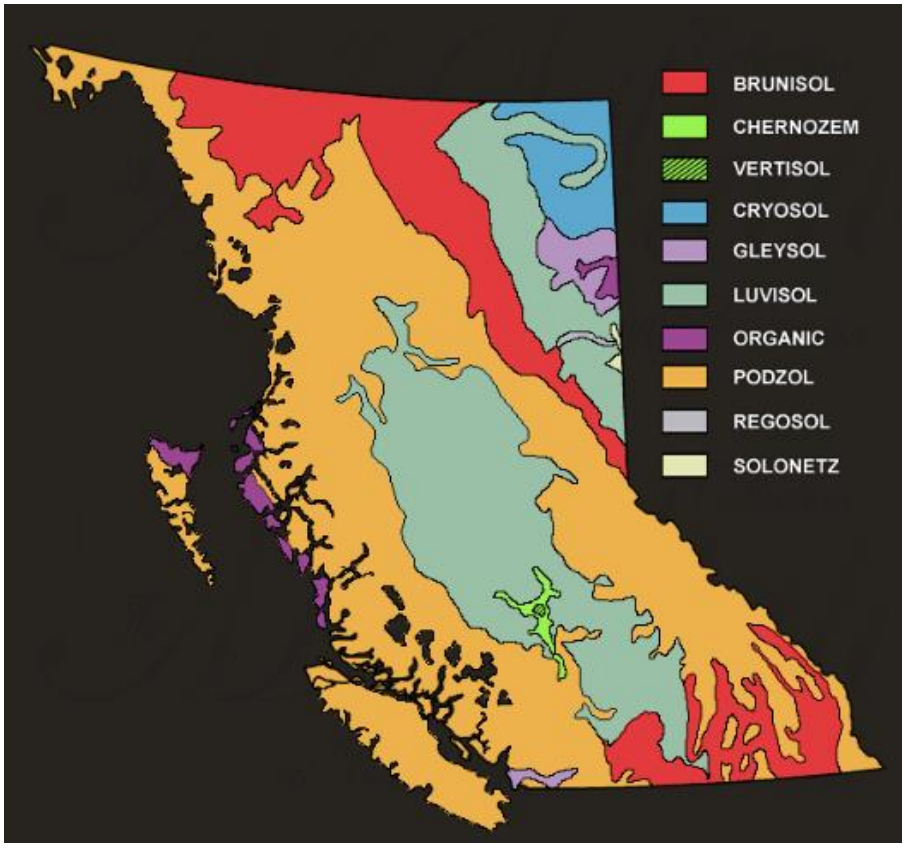

Figure 15: Soil groups of British Columbia (Virtual Soil Sciences, n.d)

The CDF is the least protected BEC zone in BC, as it has the lowest number of large protected areas (University of British Columbia, 2019). There are a total of 80 protected areas within this zone, making up only 1% of the total zone area (University of British Columbia, 2019). Less than 1% of the forest is old growth, with less than 10% older than 120 years old, most of which is found in parks (University of British Columbia, 2019). The older forests are highly fragmented and occur in small patches, which makes many of the plant and wildlife species in this zone threatened or endangered (University of British Columbia, 2019). There are 50 rare species of vegetation restricted to the CDF BEC zone, such as Macoun's meadowfoam (*Limnanthes macounii*), a rare plant species endemic to BC (Nuszdorfer, Klinka & Demarchi, n.d). In addition, the CDF zone also contains the rare Garry oak ecosystem; an ecosystem with many other rare species that are exclusive to it (University of British Columbia, 2019). The main threat to the CDF zone is logging, however, urban development has also become an increasing threat (Flynn, 1999).

12.0 Wetland Ecology

Wetlands are one of nature's most effective filtering systems for freshwater. Over long periods of time, they filter out harmful and undesirable substances from incoming freshwater. Without natural filtration systems, runoff from farms and gardens that use fertilizers containing substances such as phosphorus and nitrogen eventually makes their way to freshwater bodies and initiates a process called eutrophication, which essentially suffocates fish and submerging vegetation (McJannet et al., 2011).

A wetland's ability to effectively filter these harmful substances before they reach a water body is largely due to the vegetation and soils present (McJannet et al., 2011). The majority of vegetation found in wetlands is hydrophytic, meaning the plants grow best in low-oxygen, highly saturated soils and have alternative methods of gathering oxygen (e.g. hollow stems or cells filled with air) (State of Vermont, n.d.). These plants and soils can absorb or store extra nutrients that come through the wetlands, such as excess phosphorus or nitrogen found in agricultural runoff (McJannet et al., 2011). Presence of vigorous vegetation not only indicates a healthy wetland, but an efficacious one as well. Wetlands will filter water best when the movement of water through it is slower, because it gives the soil and plants more time to absorb (McJannet et al., 2011).

The Parksville Wetlands have been initially determined as a constantly saturated swamp and marsh mix with some ephemeral portions; further site visits would help determine water sources. The most visually obvious difference between a marsh and a swamp is the vegetation. Swamp soils see occasional surface aeration that allows for a variety of trees and shrubs, while marshes largely support only one or two grass-like species (Ministry of Forests, n.d.). The vegetation present in this wetland is largely grasses, rushes, and sedges, with lodgepole pine (*Pinus contorta*) around the perimeter. This wetland likely supports fish, bird, ungulate, and amphibian species, such as the yellow warbler (*Setophaga petechial*), black-tailed deer (*Odocoileus hemionus*), and Pacific tree frog (*Pseudacris regilla*), although due to timing of our initial assessments, and past studies minimal wildlife has been observed and recorded (Stephens, 2015). The Parksville Wetlands system provides many of the benefits listed above, so protection of this system is in the interest of the species biodiversity and water quality, along with the people of Parksville as well.

13.0 Parksville's Wetland Ecosystem Services

Ecosystem services are the benefits that humans freely gain from an ecosystem; though the concept of 'ecosystem services' originally just applied to wilderness, the concept now applies to urban parks (Shultis & Hvenegaard, 2016). In the case of the Parksville Wetlands, it takes on the role of both wetland and park and therefore provides many forms of ecosystem services. Given the fact that there has been no long-term research conducted in the Parksville Wetlands area, it is difficult to determine the full extent of the Wetland's ecosystem service capabilities in detail. In order to gain an insight to what potential ecosystem services are provided from Parksville's Wetlands, an understanding of the ecosystem services provided from wetlands in general is needed.

Due to their long- and short-term water storage capabilities, wetlands have the power to aid in the mitigation of flooding damage; evidence suggests that wetlands reduce flood peaks (both nearby and down steam), runoff, and stream flow (Kadykalo & Findlay, 2016). Overall this reduces flood frequency and flood magnitude, which, given the future predictions to climatic change on Vancouver Island and the predicted average annual increase in rainfall floods, are vital services (Kadykalo & Findlay, 2016; Ministry of Environment of B.C., 2016). Wetlands also have the potential to enhance groundwater recharge (Janse et al., 2019). This is relevant considering that Parksville gets some of its drinking water from an aquifer (City of Parksville, 2019).

Wetlands continue to affect hydrological cycle processes to further benefit the ecosystem by way of controlling water quality. Water quality is a measure of the waters' amounts of chemicals, sediments pathogens, and other factors. Improved water quality provides one of the most important services of all,

which is healthier drinking water, as well as providing cultural and recreational services; both of these aspects of water quality apply to the Parksville Wetland (Brauman, Daily, Duarte, & Mooney, 2007). The Wetland's vegetation and microbes, coupled with the soils and sediments, absorb the contaminants in the water, and through biochemical processes such as denitrification and dilution of other pollutants, water quality is increased (Brauman, Daily, Duarte, & Mooney, 2007).

Wetland chemical processes don't just stop at water quality regulation. They also aid in nutrient cycling and gas exchange. Nutrient cycling of phosphorus and nitrogen that are both considered part of agricultural run-off, are reduced or removed (Clarkson, Ausseil, & Gerbeaux, 2014). In the right conditions, wetlands also sequester carbon dioxide and ultimately have the potential to act as a buffer against one of the most significant issues of our time, climate change; carbon is stored in both the soil and the vegetation. Wetland conditions also contribute to peat accumulation, which stores carbon and in turn regulates atmospheric carbon levels and helps cool global climates (Clarkson, Ausseil, & Gerbeaux, 2014).

Additionally, the combined functions of wetlands aid in the support of flora and fauna. The biodiversity in wetlands helps secure food for many species and acts as a supporting habitat for a wide range of plants and animals, which has both cultural and intrinsic value (Clarkson, Ausseil, & Gerbeaux, 2014). In the case of Parksville Wetlands, it provides habitat for rare species of birds. These are just a few of the services that wetland ecosystems provide and although the described services may not be specific to Parksville's wetland, they provide a broad explanation to the intricacies of wetland ecosystems and give enough reasoning for wetlands to be conserved to our best ability.

13.1 Groundwater Recharge and Protection of Wetlands

Parksville Wetlands form the headwaters of Carey Creek and are positioned above aquifer 216 (Figure 16). The protection of Parksville Wetlands provides a sustainable model of drinking water protection. It also facilitates education for sustainable development, as the provincial government test wells are located adjacent to the park (Figure 17). Designating these lands as the Wetlands was an important step in protecting the groundwater recharge that occurs between the wetland and the sand and gravel aquifer below. It is clear that the aquifer in this zone is being depleted (Figure 16); as the population of Parksville grows, the RDN Drinking Water and Watershed Protection program aims to improve public awareness of where water comes from to change water consumption patterns and underline the importance of taking measures to protect wetlands (Regional District of Nanaimo, 2018).

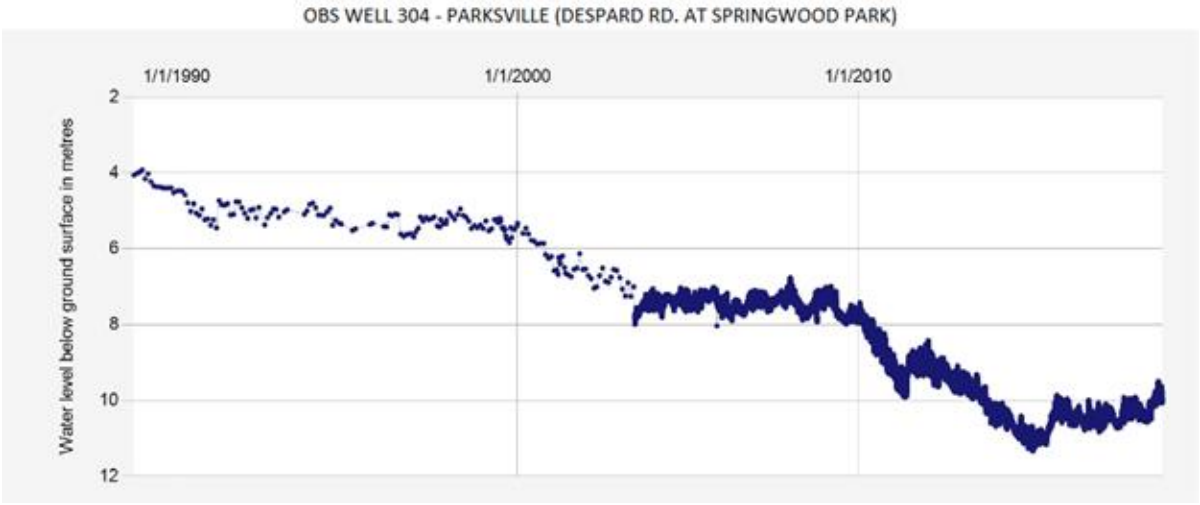

Figure 16: Declining Water Level in Well 304 (Despard Rd. at Springwood Park)

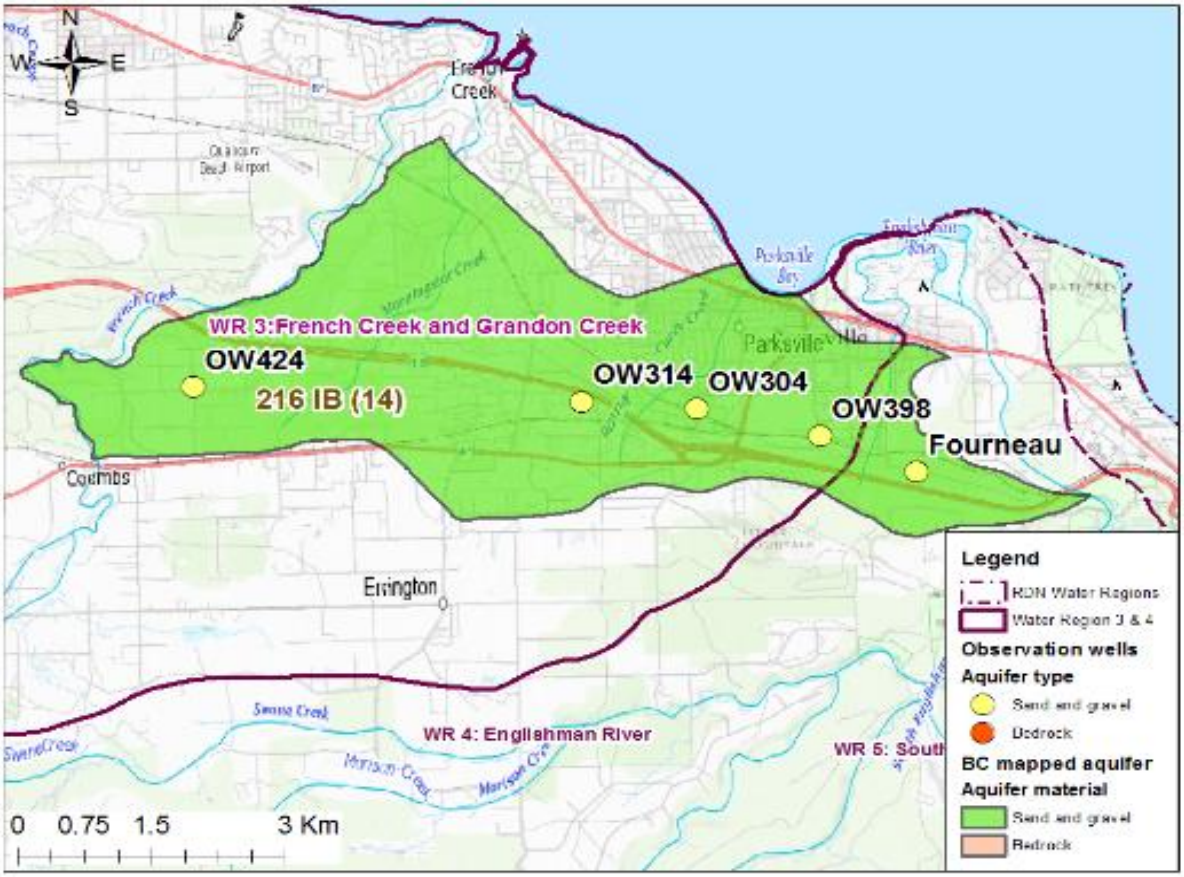

Figure 17: Location of mapped aquifer 216 and observation wells

On the federal level, riparian areas have not been a focus for planning of protected areas. However, the National Advisory Panel's report suggests that funding be made available for municipalities to encourage Canadians to engage with citizen science initiatives (Shea, 2018). The report directs municipalities to

access funding through the two-billion-dollar Mitigation and Adaption Fund, which helps Canadians face the challenges of climate change by establishing and restoring “natural infrastructure” as a means to reduce natural disaster risks such as flooding, while simultaneously conserving biodiversity.

14.0 Ecological Inventory

During the BioBlitz of the Parksville Wetlands, a total of sixty-four different flora and fauna species were recorded. Of the sixty-four species recorded, there were forty-six native flora species, eight species of fauna, and ten invasive species. Five of the six groups observed salmonberry (*Rubus spectabilis*), red osier dogwood (*Cornus sericea*), red alder (*Alnus rubra*), Oregon beaked moss (*Kindbergia oregana*), Grand fir (*Abies grandis*), and Bracken fern (*Pteridium*). The most observed fauna species was the Evening grosbeak (*Coccothraustes vespertinus*), which was observed by two groups. The most common invasive species observed were Scotch broom (*Cytisus scoparius*), observed by five groups, and Himalayan blackberry (*Rubus armeniacus*), which was observed by four groups.

14.1 Graphs

The graphs were created using species identified on the y-axis and number of groups that observed the species on the x-axis; while it may be an untraditional method of displaying the data, lacking or incomplete data gathered during the BioBlitz limited graphing abilities.

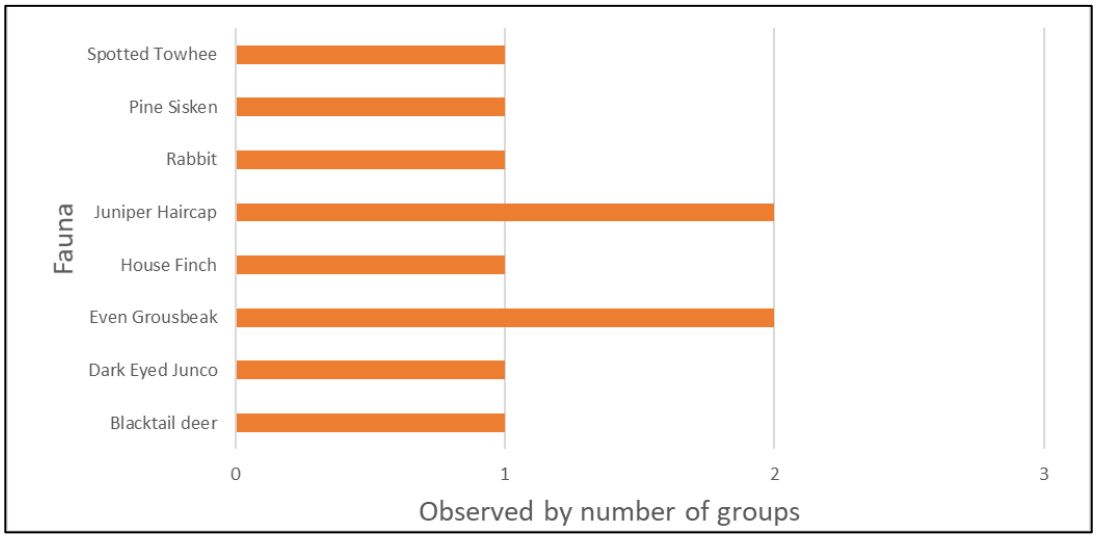

Figure 18: Observed fauna at Parksville Wetlands by number of groups that attended the BioBlitz

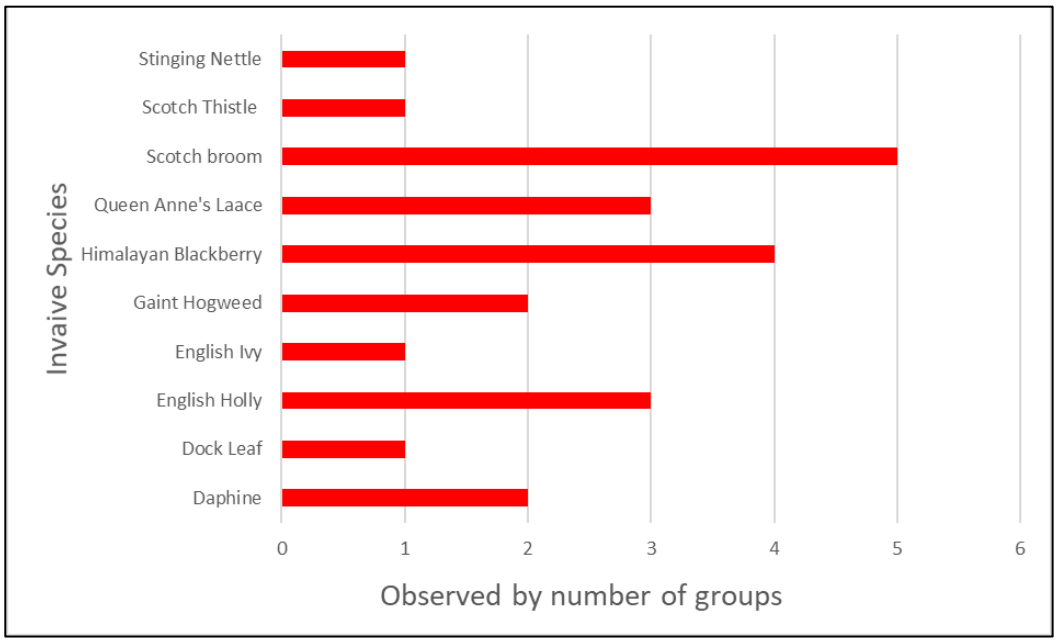

Figure 19: Invasive Species at Parksville Wetlands by number of groups that attended the BioBlitz

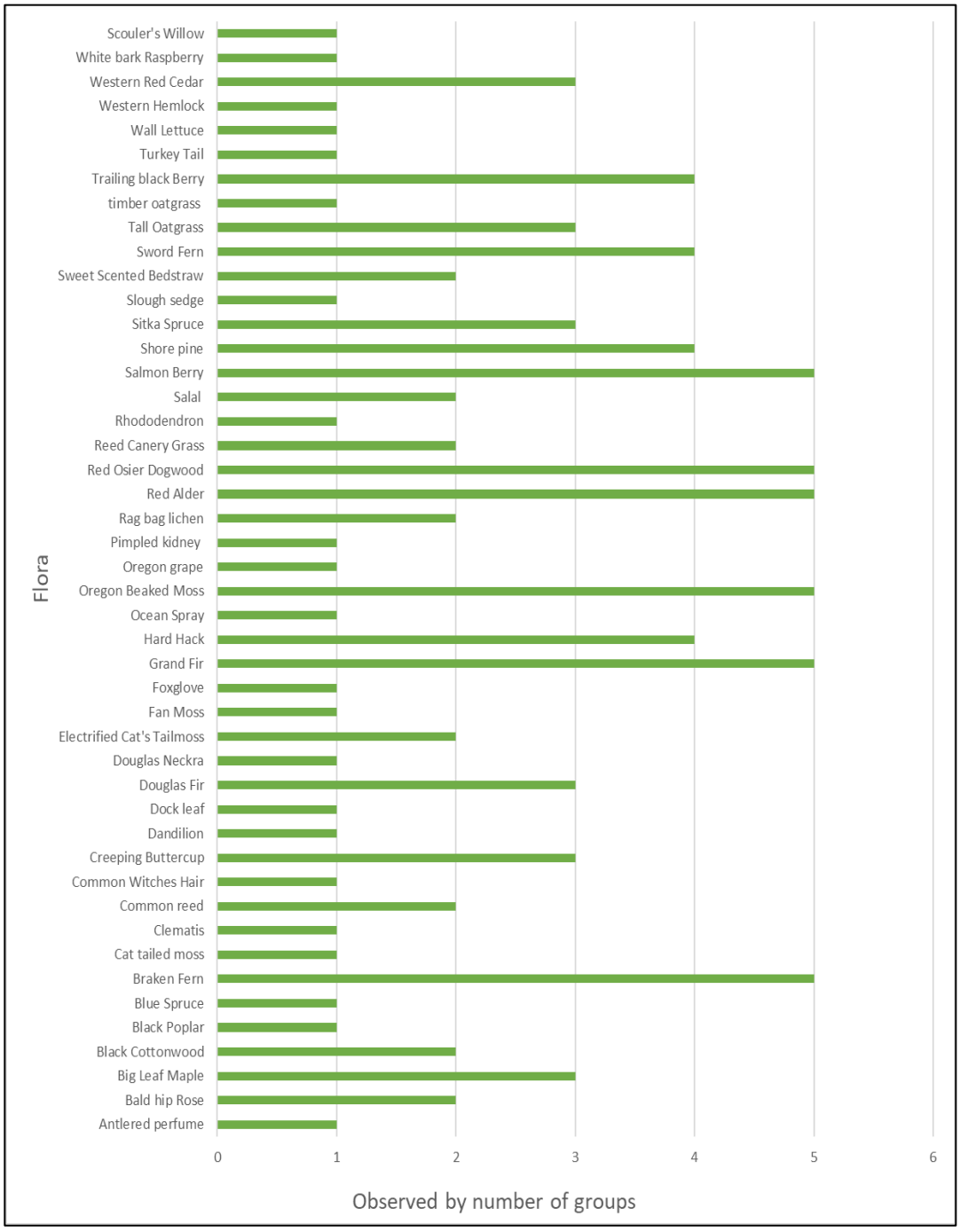

Figure 20: Observed Native Fauna at Parksville Wetlands by number of groups that attended the BioBlitz

15.0 Mapping

The map (Figure 20) shows an overview of the Parksville Wetlands, including an aerial view of the area's extent in relation to the surrounding urban area, the entrances to the park, as well as current locations

of amenities (e.g. garbage cans, doggy bag dispensers, benches, and a recently expanded trail network). It also includes the potential locations for interpretive signage.

The trail network was previously mapped out by the City of Parksville, but was also mapped by VIU students as part of the course deliverables. The students paid particular attention to points of interest and potential sign locations while on site, with the use of field note books and GPS units provided by VIU. Points of interest included wildlife trees seen in the park, as well as locations of interesting species of plants. The students went out to the park during class time in small groups, to cover as many of the trails and potential points of interest as possible within the few hours provided. Each of the coordinates and field notes were then used to create their own map using GIS software, specifically ArcMap 10.5.1 (ESRI, 2016).

The maps created by each student were to adhere to the GIS deliverables for the course. Students were required to include a trail network, wetland boundary, potential interpretive signage locations, and basic map design elements (e.g. title, legend, scalebar, etc.). In addition, an attribute table was included with each map to show details of each element, as well as measurements of the park area. The coordinate system used was NAD 1983 UTM Zone 10N, and the trails, points of interest, and the wetland boundary were all overlaid on a satellite image of Parksville Wetlands. The trails were created by importing the GPS points and connecting them using the “points to line” scripting tool and then smoothing out the trails and removing redundancies using the “editing vertices”, “split”, “snapping”, and “merging” tools in ArcMap. The wetland boundary was made by creating a new shapefile in the form of a polygon. The amenities and interpretive signage points were added via a pre-prepared shapefile and by creating a new shapefile in the form of points. All the added features were then edited to make a more clear and holistic map.

Figure 21: Overview of Parksville Wetlands

16.0 Interpretive Signs

Interpretation is a communication tool designed to facilitate how visitors engage with their surroundings (Amin, Chan, & Omar, 2014). The goal of the interpretive signs created for the Parksville Wetlands is to facilitate how park visitors engage with the wetland. Park interpretation can also be used as a management tool to promote conservation, care for the natural environment, and influence behaviour.

In order for park interpretation to be effective, it must be thematic, organized, relevant (meaningful, personal), and enjoyable (TORE) (Ham, 1992). Tilden's (1957) six guiding principles suggest that (1) personal meaning and relevance are paramount to the visitor's interpretive experience; (2) interpretation is not simply information but a revelation based on such; (3) Interpretation is both an art

and a science; (4) the central goal of interpretation is provocation, not instruction; (5) interpretation must be presented in a holistic manner, rather than just a part and must also appeal to the whole person and; (6) children and adults need respectively unique approaches in order to be successful.

A significant challenge when writing for interpretation is to capture its essence in a clear and concise manner. Ways to maintain the reader's attention are to use short words, sentences, and paragraphs (Knudsen, Cable & Beck, 2003). Word and phrase considerations include using action verbs, appealing to the five senses, choosing accurate and colorful language and linking words rhythmically (Knudsen, Cable & Beck).

Design is also an important consideration. While a sign template with City of Parksville branding was provided, attention to some basic principles was imperative. These included balance between text and images, font size and colour, and contrast between background colour and text.

Evaluation is also critical to success and quantitative formulas such as the Flesch Index (Flesch, 1974) and the Fog index (Gunning, 1962) can be used to rate readability by assessing word and sentence length. Finally, once the signs are installed, their effectiveness can be evaluated by observation, change in the state of the resource if a conservation message is promoted (e.g. using established trail), or impact on attitudes and subsequent behaviours in more theoretically complex methodologies.

By employing these principles, techniques and considerations, signs were created by the team. These included a sign to be located each entry point highlighting the parks history, purpose and connectivity to surrounding communities (Figure 21), succession (Figure 22), trophic levels (Figure 23), birds (Figure 24), wildlife (Figure 25), unique flora that is found within a wetland (Figure 26), trees and forests (Figure 27), sign locations (Figure 28), trails (Figure 29).

Figure 22: Signage for each entry point highlighting the parks history, purpose and connectivity to surrounding communities

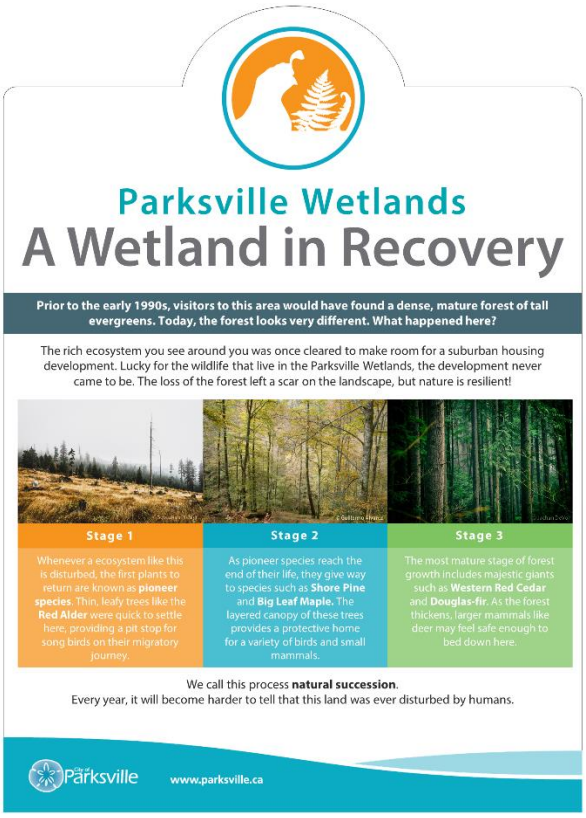

Figure 23: Signage highlighting the wetland and its recovery period through the years

Figure 24: Signage highlighting the food chain present within a wetland

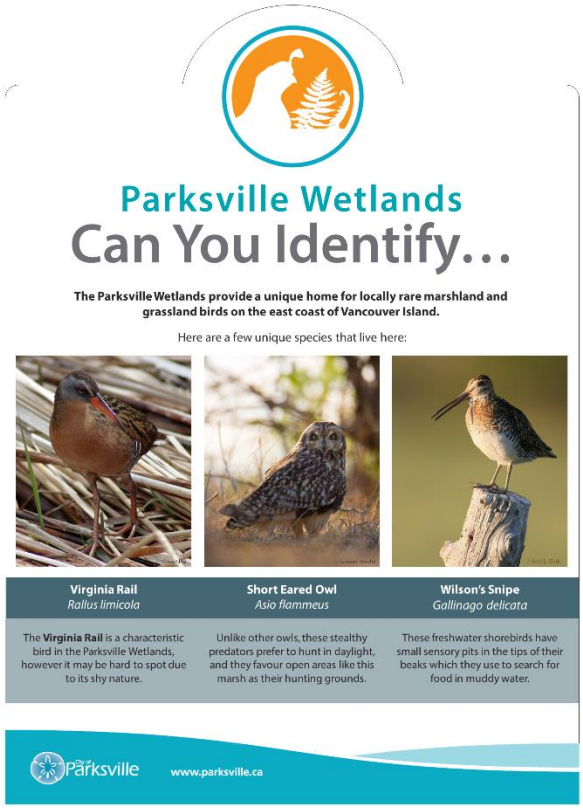

Figure 25: Signage highlighting the birds that thrive within a wetland and are specific to the wetland

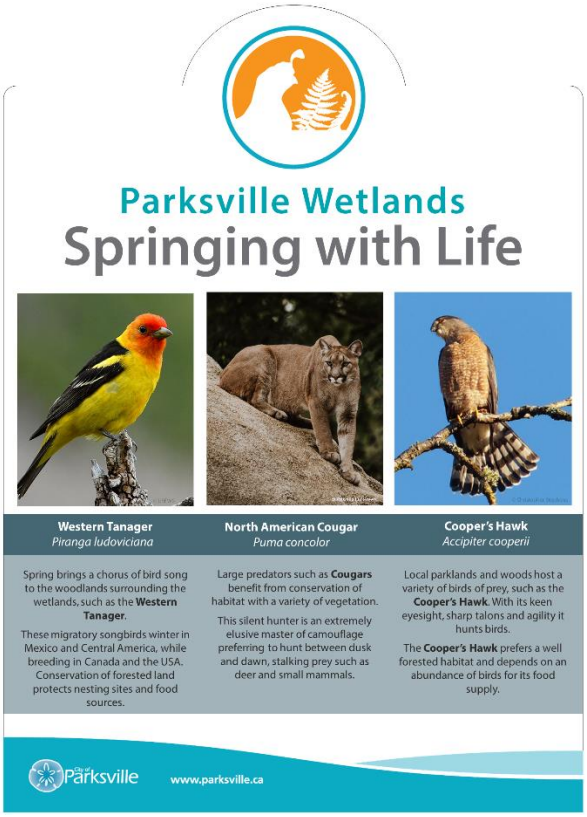

Figure 26: Signage highlighting the different wildlife that can be found within a wetland

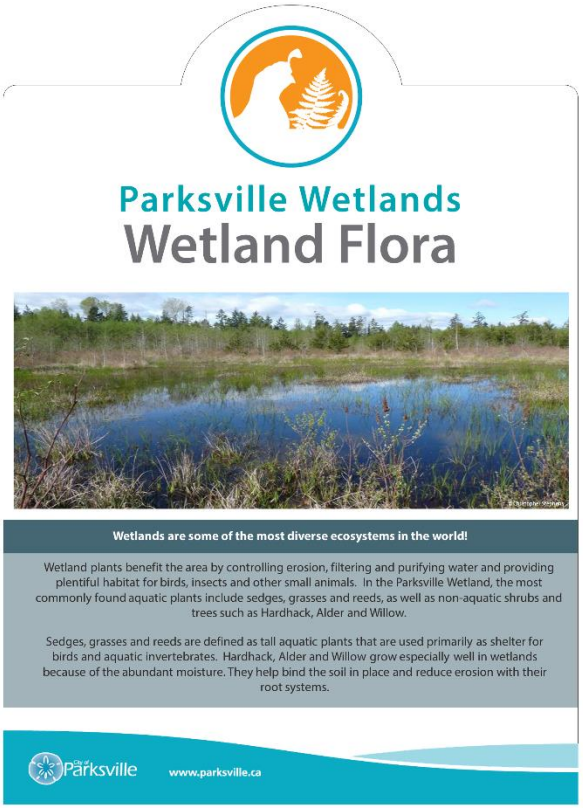

Figure 27: Signage highlighting the unique flora that is found within a wetland and keeps a wetland healthy

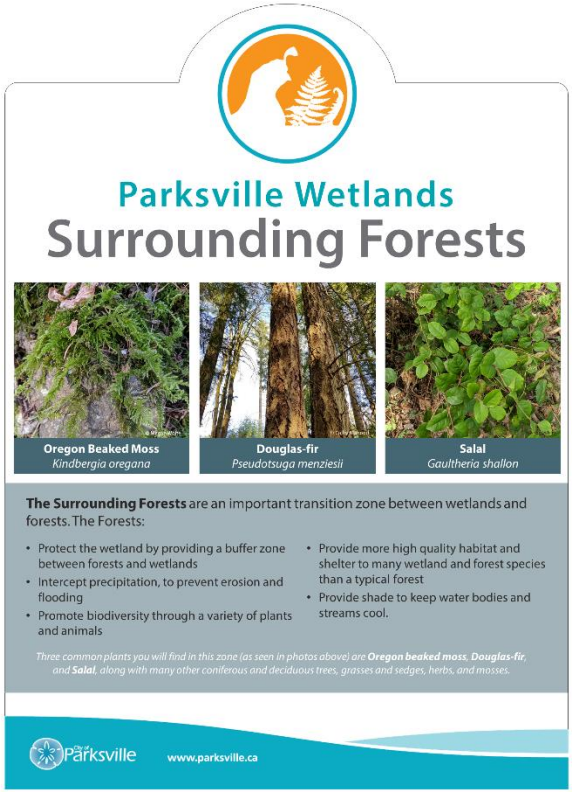

Figure 28: Signage that highlights the different trees and forests that can be found within the wetland and the region

Figure 29: Signage that has been created to show where the interpretive signage above can be found within the park

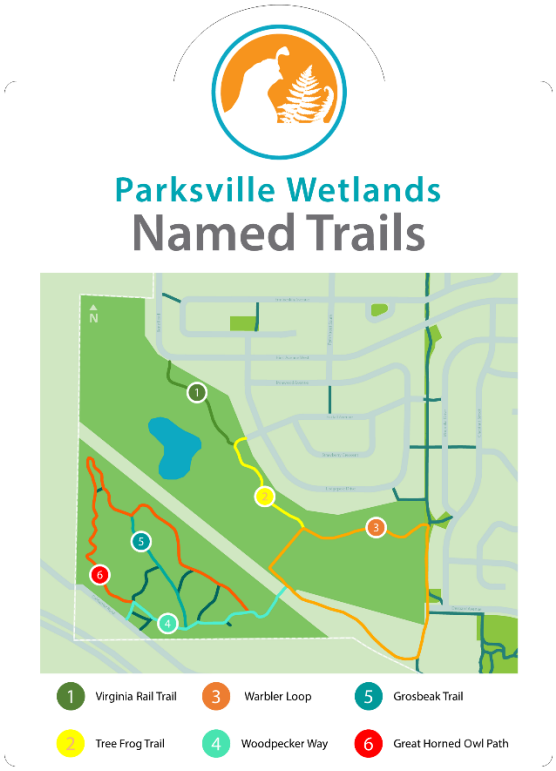

Figure 30: Signage that was created to show the different trails found within the park and their unique names

17.0 Recommendations

The VIU Geography 452 class provides the following recommendations to the Parksville City staff for the Parksville Wetlands:

1. Continue to engage citizens by collaborating with VIU to host an annual bioblitz and interpretive trail walks; consider collaborating with Springwood Elementary School as well for scavenger hunts and plant ID activities that are low-risk to species and degradation.
2. Host annual "spring clean-up parties" to remove waste and invasive plant species from site.
3. Consider assisting in the formation of a "Friends of the Parksville Wetlands" local stewardship group, capitalizing on the local community to assist with the above recommendations (1 and 2).
4. Consider including amenities such as benches, garbage disposal bins, and dog bag dispensers on the newly constructed trail networks.
5. Consider small-scale signage for important wildlife trees to highlight their ecological importance to the park's ecology.
6. Consider adding links and/or QR codes to signage that will link visitors to further information.
7. A *Can you Identify* "unique birds" poster is included in the posters above (section 16, page 32); consider duplicating this poster with a "common birds" poster as well and place them side-by-side.

8. Cost out a raised platform viewing area adjacent to the wetlands that would provide more optimal viewing opportunities, and determine if the costs and maintenance associated are feasible.
9. Consider one or two small trails that branch off a small distance from the main trails to provide better viewing access to the wetlands, with clear end-of-trail signage highlighting that any further movement would be a disturbance to the habitat, flora, and fauna.
10. Have the City signage designers use the student work as templates to print and install 10 signs in the Parksville Wetlands (3 site overview signs will be required for multiple main entrances; see recommendation 7 for possibility to design one more sign).
11. Consider naming main trail sections (highlighted in section 16, page 35).

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