

**UBC Botanical Garden Revitalization Plan**  
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# UBC Botanical Garden Revitalization Plan

CIVL 445 – Group 7

RENEW Engineering Solutions

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## **Executive Summary**

The UBC Botanical Garden provides UBC and the Vancouver region with the opportunity to view and experience a beautiful collection of rare flora and is a valuable educational resource for plant research and horticulture. It is Renew's mission to increase the number of students, tourists, and members of the community visiting the garden annually, by introducing several ecologically friendly infrastructural and educational elements that reflect the focus on sustainability of which UBC is renowned.

The anchor of the revitalization project is the construction of a several structural components. These will include an information center, indoor plant conservatory, and covered picnic shelters. The information center provides an alternate entrance to the gardens at the corner of Southwest Marine Drive and Stadium Road. The information center will provide educational resources about the plant collection to encourage visitors to enter the gardens. The inclusion of an indoor plant conservatory will increase the number of visitors to the gardens during the rainy winter months and allow the garden to acquire more sensitive plants.

The revitalization of the gardens also includes a plan to improve the existing parking lot to increase efficiency, improve overall flow, and reduce the amount of storm water runoff. The new parking lot will be constructed using permeable pavement technology in the same area as the existing parking lot and will not take up more space than what is currently being used. The new permeable parking lot will allow more visitors to park at the gardens while increasing the capacity and will give an overall sustainable appearance for the parking lot. A modular water tank will be designed to help to collect rainwater as well as storm water runoff in order to eliminate the need for the gardens to use potable water for their small streams, ponds and irrigation systems.

New signs and advertising strategies will be implemented to attract a wider range of visitors by using multi-language features to attract tourists and non-English speaking residents that make up a large proportion of the greater Vancouver population. These signs will be placed at the major entrances to UBC. The improvement of signage will help promote the gardens and provide additional revenue.

In order to increase tourism in the garden a plan has been developed to create partnerships with tour companies and schools. Additional educational programs can be developed to create more awareness of what the garden has to offer.

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## **1. Introduction**

The UBC Botanical Garden is Canada's oldest continuously operated university-based botanical garden that provides UBC with an extensive collection of temperate plants for research, conservation, education, community outreach, and public display. Renew Engineering Solutions, henceforth referred to as Renew, proposes a revitalization plan for the garden's future development. The mission for this project is to increase the number of students, tourists, and members of the community visiting the garden annually, by introducing several ecologically friendly infrastructural and educational elements that reflect and the focus on sustainability of which UBC is renowned. Therefore, Renew has produced the following UBC Botanical Garden Revitalization Plan which emphasizes sustainable leadership, economic prosperity, and educational focus.

## **2. UBC Botanical Garden Growth Opportunities**

The botanical garden is dedicated to education and research through the use of its 78 acre nationally renowned facility. The facility boasts a collection of approximately 12,000 plants from temperate regions around the world. Despite this impressive collection and facility, the botanical garden is struggling to attract the number of visitors that would generate the revenue to operate and expand the facilities. The total annual budget for the operation of the botanical garden is approximately \$2 million, of which the garden receives approximately half from UBC annually while the remainder must be raised through admission, facility rentals, and private donors (Lewis, 2013). Some reasons for the lack of visitors coming to the garden are the lack of community awareness of the garden and the ineffectiveness in targeting certain key demographics. There is also a shortage of indoor space for events and for attracting visitors to the garden during the rainy winter months.

An operational problem that is facing UBC is the large water requirements of the botanical garden. Currently all of the water used to irrigate the collection in the gardens is potable water that is drawn from the municipal water supply system. The garden sits on a thick layer of till which is not effective in retaining the excess water from runoff, while most of the stormwater that comes into the garden drains quickly from the area into the ocean. In order to currently irrigate the collection, potable water must be used since there is no current system to retain any rainwater.



### **3. Design**

Several civil engineering sub-disciplines are involved in the UBC Botanical Garden Revitalization Plan such as:

- Structural
- Environmental
- Hydrologic
- Geotechnical

The design anchor of this project, a multipurpose complex and conservatory area, involves intensive structural knowledge to be provided by Renew, which will also provide design of picnic shelters inside the gardens. Concepts of environmental engineering will be applied to achieve LEED certification for the design of the multipurpose center.

In addition, a storm water management system is proposed to collect rainwater as well as storm water runoff in order to eliminate the need for potable water irrigation. The knowledge of hydrologic engineering and environmental engineering will be applied to complete this development.

Renew's plans also include changes to the existing parking lot, which will be improved using a more effective layout, while a permeable pavement will be constructed to reduce water runoff. Geotechnical and environmental engineering is essential for this development to be accomplished.

Finally, planned upgrades to revitalize the botanical gardens include the installation of a number of advertising signs around the campus to increase public attention.

#### **3.1 Multipurpose Indoor Space**

The main feature of the proposed upgrades to the garden is the construction of multi-use indoor facilities that include an information center, plant conservatory, and picnic shelters. The construction of these facilities will involve both structural and geotechnical design. Both the information center and the conservatory will be constructed in the portion of the garden that lies to the northeast of SW Marine Drive. Both structures will be visible from the road and will provide some advertising that will further increase community awareness as to what

the garden has to offer. The information center is to be located on the southeast corner of SW Marine Drive and Stadium Road. The conservatory is to be located adjacent to the Garden Pavilion. The locations of the proposed infrastructure are included on a map of the botanical garden in the Appendix.



**Figure 1: Information Center – Top View**

### **3.1.1 Information Center**

The construction of an information center as part of the North gardens will provide a valuable educational resource to UBC and the botanical garden community. The center will also act as an additional entrance into the gardens opposite the existing entrance to provide more convenient access to the North gardens. Currently the only access point to the North gardens is through the tunnel that runs beneath SW Marine Drive. The proposed information center is pictured in Figure 2 and a complete conceptual design is included in the Appendix. The information center will include event and conference space, classrooms, a cafe, and a gift shop. The center also provides a unique vantage point to enjoy the collections from indoors. The center features a living roof and a unique glass design. The center is made up of three connected structures. The two larger leaf-shaped buildings house the functional features of

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the information center while the outer circular perimeter building provides a tranquil area to enjoy indoor exhibits and experience the outdoor collection from indoors. In total, the information center will have a footprint of approximately 5000 ft<sup>2</sup>. In order to determine the price of such a building, a building of similar design but smaller footprint was analyzed. The Priori Park Pavilion in Surrey, England shares many characteristics with the proposed information center design for the UBC Botanical Gardens and taking into consideration size differences, location, and inflation, it is estimated that the information center will cost approximately \$5 million (E-Architect, 1999).

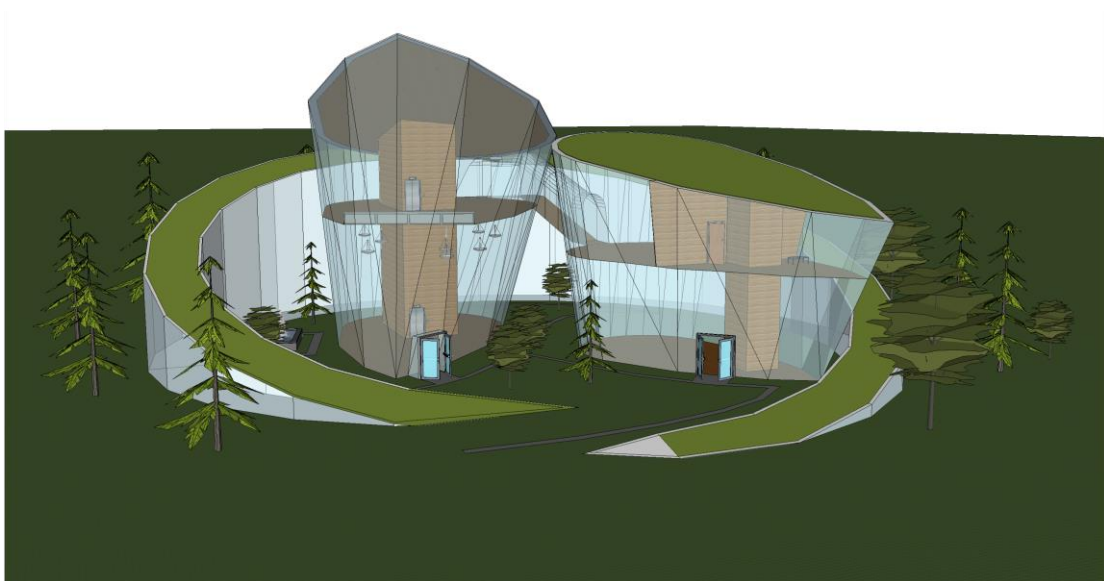


Figure 2: Information Center – Front View

### *3.1.1.1 Event Space*

Currently the garden pavilion serves as a small indoor event space where weddings and corporate events are held. The new information center boasts a very large event area on the second floor of the larger of the two interior buildings (see Figure 2) where large events can be held by the botanical gardens itself or private companies and individuals. Event rentals would provide a very substantial revenue source for the botanical garden. The unique architecture of the center paired with beauty of the surrounding garden collection will attract clientele and increase awareness of the garden in the community.

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The additional space will also allow the garden to hold educational events of their own with featured exhibits and interactive learning elements. Furthermore, the space will allow for permanent indoor plant collections and temporary showcases.

### *3.1.1.2 Café*

The information center will also house a cafe on the lower floor of one of the two interior buildings. The cafe will serve organic coffee and provide small meals and snacks made from produce grown in the garden. This will allow the cafe to provide education about the values of the garden and about sustainable growing. Visitors to the cafe will be able to see first hand where the food is grown and have a more comprehensive experience at the gardens. The cafe will also offer catering services for special events held in the center. There will be additional kitchen space available for events being catered by external catering companies. The cafe will provide additional revenue streams for the garden as well.

### *3.1.1.3 Gift Shop*

Also featured on the main floor of one of the interior buildings is a gift shop. The gift shop will provide visitors with the opportunity to purchase souvenirs, potted plants, and other featured items. The gift shop will also generate revenue for the garden.

### *3.1.1.4 Research Laboratories & Classrooms*

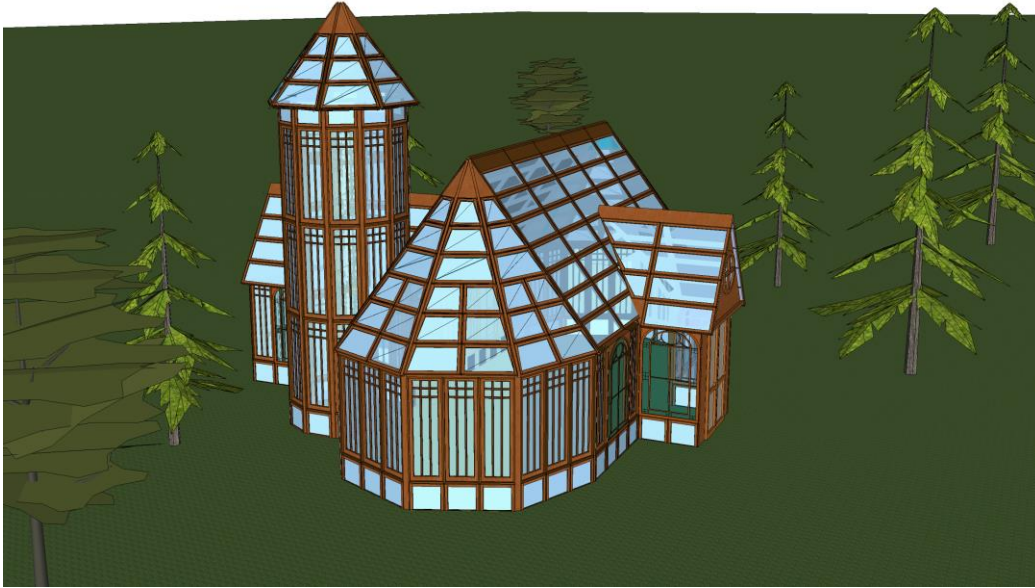
The remaining space in the information center will be used for research and classroom space. This will allow the garden to hold more classes and expand the existing botany program. Research opportunities will increase and postgraduate studies may become a possibility. The classroom space will also provide a venue for the various programs that are discussed in Section 4.2.

## **3.2 Conservatory**

The conservatory is to be located in the North gardens adjacent to the Garden Pavilion. The conservatory, which is shown in Figure 3, will allow the garden to expand its collection to include more sensitive indoor plants. The conservatory will also provide a sheltered indoor space for visitors to enjoy the plant collection during rainy days. The space also has the potential to be rented for weddings and parties that will act as an additional revenue source

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for the garden. The conservatory will have a footprint of approximately 3000 ft<sup>2</sup> and will cost approximately \$500,000.



**Figure 3: Conservatory**

The conservatory also provides an opportunity for the botanical garden to expand its enterprises to include such features as a butterfly exhibit or bird sanctuary. Local artists could feature their art collections in the conservatory. Diversifying the attractions at the UBC Botanical Garden will demonstrate its commitment to educating and serving the UBC and Vancouver community in a variety of ways.



**Figure 4: Conservatory Expansion Possibilities**

### 3.3 Picnic Shelters

In order to provide a more comfortable and enjoyable experience to visitors in the garden, a number of picnic shelters will be constructed in various locations throughout the gardens. The shelters will provide a place where visitors can sit down and enjoy the gardens while protected from the sun or rain.

The shelters are small huts located at various points where visitors may become tired and desire a place to sit down. They can also be installed at high traffic areas where visitors frequently visit so that viewers may sit and enjoy the location.

Each shelter will require a concrete padding with a footprint of about 3.7 m by 3.7 m (12 ft by 12 ft). On top of this will be a picnic table and timber posts to support the roof. Renew has developed a generic design that can be applied to each shelter. However, it is possible for the shelter design to be adapted to suit its particular surroundings. An example of one shelter is presented in Figure 5 below.

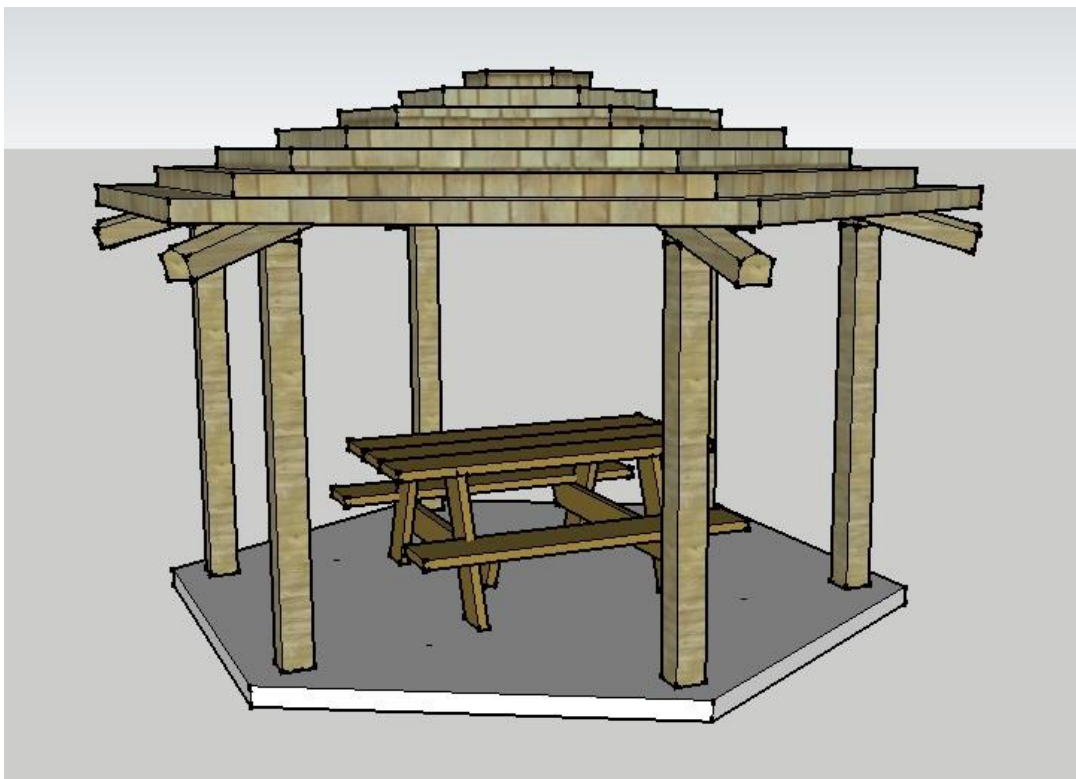


Figure 5: Picnic Shelter Example

### 3.4 Parking Lot

A large issue facing the UBC Botanical Gardens has been a lack of sufficient parking space available during events held at the gardens, such as the Apple Festival and weddings. Part of the larger changes proposed by Renew for the rehabilitation of the gardens is to incorporate environmental friendly aspects while also increasing the efficiency of the parking lot.

#### 3.4.1 Current Parking Lot

As shown in Figure 6, the parking lot currently consists of roughly 75 parking spots laid out at 90 degrees to the aisles.



Figure 6: Current Parking Lot Design

The main rectangular parking lot has a total footprint of 2,310 m<sup>2</sup> with dimensions of 55 m by 42 m. The aisle ways and stalls are paved with asphalt and connect with SW Marine drive at the intersection with Stadium Drive at the current entrance to the botanical gardens.

There are numerous problems associated with the current design of the parking lot. Firstly, the parking lot does not have enough stalls to occupy the many visitors during large events where the Garden is inundated with hundreds of visitors. This is costly for the gardens as

they require shuttle buses during these large events to transport visitors from and to other parking facilities at UBC. Secondly, the impermeable asphalt adds to the storm runoff issues faced by the garden. Currently, runoff from the parking lot drains into the main storm water ditch running along the east side of Old SW Marine Drive. Finally, the parking lot is not aesthetically pleasing and does not reflect the botanical garden’s commitment to sustainability. Since this is the first area most visitors see when coming into the gardens it is important to incorporate visual aesthetics to entice the visitors. The new design will address these three issues of parking lot spaces, stormwater management and aesthetics.

### 3.4.2 Parking Lot Redesign

#### 3.4.2.1 Parking Lot Efficiency

The efficiency of the parking lot can be increased by using the parking lot footprint area effectively as well as analyzing the most efficient stall and aisle way size and orientation.

Table 1 provides the approximate dimensions of the stalls and aisle ways for the current parking lot layout.

	Stall		Aisle ways
	Width (m)	Length (m)	Width (m)
Current Design	2.7	6.0	7.5
Vancouver Minimum Standards	2.7	5.7	7.0

**Table 1: Parking Lot Element Dimensions**

According to the municipality of Vancouver standards, the current design dimensions are similar therefore decreasing the dimensions of the aisle ways and stalls is not an option. However, by rotating the parking stalls to 45 degrees the parking space and aisle way widths can be optimized to increase the overall parking capacity. Space usage can further be optimized by adding 30-35% small car parking stalls at reduced dimensions of 2.5 meters by 4.9 meters. The resulting space savings relates to an approximate parking stall space increase of about 25%, or 25 more parking spots while keeping the existing 2,310 m<sup>2</sup> footprint size. This increase will help the gardens reduce the need for shuttle busses during large events and reduce costs for the garden.



### 3.4.2.2 *Parking Lot Runoff*

To help mitigate the problem associated with runoff from the current parking lot, a permeable paving approach will be utilized. Using parking pavers similar to those depicted in Figure 7, the parking stalls will reduce the amount of impermeable surface by 75%.

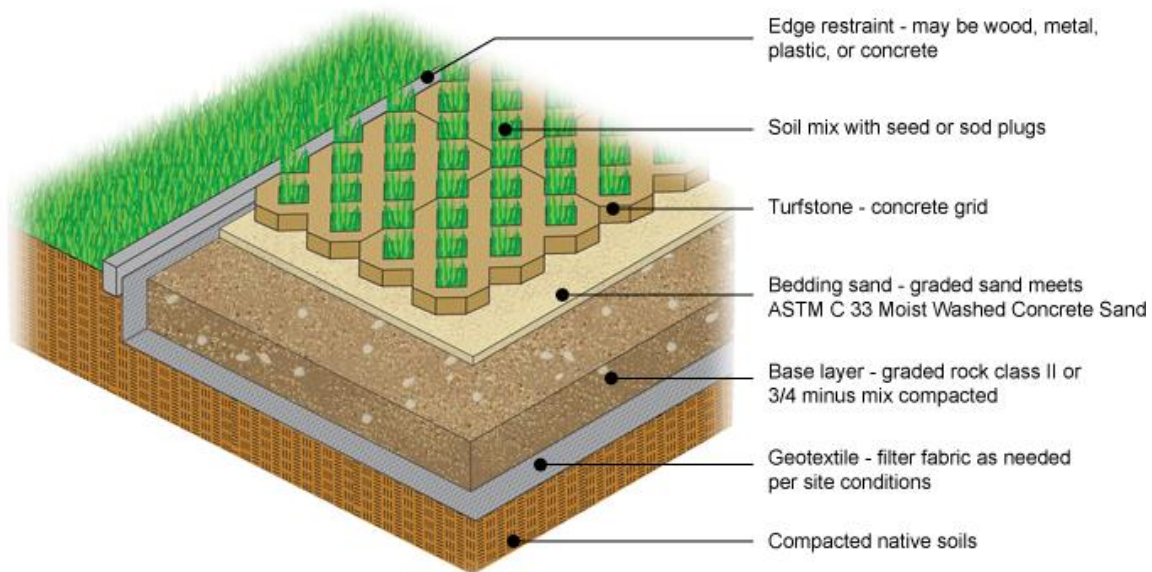


Figure 7: Permeable Concrete Pavers

These parking lot pavers are effective for mitigating runoff from the aisle ways of the parking lot, allowing the water to be slowly drained directly underneath the parking lot without the need for collection and discharge into the existing drainage ditch. This ultimately reduces erosion and increases the capacity of the drainage ditch that has been observed to be overwhelmed during past heavy rainfall events. The pavers will also have the added benefit of increasing the appearance of the parking lot, as well as decreasing the heat island effect by reducing air temperatures by 2°C when compared to common asphalt parking lots (Angelus Paving Co, 2012).

### 3.4.2.3 *Parking Lot Aesthetics*

The aesthetics of the parking lot can be improved by multiple options. The main element to take into account when designing a parking lot with respect to aesthetics is to mitigate vast expanses of pavement (NYC Department of Planning, 2007). The permeable parking lot

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design discussed previously will allow grass to be grown between the concrete squares, giving a greener look to the parking lot by decreasing the amount of visible pavement.

The current parking lot has a large green space in the median. This median is aesthetically pleasing but sacrifices a large space which could be used for parking. To help increase the capacity of the lot while keeping the aesthetics, it is proposed to decrease the width of the island and plant more plants and trees in the smaller space. Figure 8 provides some examples of small medians that reduce the vast expanses of pavement while keeping the parking efficient.



**Figure 8: Examples of Aesthetically Pleasing Small Width Medians**

The median also gives the added benefit of naturally filtering the runoff from the parking lot. By planting various species in the median, the contaminants in the runoff such as oil and grease from vehicles will be filtered through the root systems of the plants before entering the groundwater, further enhancing the environmental friendly aspects of the design. The new parking lot design is shown in Figure 9 and Figure 10 below.

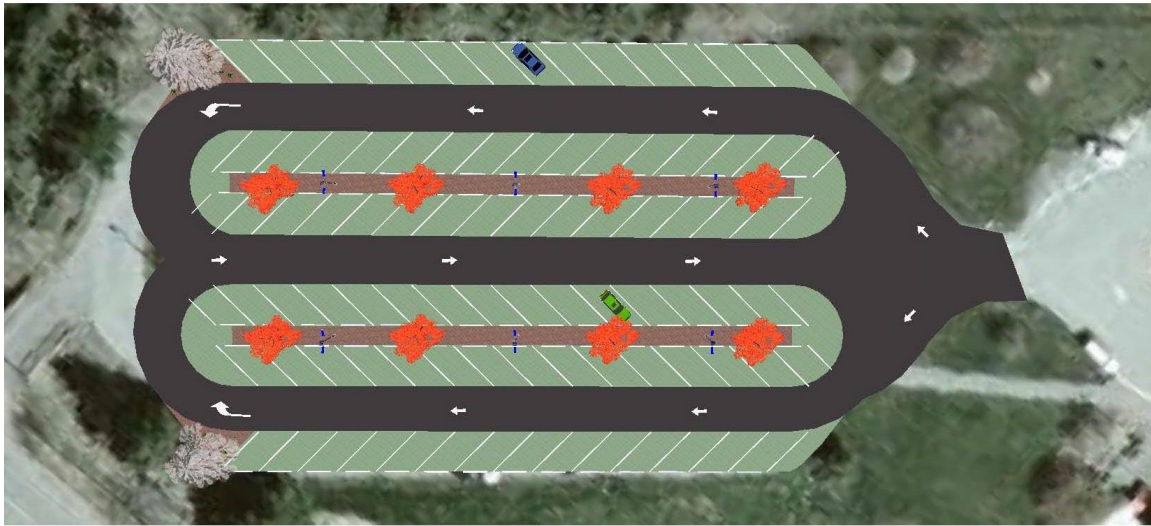


Figure 9: Parking Lot Concept - Plan View



Figure 10: Parking Lot Concept - Street View

### 3.4.3 Alternative Design Solutions

Initially the construction of a large multi-level parkade was proposed to increase the parking capacity. This would dramatically increase the amount of parking stalls; however, this design concept was considered too incompatible with the mission of the gardens as well as Renew for multiple reasons.

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Firstly, a parkade would be a large capital cost for the gardens and would be inefficient since it would only be fully utilized a few times each year during large events. A parkade would also fail to meet the sustainability goals associated with Renew’s mission, as it would greatly increase the amount of impervious surfaces. This would only add to the stormwater runoff issue and also create a large non-aesthetically pleasing visual appearance to visitors. Because of these reasons, Renew has agreed that the conceptual design described in Section 3.4.2 optimizes the balance between number of parking spots, environmental sustainability, and aesthetically pleasing criteria and therefore should be chosen in favour over a large parkade structure.

### 3.4.4 Cost Analysis

The cost of the new parking lot design consists of two stages; the construction stage and the operational stage. Due to time constraints of the conceptual design, the Lake County Forest Preserve’s permeable parking lot project case study was analyzed to provide an estimation of the final cost of the project. Table 2 provides an analysis of the costs associated with the construction of the proposed design.

Activity	Cost
Design and Tendering	\$30,000
Development/Decommissioning of Existing Parking Lot	\$100,000
Installation of Pavers and Asphalt	\$82,500
Landscaping, Seeding and Pavement Markings	\$10,000
Total Cost	\$222,500

**Table 2: Parking Lot Construction Cost Analysis**  
(Lake County Forest Preserves, 2003)

The majority of the cost is attributed to site preparation as it includes decommissioning of the old pavement surface and ensuring a properly sloped foundation for runoff. However, once the ground surface is prepared the cost will be relatively low for constructing and paving the new layout.

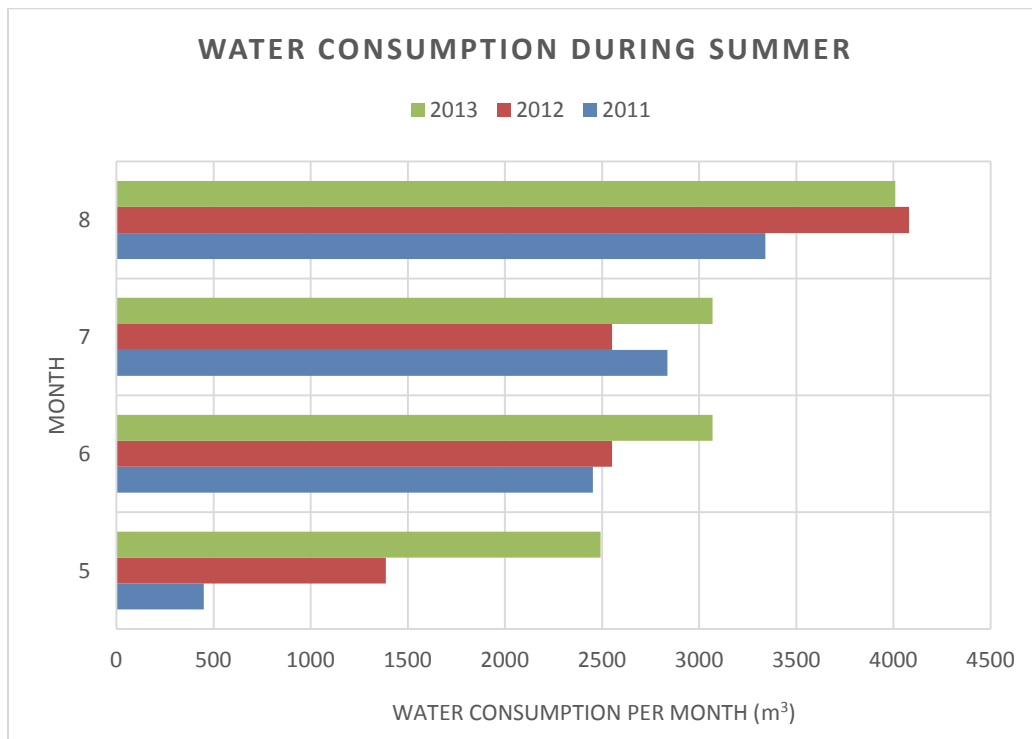
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The operational costs of the parking lot will be mostly maintenance and upkeep of the vegetation during the expected 25 year lifespan of the design. This is relatively inexpensive when compared to the construction costs and will be comparable to the current costs associated with the existing design and have been estimated at around \$2,000 to \$5,000 per year (Lake County Forest Preserves 2003).

### **3.5 Stormwater Management System**

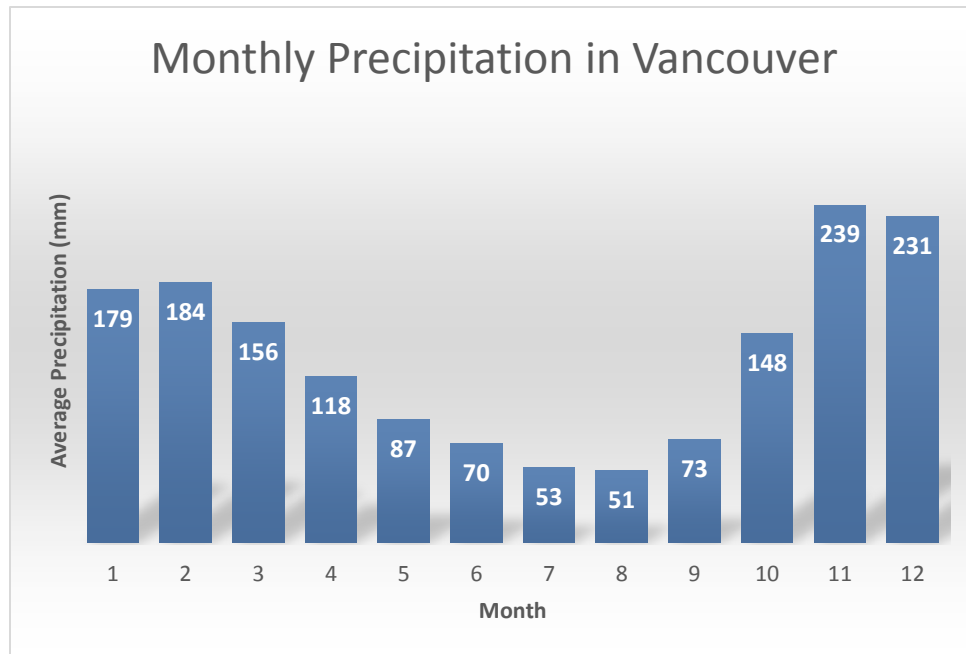
The amount of potable water consumption of UBC Botanical Garden has been increasing in recent years. Meanwhile, the erosion rate of the cliffs near the garden is also increasing due to the permeability of the garden's soil, which is comprised mostly of glacial sediments. During rainy periods, the storm water is not retained in the soil but runs through the glacial till and drains into the ocean. Additionally, the stormwater from the west side of UBC campus flows out of the stormwater pipes at the base of the cliff. In order to reduce the amount of potable water consumption and slow the cliff erosion rate, a stormwater reuse system is proposed. It will be composed of a stormwater detention system and a stormwater filtration system.

### 3.5.1 Water Supply and Demand



**Figure 11: Potable water consumption for the last three summers**  
Source: Dr. Douglas Justice (2013)

In order to select the proper size of a storage facility for the stormwater reuse system, an analysis of potable water consumption and stormwater supply was conducted. The chart in Figure 11 above shows the potable water consumption of the garden over the last three summers. Based on the chart, the weekly water consumption in summer has increased from 568 m<sup>3</sup> to 790 m<sup>3</sup> in the span of three years.



**Figure 12: Average monthly precipitation over the last 30 years in Vancouver**  
Source: The Weather Network – Statistics (2013)

On the other hand, the monthly precipitation varies considerably in Vancouver. According to Figure 12, the precipitation is relatively low in summer while the evaporation rate is high. Simultaneously, there is a high water demand of the botanical garden during the summer. Thus, an underground stormwater facility with the capacity to store enough water to meet the summer water demands is proposed for construction.

There are two stormwater channels that go through the botanical garden: West Creek and Rock Creek. According to Figure 13 below, the two channels receive the runoff from the West Side Catchment and 16<sup>th</sup> Ave. Catchment which combined, cover an area of 57.5 ha. According to the measurement taken by Shen, L. and Wong, C. (2013) on the two channels, enough stormwater flows through the pipes to supply the entire water demand of the botanical garden.

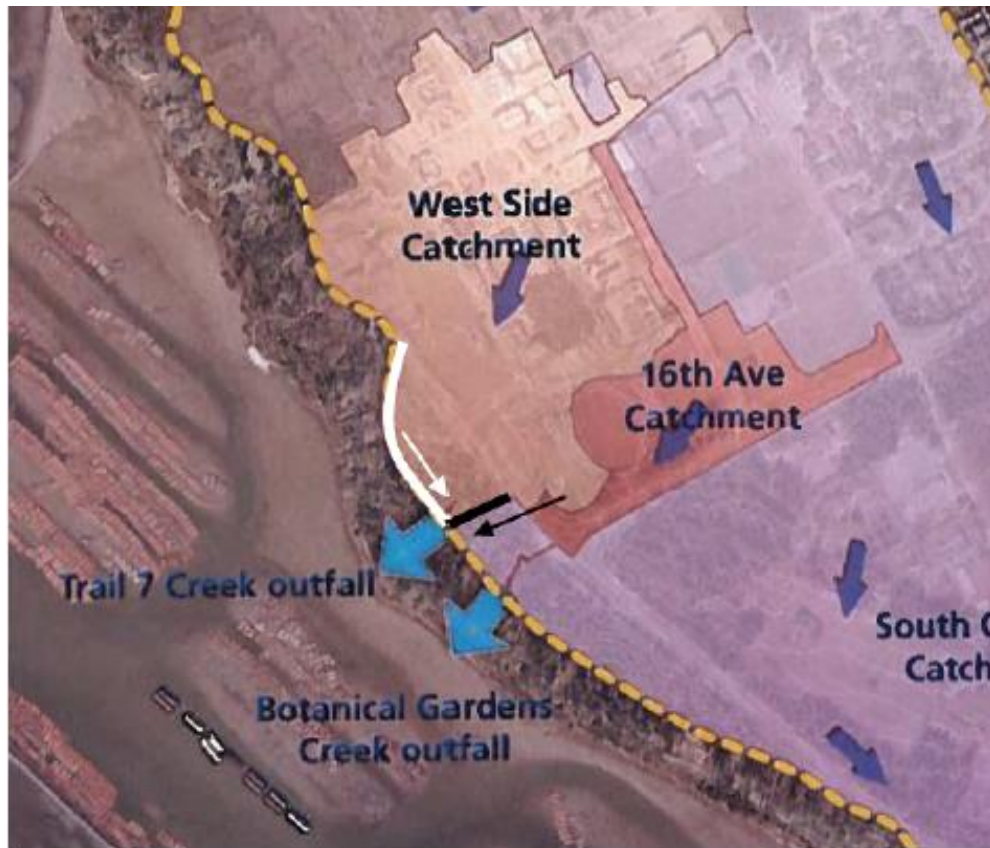


Figure 13: Catchment area for West Creek and Rock Creek  
Source: Shen, L. & Wong, C. (2013)

Based on the analysis above, a storage facility with a volume of 500 m<sup>3</sup> is proposed. A storage facility with this volume is large enough to store the required water volume but also small enough to be financially feasible. The most optimal location for the installation of such a storage facility is the garden's equipment storage and parking area along Stadium Road. By installing the storage facility in this location, the garden's collection will remain undisturbed and it will be able to connect to the stormwater drainage pipes.



### 3.5.2 Stormwater Detention System



**Figure 14: On the left is the full stormwater detention facility while the right shows one unit of said facility**

By comparing the overall price, design, and serviceability among all the producers of stormwater detention facilities, the supplier “Stormtrap”, was selected. Their stormwater reuse system is composed of a stormwater detention system and a stormwater filtration system. Figure 14 above shows the underground stormwater detention system. This system is made of precast concrete components known as “Double Trap,” which are modular and structurally sound. It can be easily customized to fit the garden’s space requirements. Thus, it will maximize the storage volume while minimizing the footprint area. Also, it will largely reduce the overall cost of installations. In addition, the system is in underground and will minimize the environmental impacts on the garden’s collections. Once installed, the detention system will not be visible and the area can be used for its original purpose as an equipment storage area.

### 3.5.3 Stormwater Filtration System



Figure 15: From left to right - sedimentation module, filtration module, and Oil/water separation module

As stormwater runoff flows across the campus and parking lots, it picks up many pollutants and contaminants. Since the stormwater will be used for irrigation, a stormwater filtration system will also be implemented. This system is modular as well and will be easily integrated with the stormwater detention system. Thus, the cost of installation and maintenance will be low.

This filtration system is made of three different modules: sedimentation module, filtration module, and oil/water separation module as pictured in Figure 15. Firstly, the sedimentation module will remove sediments and large solids from the stormwater. Secondly, pollutants, like phosphorus, heavy metals and suspended solids, will be removed from the filtration module. At last, the oil and grease from the parking lots and roads will be removed from the oil/water separation module. Then, the stormwater will go directly into the detention system and the stormwater can be used for irrigation at any time.

### 3.5.4 Detail Design and Cost Estimate

The storage capacity of this stormwater reuse system is 500 m<sup>3</sup>. The whole system will be built in the service area of the botanical garden. This is because the elevation of this area is relatively high so that the irrigation system can be mainly gravity fed. Also, it will not damage the garden's collection.

The footprint area of the whole system is 15 m by 15 m and the height of each precast concrete component, "Double Trap", is 3 m.

On a similar project with a storage capacity of 320 m<sup>3</sup> in Evanston, IL, USA in which the system was used for irrigating school athletic fields, the cost of the project was about

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\$270,000. Taking into consideration differences in storage volume and labour costs the system proposed for the UBC Botanical Garden will cost approximately \$500,000 CAD.

### **3.6 Signage**

As part of the initiative to increase public awareness of the gardens it is proposed to install a number of signs located in various locations on UBC campus. It is believed that public awareness will be improved through the use of both billboard signs that advertise the gardens and an overhead traffic sign.

#### **3.6.1 Roadside Billboard Signs**

To increase awareness of the botanical gardens four billboard signs will be installed on the roadside of the four main entrances to UBC: West 4<sup>th</sup> Avenue, West 10<sup>th</sup> Avenue, West 16<sup>th</sup> Avenue, and SW Marine Drive. At this stage, the signs are envisioned as small to medium sized billboards that will be positioned on the right-hand side of the road as vehicles are heading west into UBC. The target audiences of such signs are the students, faculty, staff, and visitors that enter the campus daily. Each sign will be angled appropriately to face oncoming vehicles, pedestrians, and cyclists as they enter UBC.

The content on each sign will fulfill three main objectives. First, the signs will alert the viewer to the presence of the gardens on campus. Second, each sign will contain text in multiple languages that explain to the viewer the new features in the gardens, including the cafe, information center, and indoor plant conservatory. It is believed that listing the new upgrades will encourage the viewer to visit. Finally, the signs will contain in large text some directional content, such as “Left in 1 km” or “Near SW Marine and 16<sup>th</sup>.”

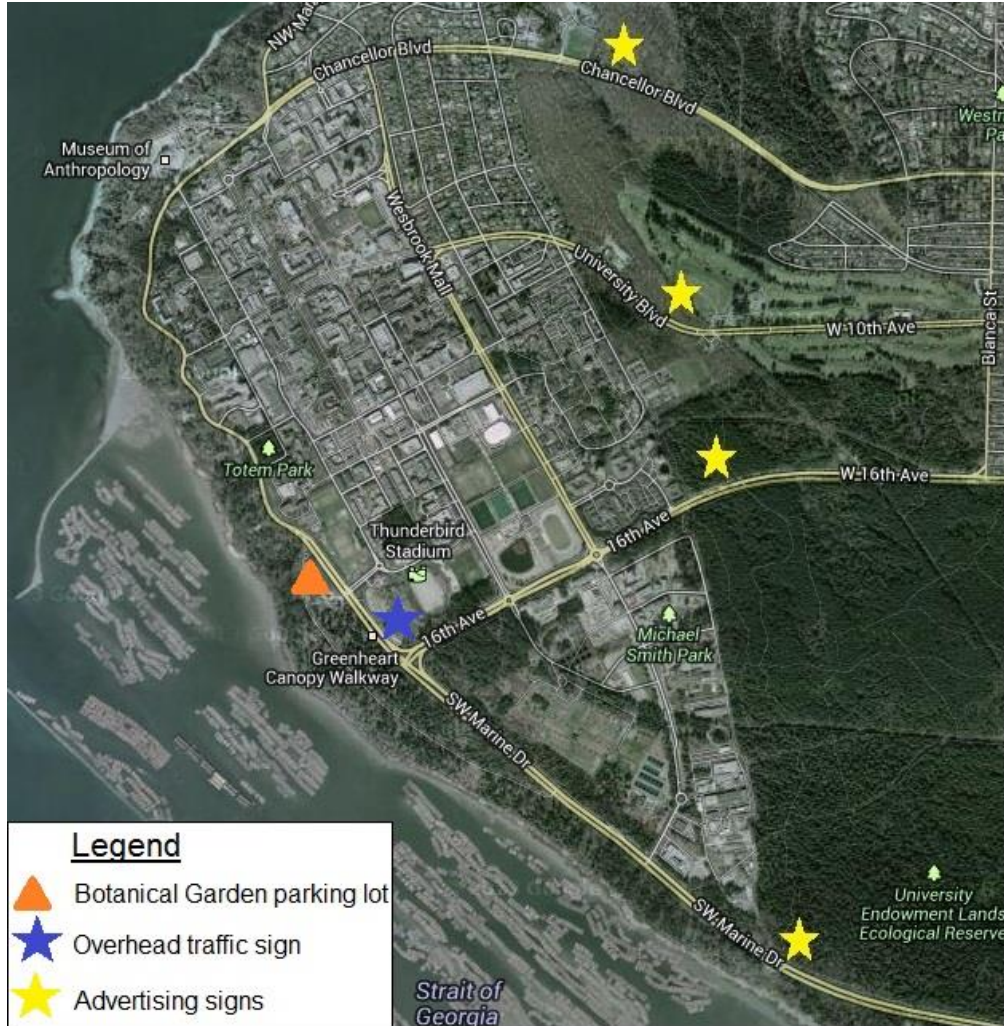


Figure 16: Proposed locations of signage around the UBC Campus

All signs will require approval by the respective body that owns the land on which they are located. In this conceptual stage all advertising signs are proposed to be installed on land belonging to the University Endowment Lands. As such, Renew will take the responsibility of coordinating meetings between the UBC Botanical Gardens, University Endowment Lands, and other involved stakeholders so that appropriate consultation will be done in order to find an area close to the roadside that is optimal for all parties.

In this conceptual stage each advertising sign is envisioned as something similar to that presented in Figure 17 below.



Figure 17: Conceptual design of advertising signs to be installed at entrances to UBC campus

### 3.6.2 Overhead Traffic Sign

An additional measure to increase public awareness of the gardens is to install a large, wide traffic sign that spans over westbound traffic as it travels on SW Marine Drive just west of West 16<sup>th</sup> Avenue. The main purpose of this sign is to direct motorists who had previously seen the advertising signs from SW Marine Drive to the parking lot of the gardens. An example of such a sign is presented in Figure 18.

Consultation for the content, design, and placement of the sign will be made with appropriate stakeholders. Since the BC Ministry of Transportation and Infrastructure holds jurisdiction over all signs that span over SW Marine Drive, Renew will make the necessary arrangements with the body to ensure that such a sign can be placed.

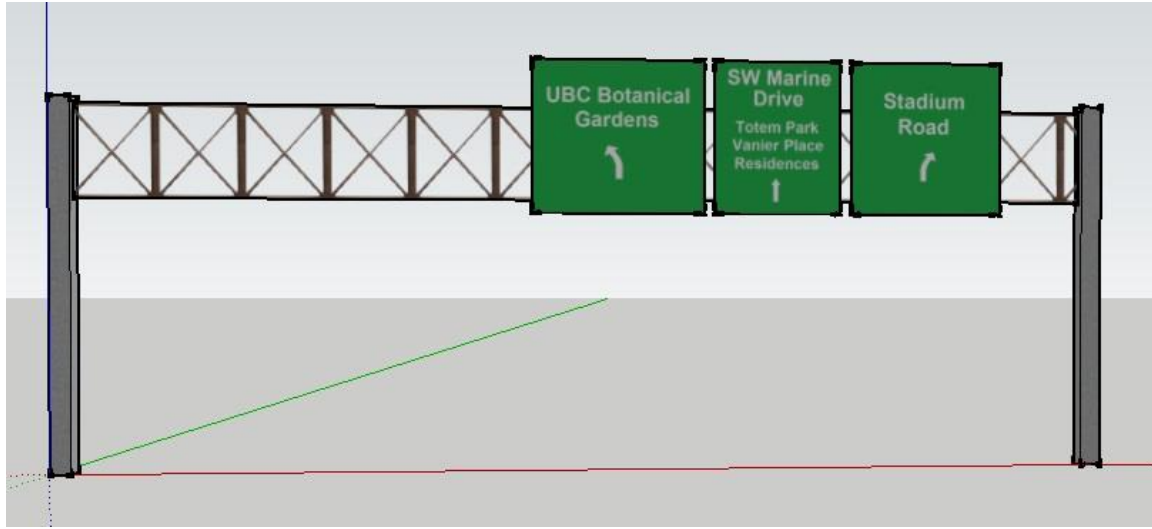


Figure 18: Conceptual design of a traffic sign spanning over SW Marine Drive

#### 4. Market Potential

In 2010, China was B.C.'s fifth-largest international market for direct customs entries, and Canada's seventh-largest market in visitation. There were 118,481 customs entries to B.C. from China, an increase of 18.9% from 2009. Over 60% of all Chinese customs entries into Canada were through B.C (Ministry of Jobs, Tourism and Innovation, 2011).

As identified in the new tourism strategy, the Province will continue to partner with the Canadian Tourism Commission to launch consumer and trade campaigns to capitalize on Canada's Approved Destination Status in China, and expand market reach to the growing Chinese middle class.

Shopping, sightseeing, visiting friends and relatives, visiting a zoo, aquarium or botanical garden are the most popular activities for Chinese travellers spending at least one night in B.C (Ministry of Jobs, Tourism and Innovation, 2011).

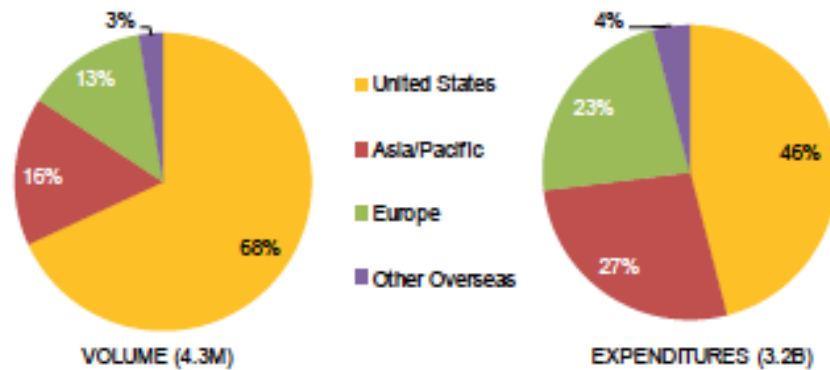


Figure 19: 2011 BC International visitor Volume and Expenditure by Market Origin  
(Ministry of Jobs, Tourism, and Innovation, 2011)

In 2011, the number of visitors from the Asia/Pacific region decreased 3%. Both volume and expenditures are lower in 2011 than they were in 2001 (-15% and -8%, respectively). However, while there was a decrease in visitor volume from Asia/Pacific (-8%) between 2006 and 2011, expenditures from Asia/Pacific visitors increased by 5%. While many Asia/Pacific markets saw declines in 2011, several markets have experienced growth in visitation from 2010, such as Australia, New Zealand, and especially China and India (Ministry of Jobs, Tourism and Innovation, 2011).

#### 4.1 Tourist Program Development

It is proposed that the UBC Botanical Garden take steps to develop their tourist program by focusing on attracting a variety of foreign visitors as well as local demographics. To accomplish this goal, the following strategies are recommended.

- Make the experience of foreign visitors more accommodating by installing multilingual signage.
- Cooperation with tour companies could be applied to increase the volume of tourist groups visiting the garden.
- Tour bus parking availability and annual entry discount to encourage tour groups or corporate groups.
- Summer camp and exchange student visits to improve the botanical garden's reputation on an international scale.

## 4.2 Program Development

The UBC Botanical Garden is nationally renowned; a living museum known for its extensive, diverse plant collections, exquisite horticultural displays, critical plant conservation research, and in-depth educational program. It has the ideal setting for teaching and learning about plants and their role in everyday life, and it is already a recognized leader in environmental education.

### 4.2.1 UBC Botanical Garden Learning Campus

Creating a new Children's Campus will boost the capacity to serve students, use the latest in learning methodology, and bring national recognition to the garden's educational programs. The Campus will be a hub of activity with many opportunities for learning and discovery, and will welcome more families with children, summer campers, teachers, and school groups to the garden. It will give greater flexibility to the garden staff and new types of activities for exploration of the natural world. It will also allow the garden to broaden its scope to include child education to serve the community.



**Figure 20 Interactive Educational Program**  
(Chicago Botanical Garden, 2013)

### 4.2.2 Horticultural Therapy Program

The horticultural therapy services program is a plant and nature based program that helps healthcare and human services practitioners launch and sustain therapeutic indoor and outdoor gardening activities. This program is not only intended creates and evaluates plant



and gardening activities that are intended to be engaging, therapeutic, and readily adaptable to a wide range of abilities, but also create potential income to the garden.

## **5. Proposed Implementation Plan**

With a total of two large structures, a parking lot upgrade, an underground water storage system, picnic shelters, advertising signage, as well as new tourist programs to be implemented at the botanical gardens, it is planned by Renew that the various changes will occur incrementally in stages over the next 5 years.

The first stage will involve the installation of 4 advertising signs at the 4 main entrances into UBC due to their short time of construction and low cost. They will also increase awareness of the botanical gardens in its current state and thus, provide a quick improvement in visitors and revenue. In this same stage it is proposed that picnic shelters be built in 5 locations inside the garden. Again, with a low capital expenditure and near-zero operating costs, the shelters will provide, after a rapid period of construction, an improved and more enhancing experience to visitors. An additional benefit of building them first is that they will immediately be available to the large influx of visitors expected after the completion of the Information Center. Concurrently, it is expected that arrangements to bring a number of tourist programs to the gardens will occur quickly. The sharp increase in visitors will again bring more revenue. The duration of this first stage is expected to take a short 8 weeks.

In the second stage, the storm water detention and filtration systems will come to fruition beneath the service area of the botanical gardens. The first major capital investment, the detention and filtration systems are expected to hold enough water to cut off the garden's reliance on the municipal water supply line; thus, savings are expected to occur immediately after completion. Subsequently, Renew suggests that the parking lot improvements be applied in this same stage. The increase in capacity will further serve to magnify the appeal of the gardens such that more revenue may be added, which will in turn go towards funding the final stage. This second stage is expected to endure about 1 year.

## RENEW Engineering Solutions

The final stage will see the beginning of the new anchor to be added to the gardens. The information center, with its event and conference space, class rooms, cafe, and gift shop, is expected to bring a substantial number of new visitors to the gardens. With such an appealing new attraction, further increases in tourist programs are expected at the garden. The last component to be built will be the conservatory building. With high revenues expected with the opening of the information center, it is likely that funds to construct the conservatory will accumulate quickly, and thus, the final step to increase visitors will be completed. The duration of this final stage is expected to last about 2 years.

### 5.1 Total Cost

The total costs of the components described in the previous sections are summarized in

Table 3. A contingency cost of 15% was added as well as a UBC building cost factor of 10%.

Design	Number of Items	Cost
Information Center	1	\$ 5,000,000
Conservatory	1	\$ 600,000
Picnic Shelters	5	\$ 100,000
Parking Lot	1	\$ 222,500
Stormwater Management System	1	\$ 500,000
Advertising Signage (4 signs)	4	\$ 20,000
<b>Total Cost</b>		<b>\$ 6,442,500</b>
Campus Building	10%	\$ 644,250
Contingency and overhead	15%	\$ 966,360
<b>Overall Cost</b>		<b>\$ 8,053,125</b>

Table 3: Total Cost Summary

## **6. Conclusion**

The UBC Botanical Gardens are an important feature for the UBC campus and the Metro Vancouver community as a whole. The gardens provide important educational and research opportunities that are essential for UBC and the surrounding community. Currently, however, the directors and various stakeholders of the gardens have expressed concern surrounding some key aspects of the gardens that need improving or revitalizing. These problems range from storm water runoff and lack of free parking space to lack of advertising and declining number of visitors coming to the garden. The design concepts proposed help solve these problems and add important sustainable practices to ensure the environmental sustainability goals of the UBC campus community. By incrementally applying the design concepts discussed in this report it is possible for the gardens to increase profitability and expand their mission while meeting their strict budgetary needs.

## 7. Bibliography

Angelus Paving Co. (2012). *Angelus Paving Stones Turfstone Grid Pavers Comments*. Retrieved November 23, 2013 from <http://www.angeluspavingstones.com/collections/paver-systems/turfstone-grid-pavers/>

District of North Vancouver (2005). *District of North Vancouver Parking & Loading Standards*. Retrieved November 23, 2013 from [http://www.dnv.org/upload/documents/Council\\_Reports/00385.pdf](http://www.dnv.org/upload/documents/Council_Reports/00385.pdf)

E-Architect. (1999, November 30). *Priory Park Pavilion, Surrey, southeast England*. Retrieved November 25, 2013, from E-Architect: <http://www.e-architect.co.uk/england/priory-park-reigate>

Lake County Forest Preserves (2003). *Permeable Paver Research Summary*. Retrieved November 23, 2013 from <http://atfiles.org/files/pdf/PermPavers.PDF>

Ministry of Jobs, Tourism and Innovation. (2011, November 3). *Province launches guide for tourism marketing to China*. Retrieved October 10, 2014, from The BC Jobs plan: [http://www2.news.gov.bc.ca/news\\_releases\\_2009-2013/2011JTI0127-001413.htm](http://www2.news.gov.bc.ca/news_releases_2009-2013/2011JTI0127-001413.htm)

NYC Department of City Planning (2007). *Design Standards For Commercial & Community Facility Parking Lots*. Retrieved November 23, 2013 from [http://www.nyc.gov/html/dcp/pdf/parking\\_lots/parking\\_lot\\_present.pdf](http://www.nyc.gov/html/dcp/pdf/parking_lots/parking_lot_present.pdf)

Shen, L. & Wong, C. (2013). Stormwater Management in the UBC Botanical Garden. *AMS Sustainability Project*.

The Weather Network – Statistics. *Theweathernetwork.com*. Retrieved Nov 20, 2013 from <http://www.theweathernetwork.com/forecasts/statistics>

# APPENDIX

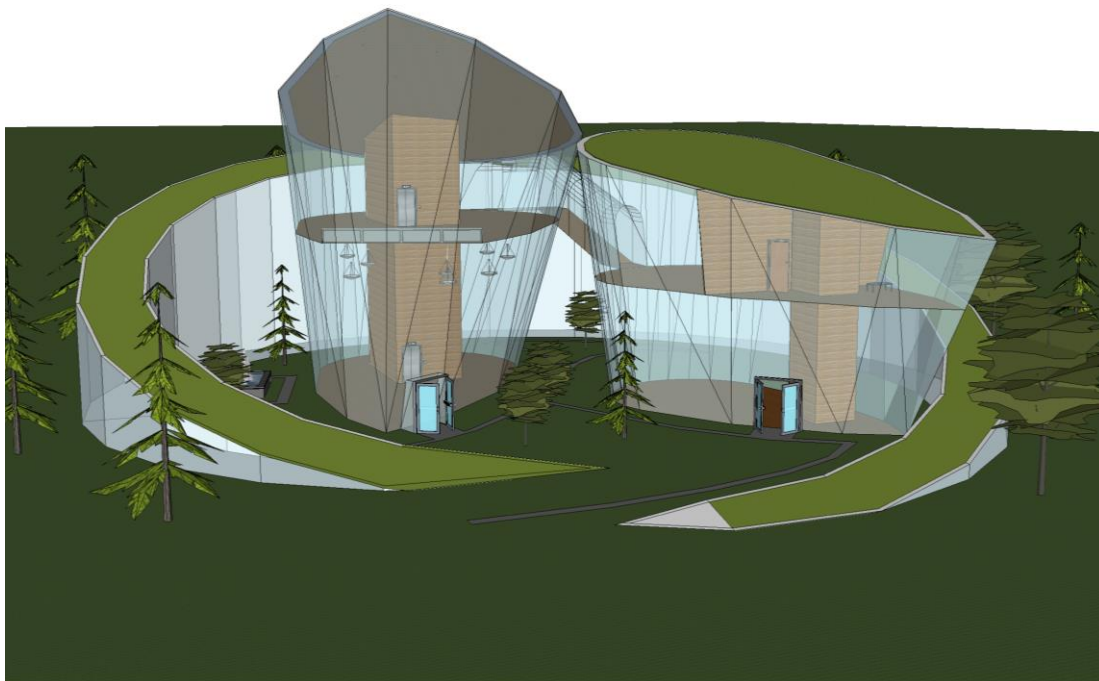
## Locations of Design Elements



## Information Center Design



**Top View**



**Front View**

**Information Center Design (continued)**



**Side View**



**Back View**