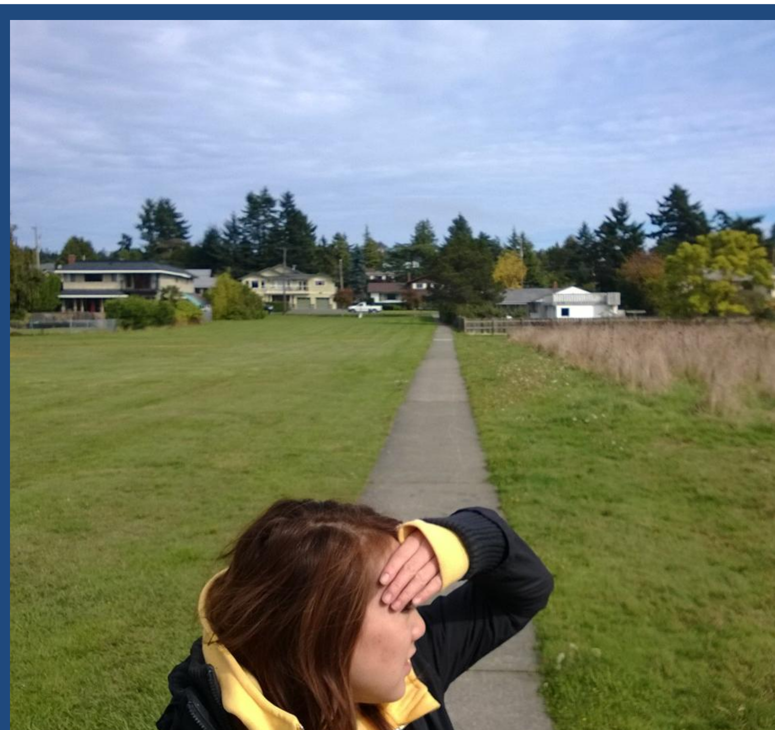
Cadboro Bay – Gyro Park

Ecological Restoration Plan

JM Cox, J Lam, M Macfarlane



ES 341 – Fall 2013

Cover photos:

Figure 1 (left): Existing recreation area (Cox, 2013)

Figure 2 (right): Overlooking the area to be restored (Cox, 2013)

Figure 3 (bottom): Panorama of Gyro Park (Cox, 2013)

Contents

Figure 4: Surveying the area to be restored (Cox, 2013)

Cadboro Bay – Gyro Park Master Plan

Vision

This project intends to generate a community space which encourages interaction between visitors and nature, and fosters culture through improved ecological function, management and education.

Introduction

Site Description

Cadboro Bay is a community and bay situated between the University of Victoria, the Uplands district to the south, Ten Mile Point to the east, and the Queenswood neighbourhood. The area is considered to be in both the Municipality of Saanich and the Municipality of Oak Bay (District of Saanich, 2012). The Cadboro-Gyro Park is jointly named after the bay upon which it sits and the Gyro Club, who in 1953 purchased the original 1.78 hectares of the park from the Goward Estate. In 1954, the Club donated the land to Saanich and in 1961 Saanich began acquiring adjacent parcels. Today the park is 6.189 hectares in size (Gyro park fact sheet, n.d.). The area is located in both the Municipality of Saanich and the Municipality of Oak Bay (District of Saanich, 2012).

General Information

Cadboro-Gyro Park is a popular area that serves local residents and the entire Municipality. It is an easily accessible park featuring prime waterfront and beach recreation facilities. The park highlights an accessible sandy beach with waterfront views of the Juan de Fuca Strait and the Olympic Peninsula (District of Saanich, 2012).

History of Cadboro Bay

Historically, the site was a coastal Douglas-fir and Gary Oak ecosystem with the area near the beach originally being a marshland. The area was later covered with hog-fuel and eventually with a heavy layer of beach sand. The bay was named after the Hudson's Bay Company (HBC) brig Cadboro, which sailed into the bay in 1837. In 1850, seventeen HBC employees were living in the area, employed at the HBC Uplands Farm which was located on the area now occupied by the University of Victoria. In 1861, Vancouver Island's first telegraph connection was made between Telegraph Cove and Olympia, Washington. This area was also home to the HBC dock, and in 1895 was the location of the Giant Powder Company of San Francisco explosives plant. Farming continued to dominate the prime agriculture lands surrounding the bay. In 1920, the popular Cadboro Bay Beach Hotel was opened, only to be destroyed in a fire in 1930. The surrounding farmland was gradually subdivided and developed as residential property (Cadboro Bay, 2008).

Current Conditions

Main Attractions

Figure 5: Playground including swing area, as viewed from the parking lot, looking northeast (Cox, 2013)

One of the main features includes a unique children's play area with iconic play structures such as the Cadborosaurus. In the summer the large grassy fields provides a popular space for recreational activities. Other amenities in the park include dog stations, a parking area, community picnic areas, an all-season permanent washroom building, and a tennis court. Additionally, there is a large compound used for sailboat storage as well as an activity building that is utilized by Scouts and Girl Guides.

In August 2013, the Cadboro-Gyro Park planning process addressed a number of accessibility concerns by creating a concrete ramp to the beach and incorporating seasonal mats to be placed on the soft sand for wheelchair access.

Park Open Areas

The park has a large five hectare grassy open area separated by a path located at the north end. This area is surrounded by a few Trembling Alders and Willows. Additionally there is a low-lying area that has been identified by the District of Saanich to have broad support for a wetland located near a mass of Himalayan blackberries.

Presently, the Cadboro-Gyro Park open spaces are suitable for hosting events. Many community events, including Saanich's Sunfest (Cadboro Bay Festival), are held yearly and attract hundreds of visitors throughout the region. The park's recreational amenities such as picnic tables, a garbage area, a permanent washroom, and the children's play area provides a popular place for families, community church groups and companies to host social events like picnics, birthday parties and fundraisers (Saanich Summer Sunfest, n.d).

Climate

Figure 6: Playground as viewed from the Cadborosaurus play structure, looking southwest (Cox, 2013)

Cadboro-Gyro Park is an associated Gary Oak ecosystem which has a unique climate within the region. The winters are mild and relatively warm due to low pressures; the Coast Mountains impede the cold high pressure systems. Winter temperatures along the coast are further moderated due to the close proximity to the ocean, which is dominated yearly by the mild waters of the California Current. The scarcity of snow and frosts allows some vegetation to remain green throughout the winter.


Figure 7: View of the waterfront, looking east (Cox, 2013)

This region lies in the rain-shadow of the Vancouver Island and Olympic Mountains; this allows the area to retain moisture from the prevailing systems that move in from the Pacific. As the systems continue to move eastward, they are forced to rise over the Coast Mountains, resulting in moister, cloudier conditions in the lower mainland of British Columbia. Consequently, southeast Vancouver Island experience drier winters than other areas in south coastal British Columbia.

Summers are cool and dry due to a large semi-permanent high pressure area that extends over the northeastern Pacific which dominates the general circulation in the area. The Olympic, Vancouver Island and Coastal Mountains intercept much of the moisture from systems moving into the region. The months of May, June, July and August bring in less than 25mm of mean monthly precipitation; consequently moisture deficits develop. Summer temperatures are regulated by close proximity to the ocean (Fairbarns, n.d).

Climate data taken from 500 m to the northwest at the University of Victoria records an average yearly precipitation of 646.5 mm, 51% of which falls during the months of November to January. These months only account for approximately 10% of the average annual sunshine hours. Refer to Figure 18: Climate data for University of Victoria, Oak Bay, BC (Environment Canada, n.d.).

Hydrology

In the summer, the water level is well below the park surface due to the absorption by soil that channels the water into the ocean. This results in expansive grassy meadows with the winter ponds drying up into dusty patches. However, in the winter, the soils saturate and the water table in the park rises to the surface in many locations


Figure 8: Newly commissioned mobility improvements include a concrete wheelchair ramp, as viewed looking southwest (Cox, 2013)

scattered throughout the park, disrupting paths and passages. Due to the synthetic composition of the park surface, it is constantly sinking unevenly (Gyro Park Redevelopment Plan, n.d).

Ecology

Victoria's mild climate allows wildlife species to be present year round. Species are more numerous during the spring and fall migrations. The highest bird numbers occur in the winter, representing several species of water birds, including gulls, cormorants, diving and dabbling ducks, and mergansers.

Native species

A variety of native species are present on the property. These species will remain, as they promote the ecological integrity of the area. Furthermore, native species that are adapted to wetland habitats are also present. Please refer to Table 3: Native species in the Cadboro-gyro park area (Macfarlane, 2013), as well as Table 6: Plants to be considered for use in the engineered ecosystem.

Invasive Plant Species

The low-lying area identified for restoration is primarily dominated by a mass of Himalayan Blackberry and Smooth Hawksbeard, though a variety of other invasive species are present on the property. Their removal from the site is recommended, but not within the scope of this project. Removal may be conducted through a coordinated volunteer project. Opportunities for a site-wide controlled and a managed planting with non-invasive species should be considered for a future project.

Protected Management Category

Cadboro-Gyro Park is designated a Community Park by the Saanich Parks and Recreation. This project team assesses the park as a Category IV (conservation through management intervention), in the IUCN Protected Area Management Categories (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012).

Natural and Cultural Heritage Values

Cadboro Bay was the principal village for the Chekonein peoples, and was called Sugayka, which meant "patches of snow". Prior to contact with the Europeans, the ancestors of the Songhees Nation were members of the Chekonein; the Chekonein occupied parts of southern Vancouver Island, including all the lands south of Mount Douglas and around Cadboro Bay, Ten Mile point, the University of Victoria and Chatham and Discovery Islands at or near Victoria, British Columbia. The Chekonein peoples later relocated to Songhees Point where they would be with the other family groups (Morohan, 2009).

The bay itself is home to the mythical sea monster Cadborosaurus, nicknamed Caddy, which has reportedly been spotted swimming in its calm waters.

Past Projects

Cadboro-Gyro Park has been the subject of many reviews in the past. Main issues addressed flooding problems, installation of services and attempts to reduce maintenance (Cadboro Bay Redevelopment plan, n.d).

- In 2009, an extensive planning and public engagement process has been undertaken by Saanich Parks. This process included several public open houses, many community and staff meetings, presentations, a facilitated workshop and several surveys.

- In 2011, the District of Saanich, led by several consulting companies proposed several conceptual plans for the redevelopment of the park. The project involved assessments of the existing condition, uses and challenges, extensive public and stakeholder consultation, developing a design based on consultation, site limitations and various issues.

- Funding from the 2012 Provincial Community Recreation Grant led to the implementation of a concrete ramp to the beach including seasonal mats on the soft sand to address the accessibility problems. The grant was posed to fund accessibility, playground and some drainage improvements in the park. The grant requires the projects to be completed by the end of March, 2015.

- In June 2013, an open house resulted in almost 250 survey responses. However, support for the three concept plans received mixed support; thus, it was not sufficient to move forward with certainty (Concept Plan Update, n.d)

Problem Identification

From the June 2013 survey, which received approximately 250 responses, support for three concept plans created by Saanich Parks was mixed and not sufficient to move forward with certainty. As a result, no definitive preferred plan has emerged. However, based on the responses in the survey, the strongest support for any individual park improvement is the development of wetland habitat to be used for seasonal flood mitigation. According to a survey conducted in 2011, another top issue that needed to be addressed included a need for an improvement for litter and garbage disposal (Cadboro Bay Redevelopment plan, n.d).

Currently, the park provides several large garbage disposal areas located throughout the area, with a concentration near the picnic area. A majority of the park garbage disposed of can be separated into recycling and compost; however, there are no bins available for either.

Presently, manicured lawns that are not ecologically beneficial, dominate the park. Internal and external stakeholders describe the park as tired and neglected; however, they also indicated that the fundamental character of the park does not need to be changed as many enjoy and are strongly protective of the existing trees, the original play structures, the open fields, and the log strewn beach. Stakeholders identified an untapped potential for improved recreational activities and incorporation of ecologically sensitive features for restoration. There has been discussion amongst the community to create a “natural” character in Cadboro-Gyro Park, where trees, shrubs, meadows, and meandering paths predominate as opposed to “constructed” features such as hard surfaces, walls, buildings and roads (Cadboro Bay Redevelopment plan, n.d). Immersion in a natural landscape promotes a greater comprehension and appreciation in nature to all members in the community.

This proposal seeks to creatively represent the desire to minimally intervene in the site by utilizing an area dominated by invasive plant species to manage seasonal flooding. Additionally, this plan strives to encourage community engagement through ecological and cultural education.

Costs/Budget

As of the result of a 2012 Community Recreation Grant, $337,500 from the Province and $337,500 from the District of Saanich has been put aside for improvements to Cadboro-Gyro Park. The plan as presented in this document estimates a one-time cost of $113,000. Although efforts will be taken to ensure the autogenic functioning of the wetland is restored, there will be basic upkeep costs associated with the yearly maintenance of approximately $25,000. This project’s prices have been estimated according to the Constructed Wetlands Design Manual (US EPA, 1999).

Table 1: Cost estimate and breakdown of constructed wetland, water management, and community engagement plan

Goal/Element	Approximate Construction Cost	Approx. Yearly Maintenance
Constructed wetland	$43,000	$10,000
Water management	$40,000	$10,000
Community Engagement	$30,000	$5,000

Wetland	Approximate Cost	Notes
Excavation, compaction and invasive species removal	$10,000	$2.30/m^3
Soil (45 cm)	$6,000	$1.30/m^3
Pond liner (30 mil PC)	$6,000	$3.75/m^2 (for 2000 m^2)
Planting	$7,000	$0.60 each, 60 cm o.c.
Plumbing	$7,500	Lump sum
Control structures	$7,000	Lump sum

Improve water management on site	Approximate Cost	Notes
Excavation and subgrading	$5,000	$2.30/m^3
Drainage (pipe)	$25,000	$25,000/field, pipe and gravel
Reuse topsoil	$5,000	$5000/field
Reuse sod	$5,000	$5000/field

Community Engagement	Approximate Cost	Notes
Picnic tables Purchase and install	$4,200	For 3
Pour concrete pads for picnic tables and shelter	$5,500	
Purchase and basic signage	$2,000-5,000	For 3
Green cone digester	$165	For 1
Benches- purchase and install	$3,000	For 3
Composting services	$2,000 - $3,000	$22.50/ pickup
Recycling services	$1,000 - $1,500	$0.10/kg
Shelter units	$12,000	For 2

Stakeholder Engagement

Stakeholders for this project include:

1) The **District of Saanich** – Gyro Park falls under the jurisdiction of the District of Saanich and will require constant communication between project managers and Saanich Parks as they're services will be relied upon.
2) The **BC Ministry of Environment**:
    (a) **Ecosystems Branch –** with regards to species at risk and ecosystems at risk.
    (b) **Riparian Areas Regulation –** responsible for protecting areas that integrate land and water *i.e.* lakes, streams, and wetlands.
3) The **Ministry of Aboriginal Relations and Reconciliation (MARR)** – as the proposed wetland is to be created on traditional Songhees First Nation land consolation with MARR may result in the need for an archaeological assessment of the area before work can begin
4) The **Cadboro Bay Resident's Association**
5) The **Department of Fisheries and Oceans Canada** – As the proposed project will directly feed water into the ocean at Cadboro Bay, the DFO must be consulted at least with initial mail out
6) **Environment Canada**

Communication Strategy

1. After the initial proposal has been developed with the assistance of hydro-engineers, biologists, and other specialists, it becomes the responsibility of the project managers to communicate with the proper levels of government, and to the public, to ensure that the project meets the logistical, environmental, and aesthetic requirements for the area, and allows for changes to be made if the initial proposal does not satisfy these requirements. The list of government, municipal and local contacts to include in the initial mail out includes the stakeholders mentioned above. The initial mail out should include the project goals and objectives, the initial design, a site assessment, and a rough budget.
2. As the project progresses it is extremely important to keep in touch with any stakeholders to avoid conflict. With regards to the governing bodies who received the initial mail out, they will largely dictate a timeline for communication throughout the process, as well as set standards with regards to their respective responsibilities. Equally as important is communication with the local community, as they will be directly impacted as a result of this project. Frequent check-ins should occur to inform the community about any changes or progress that is being made.
3. After the responses to the mail out have been collected, we are to hold an open house for the general public to attend. During the course of the open house, a comment and feedback period will take place. The information gathered will, in turn, allow us to make adjustments to the plan as necessary.
4. A second open house should be held between 2 – 6 months later that provides a more updated project plan, one that has incorporated both public feedback and government refinements. As was the case with the first open house, there will be a period for questions and feedback to fine tune the plan.

5. Information about the open house, including when and where, should be made available through local newspapers and/or through social media sites to reach a broader public
   Once the project has gone through its final adjustments, managers should have lined up an agreement with Saanich Parks to utilise the equipment and workforce to complete much of the excavation and moving work.
6. Contract work will be required for any storm water management changes, and/or if the construction work cannot be taken on by the project team or Saanich Parks. The workers will be given strict instructions that outline the details of the plan. This will not only include the dimensions of the wetland, but materials, sediments, plants and water levels.
7. The initial monitoring of the area will be significant and frequent to ensure that the system takes to its environment. This could involve a division of Saanich Parks or be coordinated within the management team.
8. After the area is established continued monitoring will be carried out and measured utilising Saanich Parks to do the menial tasks, and perhaps contracting out to research or environmental agencies to efficiency and health analysis.

Ecological Restoration Goals and Objectives

Based on the problems identified in the 2011 and 2013 surveys, this project has three specific goals:

1. Manage seasonal flooding with the use of a constructed wetland,
2. Enhance the ecological integrity of the site,
3. Encourage community engagement through ecological and cultural education.

Goal 1: Manage seasonal flooding with the use of a constructed wetland

This project proposes to improve water management on site through the responsible mitigation of seasonal floodwaters with the use of a constructed wetland.

Goal 1 Objectives

The construction of the wetland to manage seasonal flooding will meet the following objectives:

1. Reinstating key ecological processes by re-establishing natural hydrology, as well as physical and chemical conditions that support ecosystem structure and function,
2. Enhancing the ecosystem to contribute to its resilience, adaptation to climate change, and allow the ecosystem to store and sequester carbon,
3. Providing ecosystem services such as clean water, by treating nitrogen and phosphorous runoff preceding drainage into Cadboro Bay,
4. Mitigating existing flooding conditions, therefore improving the visitor experience of the park,
    a. Enhancing drainage in flood-prone areas,
    b. Rerouting existing drainage lines to wetland.

Goal 2: Enhance the ecological integrity of the site

The construction of the wetland will also facilitate the goal of enhancing the ecological integrity of the site by controlling harmful invasive species, improve biotic interactions, and increase ecological function.

Goal 2 Objectives

The enhancement of the site's ecological integrity will be accomplished by:

1. Re-instating key ecological processes by reducing the influence of invasive species,
    a. Removing Himalayan blackberry and other species as identified during implementation,
2. Promoting biodiversity and recovering species and habitat which has been degraded or lost,
    a. Restoring culturally important nature,
    b. Incorporating native plant species to facilitate a more dynamic environment,
3. Protecting and augmenting ecosystem services, re-establishing natural hydrology, or other physical and chemical conditions that support ecosystem structure and function,
    a. Reducing the prevalence of flooded areas during winter months,
    b. Utilizing ecosystem services to treat effluent water,
4. Enhancing the resilience of ecosystems and helping nature and people adapt to climate change,
5. Helping mitigate climate change by storing and sequestering carbon,
6. Improving the ecological aesthetics of the degraded area, therefore providing high quality visitor experiences,

7. Incorporating the current park management system into a long-term sustainment plan.

Goal 3: Encourage community engagement through ecological and cultural education

The final goal of this is to foster a relationship between three concepts: the engagement of the community, ecological education, and the promotion of historical cultural awareness.

Goal 3 Objectives

Enhancing community engagement through ecological and cultural education will be achieved according to the following objectives:

1. Protecting and reinforcing local traditional culture,
    a. Restoring culturally important nature by incorporating native plant species in the project design,
2. Engaging community with the enhancement of existing community area,
    a. Installation of three additional picnic tables and park benches,
    b. Implementing a recycling and food scrap program,
3. Promoting both ecological and cultural education,
    a. Erecting educational signs within community areas to promote:
        i. Ecological awareness by highlighting elements of the natural environment, native species education, invasive species awareness as well as how the restored area contributes to the overall function of the park,
        ii. Unique historical aspects of the area with respect to culture.

Ecological Restoration Approach

The design utilises most of the approximately 0.65 hectare area for wetland services, limiting the amount of human interaction in an attempt to maximize biodiversity for the area, and to allow for a more functional ecosystem.

Project Design

As the current subsoil (peat soil) demonstrates a higher than optimal porosity, an impermeable liner of EPDM material or clay must be laid to allow for the creation of a more isolated and controlled system (UN-Habitat, 2008). In order to create this ideal environment the substrate will first be excavated down to a depth between 1 and 2 meters. To reduce the potential for tears in EPDM, a layer of sand should be laid before the liner is put in (UN-Habitat, 2008).

A rerouting of the current storm water drainage system will be required to redirect some of the water flow into the wetland area. This will require excavation of surrounding areas and installation of drainage pipes that can effectively distribute the water into the wetland. To create better drainage in the recreational park areas (areas currently subject to flooding), the excavation and storm water drains should be expanded to include some of these areas.

To determine the relative size of the wetland design, project designers must determine the volume of water that flows through the existing storm pipes, and determine the level of filtration they wish to achieve (Alberta Environment, 2000). This would require the cooperation of Saanich Parks, as well as the collection of samples of untreated storm and flood water throughout the year. After these have been completed, the designer would use feasibility calculations to determine the required size of the wetland (See appendix for an example of these calculations) (Alberta Environment, 2000). As the primary source of water is storm water, and not waste water, the need for a primary treatment area is unlikely; but if the sediment load is deemed too much, then a septic tank should be installed to pre-treat the source before entering the wetland (Tilley et. al., 2008).

Below we lay out 2 different options for wetland design. The first is a Horizontal Subsurface Flow (HF) wetland, the second a Surface Flow (SF) wetland. For the goals laid out in this project it is better suited to implement an SF wetland, but it is ultimately the choice of the stakeholders to decide which of the two designs are to be implemented based upon the service they wish to see fulfilled.

The Horizontal Subsurface Flow Wetland

A Horizontal Subsurface Flow (HF) Wetland is a subset of subsurface wetlands. A more innovative design, these wetlands demonstrate an increased ability to filter waste or storm water in a smaller area of land when compared to SF wetlands (Reed, 1994); however, they are also more expensive and create less wildlife habitat than SF wetlands.

As the water is directed towards the wetland area from the existing storm drains, it will enter the wetland through a series of drains that will allow for even distribution of water. By creating a slope of ~1% between inlet and outlet pipes, the water will slowly percolate though the new substrate were it will come into direct contact with the vegetation and any microbes living at their roots (Tilley et.al., 2008).

The substrate of the HF wetland should be a combination of fine gravel and top soil. At a depth of 0.5 meters the new substrate should have a porosity of between 30-40% to allow for constant water flow even in winter months (Reed, 1993).

At the inlet and outlet spouts of all drainage pipes, larger gravel (8-15cm) must be used to prevent clogging of the irrigation system (Tilley et. al., 2008). At the outlet pipe of the will be 4 wet wells. These are responsible for controlling the level of water in the wetland, and have the potential to trap unwanted sediment before the water re-enters the storm water pipes (Tilley et. al., 2008). As there is an increased need for maintaining the wet wells, surface access points will be required.

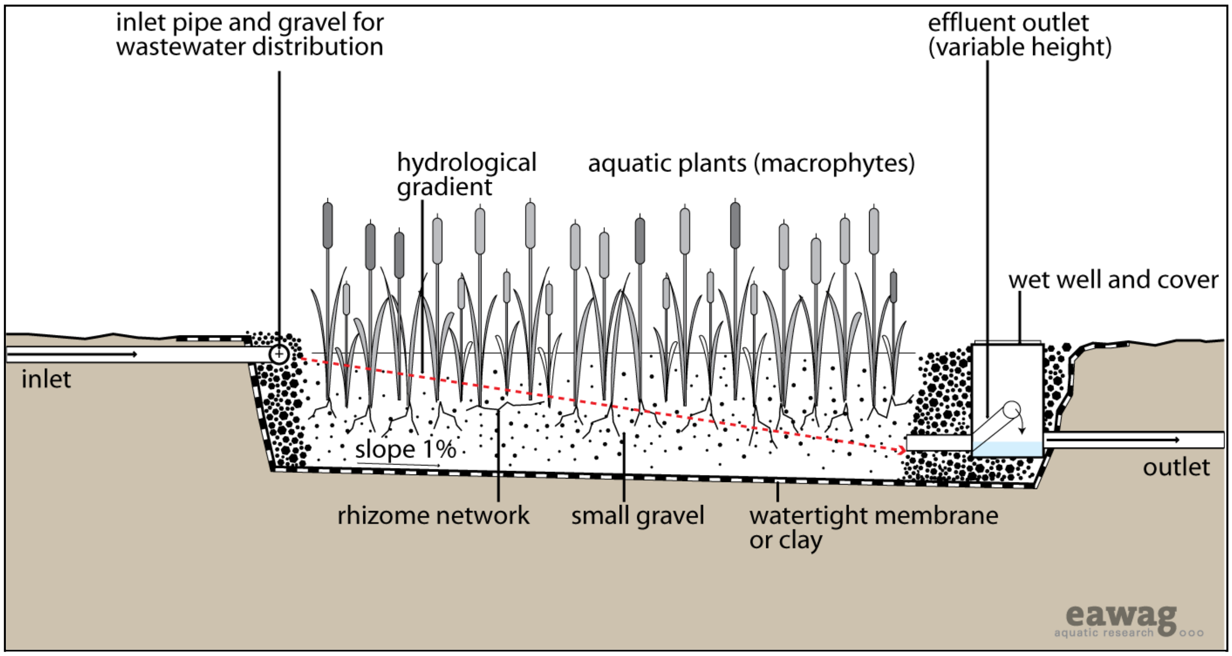


Figure 9: Horizontal view of an HF wetland (Tilley, *et. al.,* 2008)

The effectiveness of an HF wetland allows for the area to be considerably smaller in comparison to a SF wetland (likely around 2,000 m^2). By choosing this option the public would have more access to the area, or allow for other restoration efforts to occur; however, the biodiversity of the site would not see any considerable improvement as the objective is primarily to utilise an ecosystem service.

Surface Flow Wetland

Subsurface Flow (SF) Wetlands are the more traditional style of constructed wetlands as they are more representative of a natural system. They are popular due to their increased aesthetic value and for the wildlife habitat that they create when compared to subsurface wetlands (i.e., HF wetland); however, the standing water presents the potential for mosquito breeding and odour build-up (Tilley et. al., 2008).

For our design we wanted to be able to maintain a constant body of water. As a result, the inlet and outlet spouts will be located above the water level. Designers would create a staggering of drainage pipes, the outlet being bellow to inlet, to prevent back flow in the case of flooding (Tilley et. al., 2008). The side walls of the basin would also be slopped to further reduce the threat of back flow. There should be a gradient in the bed (roughly 8%) to allow for some flow of water in an attempt to avoid problems associated with stagnant water (US-EPA, 2012).

The substrate will consist of a combination of rocks, gravel and top soil and will be laid to a depth that allows the vegetation to take root. The basin is to be planted with native plants that are submergent, and/or emergent (NYS Department of Environmental Conservation, 1997). The ground should be created with varying heights to allow the water level to be a range of depths from shallow up to 1m in places near the drainage spouts. This will create a more diverse system and will hopefully prevent single species from dominating the area (MacKenzie & Moran, 2004).

The rough size of the wetland is 6500 m^2. Not shown in Figure 10: Horizontal view of an SF wetland (Tilley, *et. al*., 2008), is the need for a levy/damn surrounding the flooded area to account for different flood potentials (US-EPA, 2012).

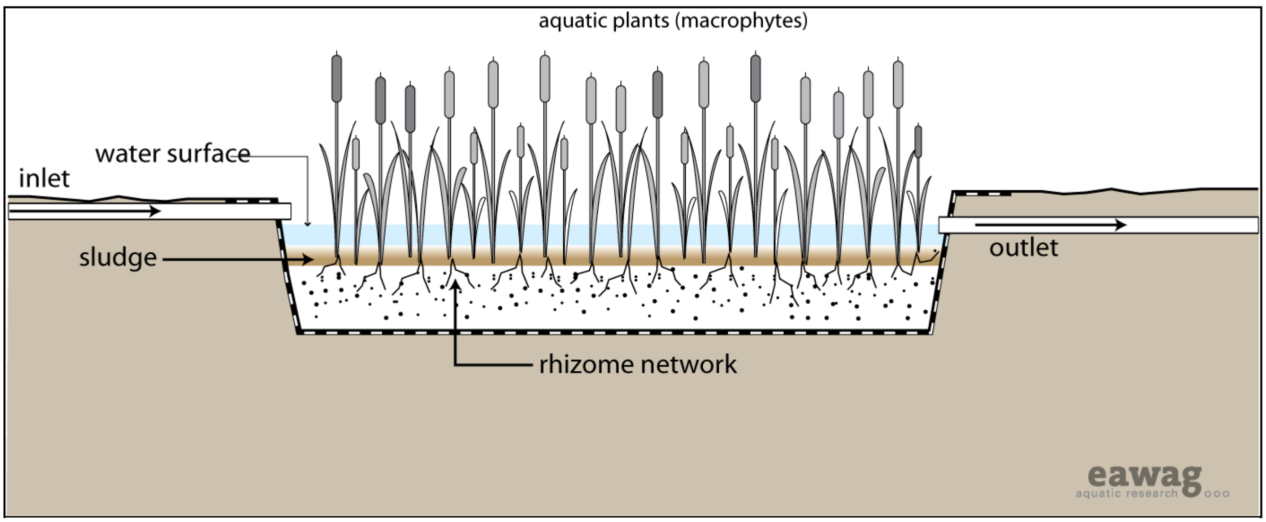


Figure 10: Horizontal view of an SF wetland (Tilley, *et. al*., 2008)

General information about the designs

The limiting factor in both designs is the flow of water, depending on the chosen design storm water pipes would be re-routed accordingly to either filter more or less of the water. In either case, if the volume of water that flows through the storm pipes is too significant to manage the project will fail.

The primary purpose of a Horizontal Subsurface Flow wetland is to treat water; where as the primary objective of the Surface Flow wetland is to create a more natural system that increase biodiversity, but does not treat water as effectively. It should also be noted that an HF wetland is considerably more expensive.

It should also be noted that the sizes suggested above are simply for aesthetic purposes (with regards to the SF wetland) or for ball-park figures. Without proper water analysis and volume figures, no final design can be created. Please refer to Figure 19: Subsurface Flow (SF) treatment wetland - preliminary feasibility calculation sheet (AENV).

In an attempt to construct a wetland that is as natural as possible, project managers should look to implement native plants that would be ubiquitous to marsh and/or shallow water wetlands in the area. Both have a tendency to be simple communities dominated by one or few relatively aggressive species (MacKenzie & Moran, 2004). We decided that planting a number of plant species would allow for the most adaptive to succeed in our engineered design. This is also an attempt to increase diversity in otherwise simple ecosystems. Please refer to Table 6: Plants to be considered for use in the engineered ecosystem.

Interactive/Recreation Area

To encourage public interaction we have decided to create a recreation area at the north-west side of the wetland. Taking up a space of roughly 2,000 m^2, it will include signage to provide information about the area and the Songhees First Nations, park benches, recycling, composting, and area general green space. The addition of three picnic tables and three park benches will attract visitors to the wetland community area and also promote community engagement.

Educational signs will be erected in the community areas near the proposed wetland to promote environmental awareness and to identify unique aspects of the history of the area. These educational signs highlight elements of the natural environment and are a fun way to engage people in interacting with the natural environment. Furthermore, information about the First Nations promotes cultural and historic awareness will be provided in that area. Please refer to: Figure 11: Park education and general information sign 1 of 3 (Lam, 2013), Figure 12: Park education and general information sign 2 of 3 (Lam, 2013), Figure 13: Park education and general information sign 3 of 3 (Lam, 2013), and Figure 14: First nations cultural significance education sign (Lam, 2013).

Recycling food scraps reduces garbage and greenhouse gas emission, extends the life of the Hartland landfill, and turns a valuable resource into a useful product. As a reference project, in 2003, the University of Victoria implemented composting for all food waste from operational activities on campus. The program has grown steadily over the years. The University's waste is picked up by the reFUSE Resource Recovery and sent to an industrial composting system in Cobble Hill. This system can take many items that cannot normally be put in a backyard composter. For example, all meat and dairy products, paper towels and paper coffee cups can be composted. (Composting, n.d.; Green Garbage Collection, 2013). To ensure that users dispose the correct items in the food scrap bin, a small sign will be erected near the bins that will let people know what is acceptable. Refer to Figure 15: Acceptable items for cone digester compost system (Lam, 2013).

ReFUSE provides commercial composting services to business and companies throughout the region, as well as:

- Assessing the needs of the area and provide containers to store material for pick up,
- The pickup of containers on scheduled days and replaces old containers with clean ones
- All compostable materials are taken to a licensed composting facility.

ReFUSE also provides commercial recycling services. Paper and cardboard recycling as well as a glass, tin and hard plastics recycling bins will be implemented (reFUSE). ReFUSE provides a selection of different sized refuse bins. Pick up fees depends on certain areas and special service requirements (reFUSE). Due to the seasonal trends in usage in the park, a 360L refuse bin would be used during spring and summer months (April to September) and a 240L refuse bin will be used otherwise to minimize costs and service. Pick up will be based on usage and seasonal trends.

A shelter will be built to house the compost and recycling bins. Two shelters comprising of the compost and recycling units are to be placed in the park; the site plan will further define appropriate uses and locations. Refer to Figure 17: Overhead view of current and proposed drainage lines in Gryo Park, Cadboro Bay for a Surface Flow (SF) Wetland (Macfarlane, 2013) for location.

Implementation and Management

This plan requires participation from all parties identified in the stakeholder engagement section. Additionally, the Contractor must align with processes used by the Municipality of Saanich during the construction of the wetland, as well as for long term sustainment. It is hoped that the University of Victoria's Ecological Restoration or Biology Departments become involved in this plan's implementation, as well as the monitoring and evaluation. This project shall adhere to the timeline as established in Table 5: Gyro Park Wetland Timeline (Macfarlane, 2013). This project shall also adhere to the proposed budget as established in Table 1: Cost estimate and breakdown of constructed wetland, water management, and community engagement plan.

The three components to be addressed during implementation are:

1. Implementation of water management improvement
    a. The Contractor shall ensure that all applicable approvals are in place before breaking ground,
    b. The Contractor shall reinstate key ecological processes by re-establishing natural hydrology, as well as physical and chemical conditions that support ecosystem structure and function,
    c. The Contractor shall enhance the ecosystem to contribute to its resilience, adaptation to climate change, and allow the ecosystem to store and sequester carbon,
    d. The Contractor shall allow the ecosystem to provide services such as clean water, by treating nitrogen and phosphorous runoff preceding drainage into Cadboro Bay,
    e. The Contractor shall allow the existing flooding conditions to be mitigated, therefore improving the visitor experience of the park by,
        i. Enhancing drainage in flood-prone areas,
        ii. Rerouting existing drainage lines to wetland.
2. Ecological restoration of the site
    a. The Contractor shall develop this area in accordance to plan as established in this document, using care to provide meaningful engagement to volunteers at the site,
    b. The majority of invasive plants on the site will be removed during the excavation phase of construction,
    c. The Contractor shall re-instate key ecological processes by reducing the influence of invasive species,
        i. Removing Himalayan blackberry and other species as identified during implementation,
        ii. Promoting biodiversity and recovering species and habitat which has been degraded or lost,
            1. Restoring culturally important nature,
            2. Incorporating native plant species to facilitate a more dynamic environment,

    d. The Contractor shall protect and augment ecosystem services, re-establish natural hydrology, or other physical and chemical conditions that support ecosystem structure and function,
        i. Reducing the prevalence of flooded areas during winter months,
        ii. Utilizing ecosystem services to treat effluent water,
    e. The Contractor shall enhance the resilience of ecosystems and helping nature and people adapt to climate change,
    f. The Contractor shall incorporate the current park management system into a long-term sustainment plan, including,
        i. Establishing a schedule for ongoing invasive plant removal,
        ii. Working with community and school groups to provide monitoring and evaluation,
3. Construction of eco-cultural education/recreation area
    a. The Contractor shall construct this area as discussed in Project Design section,
    b. The Contractor shall protect and reinforce local traditional culture,
        i. Restoring culturally important nature by incorporating native plant species in the project design,
        ii. Utilizing traditional ecological knowledge, where possible, throughout the development of the site,
    c. The Contractor shall be engaging to the community during the enhancement of existing community areas,
        i. Installing three additional picnic tables and park benches,
        ii. Implementing a recycling and food scrap program,
    d. The Contractor shall promote both ecological and cultural education,
        i. Erecting educational signs within community areas to promote:
            1. Ecological awareness by highlighting elements of the natural environment, native species education, invasive species awareness as well as how the restored area contributes to the overall function of the park,
            2. Unique historical aspects of the area with respect to culture.

Monitoring and Evaluation

Specialized input from biologists, hydrologists, hydro-geologists and engineers should be sought before designing and implementing any monitoring. Corrective actions should be taken if monitoring indicates that performance criteria are not being met, or if other indications are found that the wetland is not functioning as designed. Unsatisfactory findings, such as significant changes in water levels should be investigated immediately. Nuisance and exotic plants should be controlled during wetland grading and planting. Litter should be kept out of wetland area during and after construction.

The restored area shall undergo periodic monitoring and evaluation which will include but not be limited to:

1. Assessment of water management
    a. Prevalence of flooding/drainage,
    b. Water flow to/from wetland,
    c. Water levels of wetland,
    d. The inlet and outlet manifolds should be inspected routinely and regularly adjusted and cleaned of debris that may clog the inlets and outlets.
    e. Water quality sampling measuring BOD, Salinity, pH and other factors,
2. Monitoring the ecological integrity of the site
    a. Biological surveys of vertebrate and invertebrate communities, including species richness and interactions, native species propagation,
    b. Measure vegetative cover (as a percentage) and composition, species diversity, and presence of undesired plants or animals,
    c. Harvesting undesired plants (like weeds) when and where necessary.
3. Ongoing management of eco-cultural education/recreation area
    a. Litter management,
    b. Facilities repair,

It is proposed that the site will be monitored in part by the Municipality of Saanich and the University of Victoria's Environmental Studies and/or Biology students on a semester-basis.

Attributes of Restored Ecosystem

Restoration has succeeded when our project's goals and objectives have been met. However, as this is a long-term process, specific targets must be met. The restored area will be assessed based on, but not limited to, the following criteria (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012):

1. The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provide appropriate community structure,
2. The restored ecosystem consists of indigenous species,
3. All functional groups necessary for the continued development/stability of the restored ecosystem are represented, or have the potential to colonize by natural means,
4. The physical environment of the ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory,

5. The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent,
6. The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows of change,
7. Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible,
8. The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain its integrity
9. The restored ecosystem is self-sustaining to the same degree as the reference ecosystem and has the potential to persist indefinitely under existing environmental conditions.
    a. This may change as a part of normal ecosystem development, or fluctuate due to periodic stress.

The ecological integrity of the site will be assessed according to Table 2: Indicators for assessing ecological integrity in protected areas (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012):

Table 2: Indicators for assessing ecological integrity in protected areas (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012)

Assessing Ecological Integrity		
Biodiversity	**Ecosystem Functions**	**Stressors**
Species richness - Change in species richness - Numbers and extent of exotics	Succession/retrogression - Disturbance frequencies and size (fire, insects, flooding) - Vegetation age class distributions	Human land-use patterns - Land use maps, road densities, population densities - Poaching incidence - Presence of invasive species
Population Dynamics - Mortality/natality rates of indicator species - Immigration/emigration of indicator species - Population viability of indicator species - Population density of individuals or species	Productivity - Remote or by site - Biomass - Growth rates	Habitat fragmentation - Patch size, inter-patch distance, forest interior - Evidence of incursions - Pressures surrounding the protected area
Trophic structure - Faunal size class distribution - Predation levels - Plant/animal relationships (pollination, propagules dispersal)	Decomposition - Decomposition rates Nutrient retention - Calcium, nitrogen	Pollutants - Sewage, petrochemical, etc. - Long range transport of toxins Climate - Weather data and trends - Frequency of extreme events

		Other - Park visitor pressure - Hydrologic and sediment processes

Conclusion

As detailed in this plan, this project hopes to achieve the vision of generating a community space which encourages interaction between visitors and nature, and fosters culture through improved ecological function, management and education. This will be achieved through detailed design, preparation, communication, organization of personnel, implementation, adaptability to changing environment, monitoring, evaluation and reassessing. This project will be successful not just if it produces our tangible goals, but if it does so while adhering to the Guiding Principles as highlighted in the Appendix. It is desired that this plan inspires future development and improvement by the students of Environmental Studies.

Appendix

Table 3: Native species in the Cadboro-gyro park area (Macfarlane, 2013)

			
Evergreen huckleberry	Red huckleberry	Pacific Parsley	Cow Parsnip

Table 4: Invasive species in the Cadboro-Gyro park area (Macfarlane, 2013)

	
Himalayan Blackberry	Smooth hawksbeard

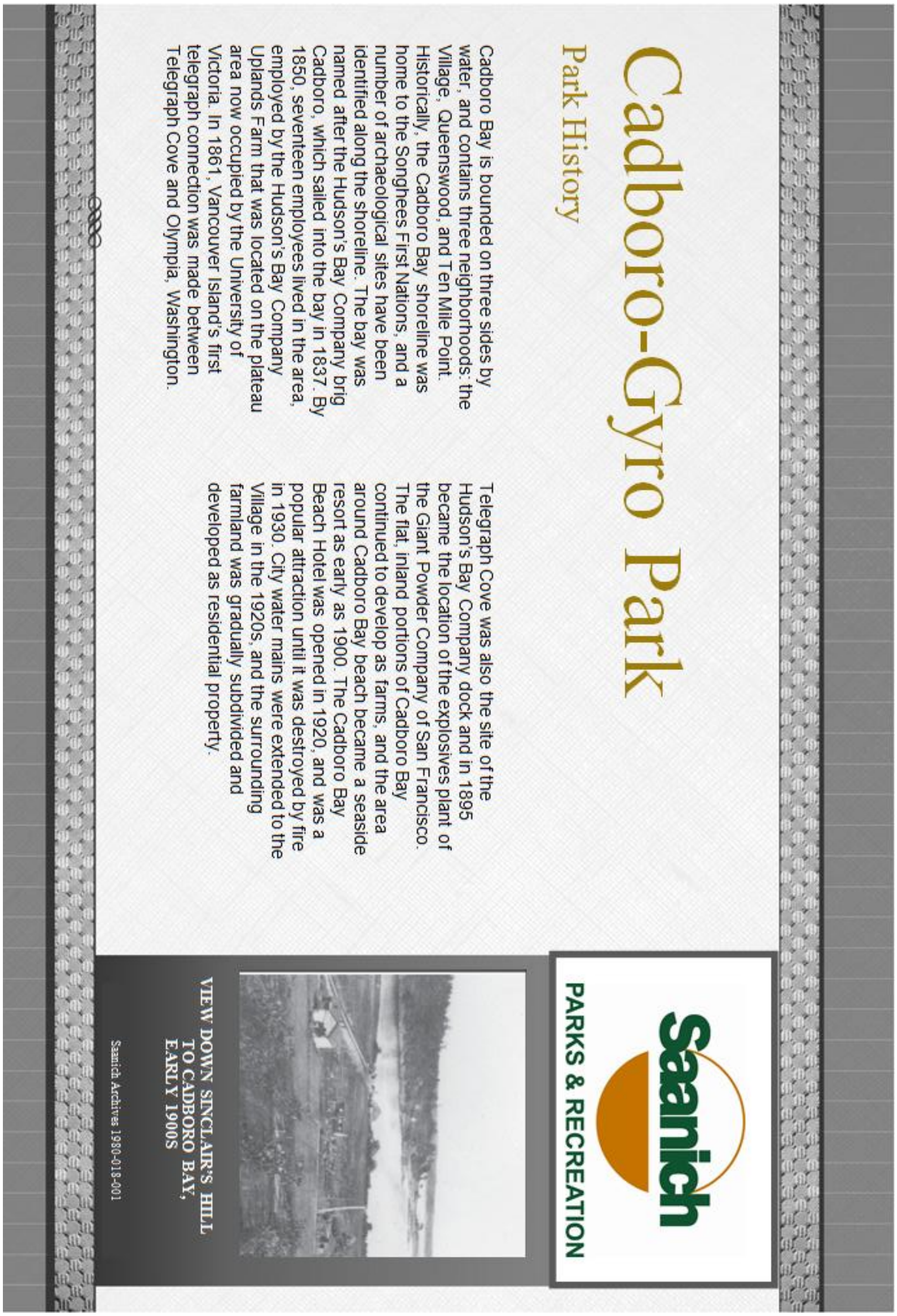


Figure 11: Park education and general information sign 1 of 3 (Lam, 2013)

Figure 12: Park education and general information sign 2 of 3 (Lam, 2013)

Figure 13: Park education and general information sign 3 of 3 (Lam, 2013)

Figure 14: First nations cultural significance education sign (Lam, 2013)

Figure 15: Acceptable items for cone digester compost system (Lam, 2013)

Table 5: Gyro Park Wetland Timeline (Macfarlane, 2013)

Gyro Park Wetland Timeline (rough)

Site Assessment	~ 2-4 MONTHS	Including List of current species, Background Information, Soil Composition, Problems that are needed to be addressed
Develop initial Proposal		Develop Goals and Objectives, Design Plan, Plant Database, Rough Cost Estimate, Timeline, Engagement Plans, Potential Contractors,
Make contact with key Stakeholders	6-14 MONTHS	Municipal representatives, CRD, BC Ministry of Environment (Ecosystems Branch and RAR branch), Department of Fisheries and Oceans, Ministry of Aboriginal Relations and Reconciliation, Saanich Parks, Environment Canada
Hold Open House #1		Opportunity for local and non-local community members to meat in a public area to observe Project Proposal, Allow for workshop type environment for community feedback
Reform Proposal		adjust according to feedback
Hold Open House #2		Come to the table with more solidified Plan of project and again allow for feedback
Finalize Project Plans		Adjust plans accordingly and finalize any design, cost, etc. issues,
Break Ground and Implement Design Plans on site	~ 5-8 MONTHS	
		with use of contractors initiate dredging and implementing drainage irrigation that feeds Wetland Area.
		lay membrane to separate porous peat soil from new soil to allow for better growth and maintenance, plant new species, fill water and back fill where necessary
		Implement composting and Recreational area, Erect Educational board
Project Monitoring and Sustainability Plan	INDEFINATELY	With co-operation of current maintaince system and likely a connection to University of Victoria ES, ER or Bio department to ensure maintenance, health and longevity of Wetland ecosystem

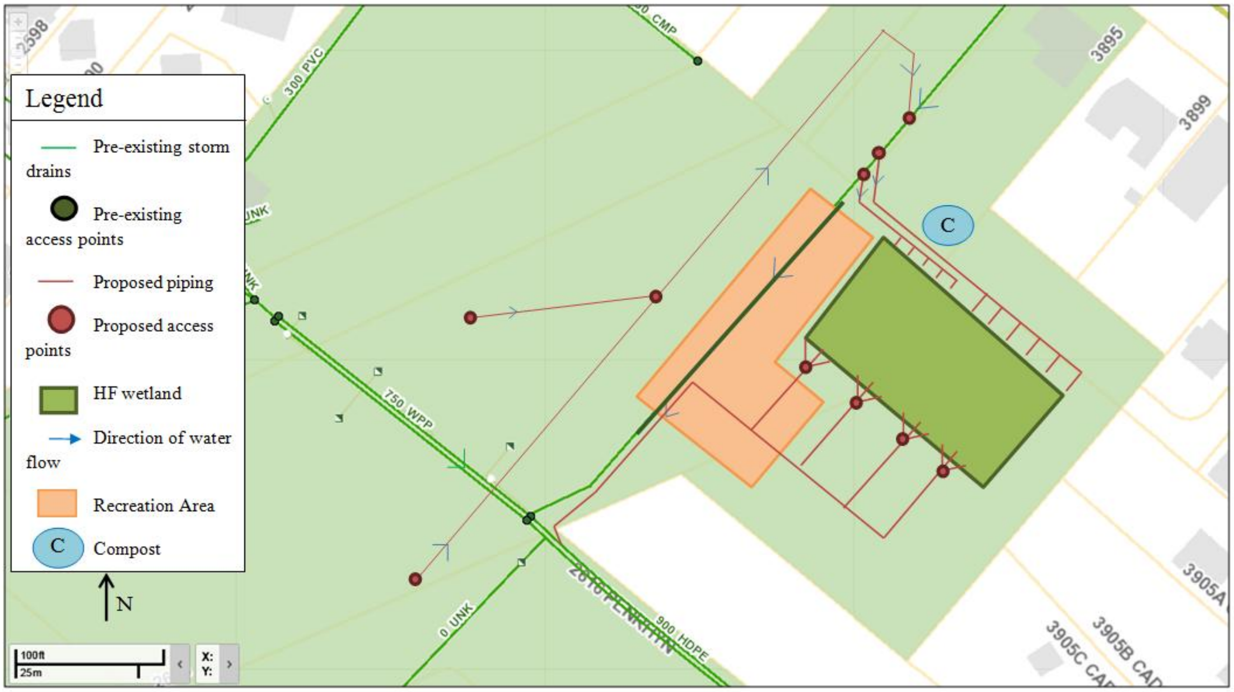


Figure 16: Overhead view of current and proposed drainage lines in Gyro Park, Cadboro Bay for a Horizontal Subsurface Flow (HF) Wetland (Macfarlane, 2013)

Figure 17: Overhead view of current and proposed drainage lines in Gryo Park, Cadboro Bay for a Surface Flow (SF) Wetland (Macfarlane, 2013)

Table 6: Plants to be considered for use in the engineered ecosystem (MacKenzie & Moran, 2004: USDA, 2013)

Name (Common, *phylogenetic*)	**Information**	**Implementation**
Common Cattail *Typha latifolia*	- Considered an invasive plant - Highly effective nutrient fixer - Common throughout the Coast at low levels with warm summers - Grow in substrate which remains saturated - Adapted to various sediments - Can be up to 3m in height - Food source for Muskrat and Canada Goose - Shelter for range of species - Flower from May to July	- Grow in water up to 1m in depth - pH must be between 5.5-8.7 - Soil must be greater than 14 inches - Low salinity in water - Plant seedlings at 1m intervals
Narrow-leaved bur-seed *Sparganium angustifolium*	- Commonly found throughout the province in small ponds - Fruit eaten by ducks - Submergent or floating	- Water depth between 20-100cm - Initially established in pots - Plant in summer
Hardstem Bulrush *Schoenoplectus acutus*	- Perennial - Dense root mass that can prevent erosion - Up to 3m in height - 1-2cm in width	- Plant 30- 45cm apart - During first growing season water should be 4-5cm deep - After established water can be up to 1m in depth in flood season

Climate data for University of Victoria, Oak Bay, British Columbia													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	15.0 (59)	16.5 (61.7)	21.0 (69.8)	23.8 (74.8)	28.8 (83.8)	32.2 (90)	37.6 (99.7)	34.5 (94.1)	28.1 (82.6)	23.5 (74.3)	16.8 (62.2)	16.5 (61.7)	37.6 (99.7)
Average high °C (°F)	8.4 (47.1)	9.3 (48.7)	11.0 (51.8)	13.9 (57)	17.5 (63.5)	20.5 (68.9)	23.7 (74.7)	23.5 (74.3)	20.1 (68.2)	14.3 (57.7)	10.5 (50.9)	8.3 (46.9)	15.1 (59.2)
Daily mean °C (°F)	5.9 (42.6)	6.2 (43.2)	7.5 (45.5)	9.6 (49.3)	12.6 (54.7)	15.3 (59.5)	17.7 (63.9)	17.6 (63.7)	15.1 (59.2)	10.7 (51.3)	7.7 (45.9)	5.7 (42.3)	11.0 (51.8)
Average low °C (°F)	3.5 (38.3)	3.2 (37.8)	3.9 (39)	5.3 (41.5)	7.6 (45.7)	10.1 (50.2)	11.7 (53.1)	11.7 (53.1)	10.0 (50)	7.1 (44.8)	4.8 (40.6)	3.2 (37.8)	6.8 (44.2)
Record low °C (°F)	−7.5 (18.5)	−5.4 (22.3)	−4.1 (24.6)	−0.5 (31.1)	0.2 (32.4)	5.2 (41.4)	6.2 (43.2)	7.2 (45)	4.7 (40.5)	−0.9 (30.4)	−9.5 (14.9)	−11.2 (11.8)	−11.2 (11.8)
Precipitation mm (inches)	103.8 (4.087)	53.7 (2.114)	54.2 (2.134)	33.5 (1.319)	27.1 (1.067)	19.4 (0.764)	11.2 (0.441)	15.8 (0.622)	25.8 (1.016)	75.9 (2.988)	130.2 (5.126)	95.9 (3.776)	646.5 (25.453)
Mean monthly sunshine hours	74.1	93.7	149.5	201.5	266.6	273.8	327.8	297.3	204.1	153.4	83.1	68.7	2,193.3

Figure 18: Climate data for University of Victoria, Oak Bay, BC (Environment Canada, n.d.)

Location: ______________________

Design Flow, m^3/d — **Q=** [ ]

		TSS	BOD	TP	TN	NH_4-N	Org-N
Influent Concentration	C_i =						
Target Effluent Concentration	C_e =						
Wetland background limit, mg/L for TSS, $C^* = 7.8 + 0.063C_i$ for BOD, $C^* = 3.5+0.053C_i$	C^* =			0.05	2	0	1.5
Areal rate constant @ 20°C, m/yr.	k =	1000	34	12	22	18	17
Required wetland area, ha	A =						

$$A = \left[\frac{0.0365 \times Q}{k}\right] \times \ln\left(\frac{C_i - C^*}{C_e - C^*}\right)$$

maximum calculated area from above boxes (A_{max}) = [ ]

		TSS	BOD	TP	TN	NH_4-N	Org-N
Effluent concentration, mg/L via k-C* model	**C_o @ maximum area =**						

$$C_o = C^* + (C_i - C^*)\exp\left[-\frac{kA_{max}}{0.0365 \times Q}\right]$$

Figure 19: Subsurface Flow (SF) treatment wetland - preliminary feasibility calculation sheet (AENV)

Guiding Principles

Our ecological restoration efforts focus on developing and maintaining a resilient, self-sustaining ecosystem that is characteristic of the area's natural region.

The following outlines the major principles that our project will be guided by and is based on key points from course readings.

Effective, Efficient, Engaging

This project strives to follow the principles of being Effective, Efficient and Engaging according to IUCN's *Ecological Restoration for Protected Areas: Principles, Guidelines and Best Practices*.

Our project will be:

Effective when it: restores natural systems structure, function, composition, dynamics, strives to ensure ecosystem's resilience over time, and endeavours to increase natural capital.

Effective because it: respects changing biophysical environment, is attentive to historical ranges of spatial and temporal variability, allowing for evolutionary change, depends on a blend of best available scientific knowledge, traditional knowledge and local knowledge, avoids adverse effects on ecosystem's components, heritage resources and socioeconomic conditions. It requires continued commitment and humility in the face of complex ecological and cultural uncertainties.

Efficient when it: strives for consistent and timely results, is mindful of limited resources and creating novel means, fosters creativity, innovation and knowledge-sharing, is responsible to the individuals, communities and institutions upon which it depends.

Efficient because it: takes advantage of synergistic partnerships and encourages a minimum level of intervention. It ensures that long-term capacity for ecosystem's maintenance through monitoring, intervention, reporting, and reports and communicates on actions and activities undertaken.

Engaging when it: integrates cultural resources, provides people to connect more deeply, offers opportunities to discover nature, provides opportunities for community members, individuals, and groups to work together towards a common vision, promotes community wellness, creates opportunities for culture/nature reintegration. Engaging because it: is inclusive and creates opportunities for meaningful engagement in restoration activities that support the development of a culture of conservation, as well as recognizes longstanding, tested, ecologically appropriate cultural practices (Keenleyside, Dudley, Cairns, Hall, & Stolton, 2012).

Wild Design

This project also strives to capture the seven principles of the Eric Higgs' and Richard Hobbs' 2010 article *Wild Design: Principles to Guide Interventions in Protected Areas*

1. Clarity
    a. Clear goals and objectives = transparency of values guiding the interventions
2. Fidelity

    a. Faithful to the ecosystem,
    b. Careful historical research to understand past conditions and variability of the ecosystem,
        i. What is known (historically) about the ecosystem?
        ii. Have all sources of knowledge been explored?
        iii. What signals in the contemporary ecosystems can be inferred from historical information?
3. Resilience
    a. Necessary to ensure that the autogenic functioning is restored,
        i. What are the functional requirements of the ecosystem?
    b. The ecosystem is able to cope with external perturbations such as climate change,
    c. Is adaptive to rapid changes,
    d. "Hybrid systems" based on native and new species (Chapter 4 of Wild Design),
    e. Have resilience a primary goal,
        i. How much continued intervention or management will be needed?
        ii. Are long-term experiments and simulations being undertaken to clarify the character of the ecosystem?
4. Restraint
    a. "Less intervention is better than more",
    b. Knowing when to back away and allow ecological processes to take over is paramount,
        i. How do we encourage wild processes?
        ii. Are there means in place to assess the social and ecological impacts of the intervention?
        iii. Is there a line between too little and too much intervention?
            1. At what point is less intervention inadequate to meet agreed goals?
        iv. Is "precaution" central to intervention strategies?
5. Respect
    a. Be attentive to the idea that interventions are always proxies for assumptions about what is appropriate to a particular ecosystem,
        i. "Ecosystems are not only more complex than we think, they are more complex than we can think" –Egler
    b. Will intervention fix one problem, but allow another to take over?
    c. Are all involved that this intervention is simply the best present-day approximation of what is best for the ecosystem, and that assumptions underlying these approximations may shift?
6. Responsibility
    a. Must have wide knowledge of techniques and projects,
        i. Are intervention practitioners properly trained?
    b. Operate according to high ethical standards,
        i. Is there professional conduct in place?
        ii. Prove which ethical standards we are following

c. Strive to allow ecosystems to flourish instead of becoming monuments to human ambition,
    i. Intervention intensity does not mean success.

7. Engagement
    a. This is the strong reciprocal tie that people form with ecosystems through first-hand experience,
        i. Is the role of the concerned public substantial?
        ii. Is community support strong and growing?
            1. How do we plan to add to this?
        iii. How do we plan to engage the wider public?
            1. Participation in decision making,
            2. Connect physically and emotionally,
    b. Necessary for long-term sustainment (Higgs & Hobbs, 2010).

Considerations for Working with a Culturally Significant Site

This project was also inspired by work done by Benesh, *et. al,* in their 2008 project titled *Medicinal and Food Native Plant Gardens* regarding considerations when undertaking an ecological restoration project with First Nations peoples. Their paper highlights four key principles (Benesh, et al., 2008):

1. Early engagement: finding out if there are particular protocols, rituals, or specific significance for the site to be restored.
2. Plan development: ensure the plan incorporates and considers appropriate language, dialect, stories, species, etc.
3. Involvement: ongoing engagement of the local First Nations people in the work as the project progresses
4. Community: consider how the restoration project can contribute to the First Nations community.

References

Albany, G. (n.d). *Songhees nation.* Retrieved November 27, 2013 from http://www.temexw.org/SongheesNation.htm

Benesh, K., Joseph, L., MacMillan, J., Morfini, E., Warbeck, L., & Woolridge, R. (2008). *Medicinal and Food Native Plant Gardens.* Victoria, BC: University of Victoria Ecological Restoration 341.

Cadboro bay. (2008). Retrieved November 27, 2013 from http://www.saanich.ca/discover/artsheritagearc/heritage/pdf/cadboro_bay.pdf

Cadboro-gyro park public survey. (2011). Retrieved November 27, 2013 from http://www.saanich.ca/parkrec/parks/projects/current/documents/Cadboro-GyroMasterplan_OnlineSurveySummary_PUBLIC.pdf

City, State, and Regional Alberta Environment (2000) Guidelines for the approval and design of natural and constructed treatment wetlands for water quality improvement, Alberta Environment Municipal Program Development Branch: Edmonton, Alberta.

Composting. (n.d). Retrieved November 26, 2013 from http://www.uvic.ca/sustainability/operations/waste/composting/index.php

Concept plan update. (n.d). District of Saanich. Retrieved November 26, 2013 from http://www.saanich.ca/parkrec/parks/projects/current/cadboro.html

District of Saanich. (2012). *Cadboro-Gyro Park*. Retrieved October 17, 2013, from http://www.saanich.ca/webapp/parks/displaypark.jsp?mapNo=24

Environment Canada (n.d.) *Victoria University CS Climate*. Retrieved October 17, 2013 from http://climate.weatheroffice.gc.ca/

Fairbarns, M. (2013). *Gary Oak Ecosystems in Biodiversity of British Columbia.* Vancouver: Lab for Spatial Analysis, Department of Geopraphy, UBC.

Greener garbage collection. 2013. District of Saanich. Retrieved November 25, 2013 from http://saanich.ca/living/about/news/2012/proposedcubrsidecollection-kitchenscraps.html

Gyro park fact sheet. (2011). Retrieved November 27, 2013 from http://www.saanich.ca/parkrec/parks/projects/current/pdf/CadboroGyro_OpenHouse_FactSheet_March2011.pdf

Gyro park redevelopment plan. (n.d). Cadboro Bay Residents Association. Retrieved November 25, 2013 from http://www.cadborobay.net/resources/download_docs/2012_12_05-GyroPark-ParksComm.doc

Higgs, E., & Hobbs, R. (2010). Wild design : Principles to guide interventions in protected areas. In: Cole, D and Yung, L (eds.). *Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change*, 234-251.

Keenleyside, K., Dudley, N., Cairns, S., Hall, C., & Stolton, S. (2012). *Ecological Restoration for Protected Areas: Principles, Guidelines and Best Practices.* Gland, Switzerland: IUCN.

Miskelly, J. (n.d). Gary-oak associated wetlands in Canada in Victoria, British Columbia. Retrieved November 27, 2013 from http://www.ou.edu/cas/botany-micro/ben/ben450.html

Morahan, R. (2009). Songhees statement of claim. *Morahan & Company.* Retrieved November 27, 2013 from http://www.turtleisland.org/news/songhees09.html.

MacKenzie, W.H. & Moran, J.R. (2004). Wetlands of British Columbia: a guide to identification. Res. Br., B.C. Min. For., Victoria, B.C. Land Manage. Handb. No. 52.

N.A. (1999). Surface Flow Systems Work Like Natural Wetlands. Pipeline, West Virginia University, Morgantown, WV. Retrieved from http://www.wateronline.com/doc/surface-flow-systems-work-like-natural-wetlan-0001

New York State Government. (1997) .Technical Guide for creating Wetlands As part of unconsolidated surface mining reclamation. Department of Environmental Conservation: Albany, New York.

Reed, SC. (1993). Subsurface flow constructed wetlands for wastewater treatment, A technology assessment. United States Environmental Protection Agency, USA. Comprehensive design manual.

Ronca, D. (n.d). *How a wetland works.* Retrieved November 27, 2013 from http://science.howstuffworks.com/environmental/green-science/wetland.htm

Saanich summer sunfest. (n.d) District of Saanich. Retrieved November 25, 2013 from http://saanichsunfest.ca/

School-based weather system network. (n.d). Retrieved November 27, 2013 from http://www.victoriaweather.ca/station.php?id=143

Tilley, E., Lüthi, C., Morel, A., Zurbrügg, C., and Schertenleib, R. (2008). Compendium of Sanitation Systems and Technologies, published by Sandec, the Department of Water and Sanitation in Developing Countries of Eawag, the Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland.

UN-Habitat. (2008). *Constructed Wetlands Manual*. UN-HABITAT Water for Asian Cities Program: Kathmandu, Nepal

US EPA. (1999). *Constructed Wetlands Design Manual.* Cincinnati, Ohio: National Risk Management Research Labratory.

US-EPA. (2012). Post-Construction Stormwater Management in New Development and Redevelopment: Retention/Detention. Retrieved from http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

USDA Plant Database: Natural Resource Conservation Services last modified 11/14/2013

Water purification. (n.d) Retrieved November 25, 2013 from http://www.ramsar.org/pdf/info/services_05_e.pdf

White, R., & Stoecklin, V. (1998). Children's outdoor play & learning environments: Returning to nature. *Accessed June*, *11*, 2004.

Wikimapia.org (n.d). Retrieved November 26, 2013 from http://wikimapia.org/#lang=en&lat=48.459732&lon=-123.294153&z=16&m=b&show=/675981/Gyro-Park

This project team would also like to acknowledge the guidance and support provided by:

Glenn Harris, Senior Manager, Environmental Protection for the CRD

Mike Macfarlane, Director, Land Remediation, BC Ministry of Environment

Project Work Breakdown Structure

Table 7: Project work breakdown structure

Mitch Macfarlane	**Jessica Lam**	**J Michael Cox**
Stakeholder Engagement Communication Plan Project Design Plant Identification Cost Estimates Subject Matter Expert Consulting Project Site Drawings Monitoring and Evaluation	Google Documents Workspace Introduction Problem Identification Cultural Significance Cost Estimates Ecological Education Signs First Nations Cultural Signs Compost and Recycling Plan	Selected Photos Goals and Objectives Ecological Restoration Approach Problem Identification Cost Estimates Monitoring and Evaluation Appendices Overall Content and Structure