UBC Botanical Garden Revitalization

Alex Faubert, Andrew Burgin, Ewan Mceachern, Michael Lemm, Rahim Fazal, Richie Chin

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Group 4

Alex Faubert
Richie Chin
Ewan Mceachern
Andrew Burgin
Michael Lemm
Rahim Fazal

Executive Summary

G4 Consulting Limited has prepared a concept to revitalize the UBC Botanical Garden, with respect to its mission, as requested by the Garden Director on September 3rd 2013. The Botanical Garden is located at 6804 SW Marine Drive in Vancouver, BC and was established in 1916 with 900 species of plants. The Garden provides resources to researchers, students and the public and is a key part of the University's biodiversity collections. The concept proposed addresses most aspects of civil engineering and incorporates various sustainable practices within the redevelopment process. Five main development components were considered for this project: a pedestrian overpass, a conservatory and multipurpose room, a lookout tower, a state-of-the art café, and improving access and sustainability. G4 Consulting is confident that these five components will be sufficient enough to increase both student and public attendance within the Garden and in turn bring in additional revenue.

As part of G4 Consulting's garden redevelopment project, the first component involves installing an iconic structure. This structure will be a tied-arched overpass that will span across SW Marine Drive to connect the existing visitor centre by the Asian Garden to the North Garden area. The overpass provides an efficient loop pathway for visitors to explore the garden. The uniqueness of the overpass is the architecturally designed leaf-shaped structure. Similar to a leaf, the steel arch, the semi-covered roof, and its drainage system will resemble the midrib, blade and veins of a leaf. Collected rain will be drained to replenish the north garden's pond and Asian Garden's storm water system. Construction methods and the design of the overpass will meet *LEED* sustainability requirements. SW Marine Drive users will be able to view the overpass while passing by, which should bring attention to the Garden.

Education and research are key components of the gardens mission statement and will be taken into consideration for the second component of our redevelopment concept. A combined conservatory/multipurpose area is proposed to promote education and research. Having the nursery at the garden will greatly improve labour efficiency from its current location near UBC Farm. The multipurpose area will be used for activities such as lectures, garden work, garden events and public rentals to bring in additional revenue. The building will be located in the North Garden and will house some of the latest in state-of-the art technologies and features.

To attract more visitors and inform the general public of the existence of the UBC Botanical Garden, the third component, a lookout tower, has been proposed to be built in the North West corner of the Garden. This lookout tower will serve two important functions. First, the tower will complement the current Canopy Walk as an attraction of visiting the garden. Situated near the Strait of Georgia, the tower will provide scenic views of the ocean to the West, birds-eye views of the Botanical Garden to the South and South East, and a glimpse of the skyscrapers of downtown Vancouver to the North East. The tower design will reflect the natural image of the Botanical Garden and exhibit sustainable construction practices and materials. The tower will have a proposed height of approximately 200ft (60m) with multiple vantage points throughout its height.

The second function served by the tower is to act as a beacon to let the general public know where the Botanical Garden is. A tower of sufficient height will be seen by many around the

university campus, particularly people visiting the nearby Thunderbird Stadium. People unaware of the Botanical Garden will see this lookout tower and investigate, subsequently boosting attendance. Charging visitors a fee for climbing the tower will help UBC recoup part or all of the design and construction cost.

The fourth component will be a state-of-the art café in the North Garden area. Following the trend of some of the new sustainable buildings built at UBC, the new Café will be a *LEED* Gold certified building with features including: a sleek modern look, a green roof, and storm water utilization. Being encased within the Garden and by serving appetizing food, the café is sure to attract many people from all over Vancouver as well as tourists. This great attraction will allow the garden to generate income for further improvements and will also raise awareness of the garden to new crowds.

Improving sustainability and access of the garden is a goal of G4 Consulting and will be the fifth component of the Garden's redevelopment. The water features of the UBC Botanical Garden are currently fed by potable water, a wasteful practice. Other water features such as roof rainwater catchment and ponds will feed into the existing pond system and then water will be distributed for irrigation and café use. Improvements to the existing water features will also be addressed with new natural irrigation systems. Solar panels are also being proposed for buildings on the garden. Additionally, accessibility improvements are being proposed by adding 160 parking spaces along SW Marine Drive.

Incorporating all of these components into the Garden, G4 Consulting aims to meet the UBC Botanical Garden's mission "to assemble, curate and maintain a documented collection of temperate plants for the purpose of research, conservation, education, community outreach and public display" and also provide an efficient design capable of attracting visitors throughout the year.

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1.0 - Introduction

1.1 - Background

The University of British Columbia (UBC) Botanical Garden was originally established in 1916, its primary purpose being a teaching and research facility. In the 1960's it had been reduced to the campus arboretum and a rock garden and finally in 1990 major upgrades were carried out including: a reception building, gift shop, washroom facilities, lookout platform and parking lot (Kreuk, 2001).

The Garden has been an important component to the surrounding area and the local community and it has an internationally renowned collection of flora. However, this is not enough to efficiently utilize the research facility. With the creation of the UBC Botanical Garden and Centre for Horticulture in 2000, the main focus shifted to promote research and horticulture training. With the implementation of the proposed concept that will be laid out within this report, the Garden will be more efficient in the areas that have been suffering, such as inadequate funding and underutilization by university research and education programs.

1.2 - Design Philosophy

The concept proposed, as per request of the Garden Director, adheres to the mission statement and the objectives that have been set forth. It also takes into consideration the Master Plan that UBC has in place with its specifications that are to be met. The approach that was used by our team of consultants incorporated the mission statement and all aspects of sustainability to come up with an effective and innovative solution to the concept development request. It allows for improvements to the visitor experience, research facilities, education program and sustainable horticulture practices. The concept also provides amenities that were previously lacking.

To promote research and education the use of state-of-the-art technologies and fixtures are to be incorporated into the design to ensure the best learning experience. Environmental considerations were also considered and solutions such as double pane windows and solar panels were implemented. In order to increase visitors to the garden year round, amenities to provide a warm covered space in the winter months and a dry cool place for the summer need to be provided. Providing the facility will generate the necessary means to attract the crowd and benefit from the concept proposed. Incorporating sustainable features, improving access and allowing for smooth flow within the garden will allow for the mission and objectives to be achieved and for this reason they were incorporated throughout the concept development phase within this project.

1.3 - Project Scope

Our project scope for the revitalization of the Botanical Garden in this Report addressed the structural, hydro technical, geotechnical, transportation and environmental aspects, among others, of civil engineering for the visions/concerns/potentials for the redevelopment with limitations to the land and development area. All relevant codes, rules, and regulations were considered throughout the concept development.

This report does not go beyond the concept development and this proposal is open ended, that is, it is just a concept and subject to changes and modifications to increase efficiency. The detailed costs associated are beyond the scope of this proposal, however, a brief cost based on approximate area and material is provided in section 3.0 of this report.

The Conceptual Design is broken down into five separate components, each component includes a sub-section for description, sustainable practices and function and purpose

2.0 - Conceptual Design

2.1 – Overpass

Figure 1: Leaf Bridge Pedestrian Overpass

Description

A pedestrian overpass called the “Leaf Bridge” is proposed for the UBC Botanical Garden. The “Leaf Bridge” spans across SW Marine Drive connecting the North Garden with the Asian Garden. Unlike typical pedestrian overpasses found in British Columbia which have a horizontal flat deck structure, the Leaf Bridge features an arched deck with a corresponding arched wooden roof that provides shelter from rain and snow. The west ramp begins from the Asian Garden near the main entrance. The east ramp ends at the North Garden near the conservatory, café and the multipurpose building. The bridge deck is supported by two uniquely designed concrete columns (refer to Figure 3). There are three thick concrete columns on each side of the ramps. The use of translucent glass for the handrail adds to the aesthetics of the deck. Steel is utilized as the structural backbone of the overpass. A summary of design dimensions of the Leaf Bridge is shown in the table below.

Leaf Bridge Components	Length (m)
Wooden Deck	38
Wooden Roof	38
Handrail height	1.4
West Ramp Length	50
East Ramp Length	37.0
Clearance Height	5.5
Deck Width	5.0

Figure 2: Dimensions of Overpass

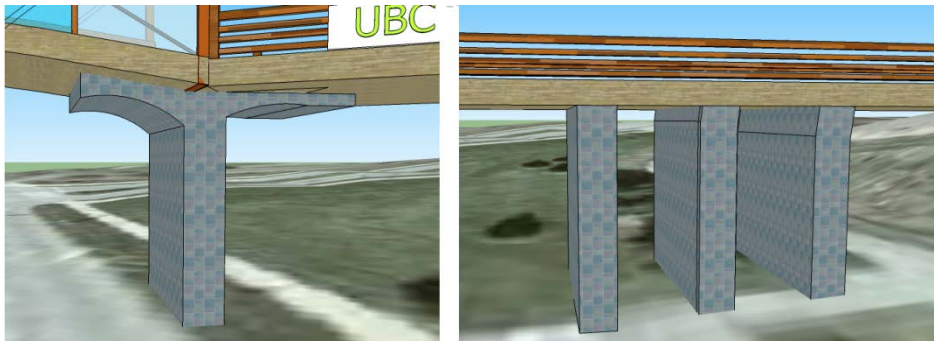

Figure 3: Unique Columns

Sustainability

The Leaf Bridge will be subject to both federal and provincial environmental assessment processes. A proposed environmental monitoring plan for the construction phases and rainwater collection will ensure the Leaf Bridge meets *LEED*'s design goals. It is designed for sustainability and projected to achieve *LEED Certification.*

Structural Features

There are several features and components being integrated into the Leaf Bridge that will promote its sustainability. The Leaf Bridge is built at a relatively low height while still satisfying the minimum clearance height, reducing the length of the ramps and subsequently the amount of raw materials (wood and steel) needed for construction.

Storm Water Management

The arched deck, arched roof and the declining ramps provide an independent storm water collection area which effectively drains water to existing ponds and streams in the North Garden and the Asian Garden. It is predicted to collect 0.7 m^3 per millimeter of rain. The veins on the roof are designed to allow uniform distribution flow of captured storm water while reducing peak runoff. This would relieve the stress on the overpass structure and prevent erosion of the garden. In addition, concrete curbs run the length of the bridge, stiffening the deck and controlling runoff.

Function and Purpose

Besides structural and aesthetics purposes, the Leaf Bridge brings three main benefits to the UBC Botanical Garden. The Leaf Bridge will improve accessibility within the garden, decrease the use of potable water for irrigation, and attract more visitors to the UBC Botanical Garden.

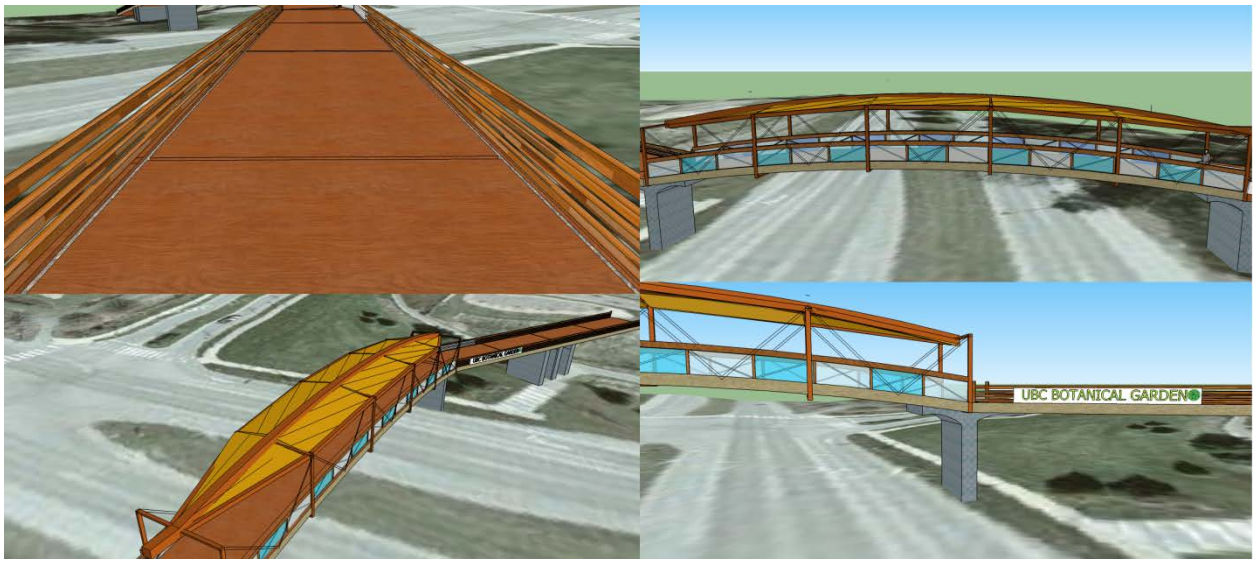

Figure 4: Top Left Ramp Drainage, Bottom Left Leaf Shape Roof, Top Right Arch Deck and Arch Roof, Bottom Right UBCBG Logo

Structural and Aesthetics

In terms of aesthetics, the golden leaf shaped roof resembles an autumn leaf that blends in with the environment. The inspiration for a leaf shape comes from the UBC Botanical Garden's plants and vegetation. The translucency of the blue and green glass will shine onto the deck, making it visually appealing. The design focuses on creating a simple arch roof in both directions (longitudinal and transverse) that will create an aerodynamic surface and subsequently reduce wind load onto the overpass structure. The decision to use wood for the roof allows for a smaller dead load when compared to a steel roof. The bridge will be five metres in width to accommodate for both pedestrian and wheelchair users. Ramp design will ensure easy access for wheelchair and stroller users.

Benefits to the Botanical Garden

The Leaf Bridge primarily focuses on improving UBC Botanical Garden's internal accessibility, storm water management system and visibility to the public.

Accessibility within the Garden

One of the greatest benefits the Leaf Bridge can offer to the garden is providing an efficient loop and improving accessibility within the botanical garden. Without an overpass, visitors and Garden users have to pass through the underground tunnel to reach the North Garden, and return to the Asian Garden through the tunnel again in order to exit. This creates an inconvenience and accessibility difficulties for visitors and those working at the Garden. The Leaf Bridge will provide more route choices and a circular loop for improved accessibility around the Botanical

Garden. The circular loop route can be seen in the figure below. Moreover, the Leaf Bridge compliments the Conservatory and the Café by providing direct and easy access from the main entrance.

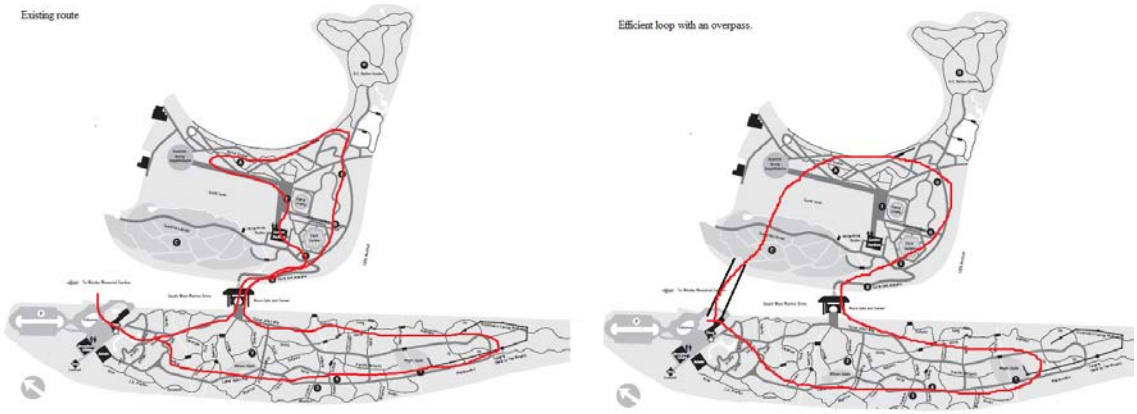

Figure 5: Improve Accessibility

Storm Water Improvement

Due to its large surface area, the Leaf Bridge can capture up to $0.7m^3$ per millimetre of rain, which is then reused for landscape irrigation. Captured storm water is treated and utilized by the Café, the Conservatory, and the Look-Out Tower, reducing the need of potable water usage. Figure 4 shows the design of the ramp that captures and drains storm water.

Visibility

The Leaf Bridge provides advertisement for the UBC Botanical Garden and acts as a landmark for South West Marine Drive users. In addition, the UBC Botanical Garden name and logo are displayed on the edges of both ramps facing SW Marine Drive (see Figure 4). Many people will want to come to see this magnificent Leaf Bridge. This will increase awareness of the location of the UBC Botanical Garden and subsequently bring more local and foreign visitors to the garden.

Figure 6: Leaf Bridge Conceptual Design

2.2 – Conservatory and Multipurpose Building

Description

A combined conservatory and multipurpose building is proposed for the North Garden. The building will be located on the east side of the Great lawn near the existing service yard to allow easy access for the public and garden employees. To meet UBC's goal of sustainability the building will meet or exceed *LEED* Gold standards. The building will be a single story structure with large open vaulted ceilings. The building will also consist of a 1920 ft^2 multipurpose area and a 1600 ft^2 conservatory.

In the multipurpose area there will be a flexible multipurpose space, washrooms, small kitchen and foyer. This section of the building will be a timber frame structure with large windows to provide natural lighting and views of the garden. The alternating sloped roofs and large timber members provide an aesthetically pleasing building with eye-catching architecture that will stand out to visitors. Sustainable features include a green roof, roof water catchment and solar panels.

The conservatory will have three entrances, from the foyer, multipurpose space and exterior of the building facing the Great Lawn. This section of the building will be enclosed in large glass panels with a structural steel frame. The cube-like structure of the conservatory contrasts the natural timber frame of the multipurpose area making it a unique and visually pleasing structure. The cube-like structure is designed from a similar building at the State Botanical Garden in Georgia. The roof system consists of many low-sloped pyramids, allowing for water runoff yet they are not visible from the ground level to keep the structure's image as a cube intact. Similar to the multipurpose area, sustainable features include a roof water catchment, skylights and solar panels.

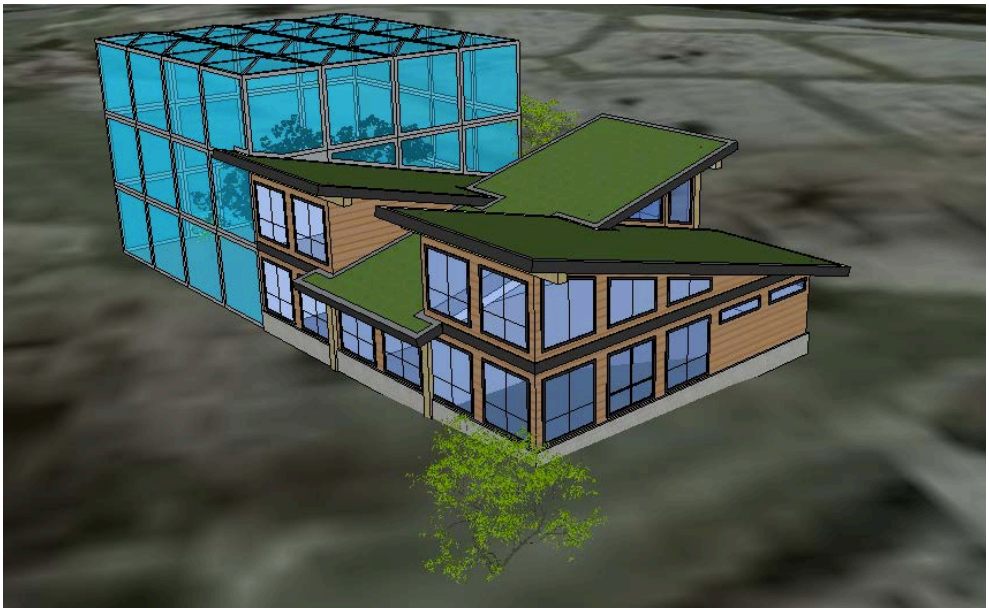

Figure 7: Conservatory and Multipurpose Building

Sustainability

As mentioned previously, the conservatory and multipurpose building will meet *LEED* gold standards. Sustainable features are summarized below:

- **Extensive Green Roof** – Provides a natural habitat for insects and other bugs. It will also promote the natural green colour of the garden which is visible on the sloped roof when approaching the building. Low profile plants and ground cover requires irrigation, which reduces the amount of surface runoff from the roof. The sloped green roof can be seen in Figure 7.
- **Natural Lighting** – To maximize natural light in all interior spaces and reduce the demand for energy needed for lighting. Skylights and the large number of windows allow this to be possible.
- **Timber Structure** – Timber is renewable, recyclable and sequesters greenhouse gases. The use of timber and other green materials reduces the carbon footprint of the building.
- **Roof Water Catchment** – Rainwater is harvested from the green roof and conservatory roof, which is transported to the pond system adjacent to the great lawn. With an average annual rainfall of 1260mm/m^2 (UBC Sustainability, 2013), the roof would provide approximately 460000 L/year. This water harvesting would reduce the amount of potable water currently required to supply the pond system near the great lawn.
- **Solar Panels** – Photovoltaic arrays are proposed to capture natural energy and offset the energy use of the building.
- **Landscape** – Landscape features will be incorporated into the design to bridge the gap from the garden to the building. Living walls are an example of a landscape feature that could be included in the design.

Function and Purpose

The multipurpose building will function as a place to hold lectures, meetings, weddings and other private functions. During lectures, Science and Horticulture students will have access to the conservatory and a lecture room to gain practical experience with plants in the garden. Providing a space for lectures will promote education and research of the natural environment in the Botanical Garden. The flexible space can also be rented for private functions such as meetings and weddings to generate revenue. It can also be used for garden-based events such as Apple Fest.

The foyer could also be used as a second ticketed entrance to the garden on weekends and during peak season visitation. Having two entrances to the garden complements the improvements to accessibility, overpass and café. Guests can use the overpass to access the conservatory building if desired. The building's proximity to the café will attract customers from the café into the garden and conservatory. Washrooms provide convenience of the guests during any event. A small kitchen area is provided in the flexible area for use during garden events.

The conservatory will function as a year-round exhibit of exotic plant species for public display. The conservatory will increase the number of guests during winter months because it is an indoor display where visitors can stay dry and comfortable. Also, it will be able to be used as a nursery

for warmer climate plants during the cold winter season. Having a nursery on the Garden grounds greatly improves its function from its current location at UBC Farm. As already mentioned, weddings are a possible rental event, and people prefer having weddings in good weather and beautiful natural spaces. The conservatory addresses this by bringing the natural environment into a covered area that is independent of the weather.

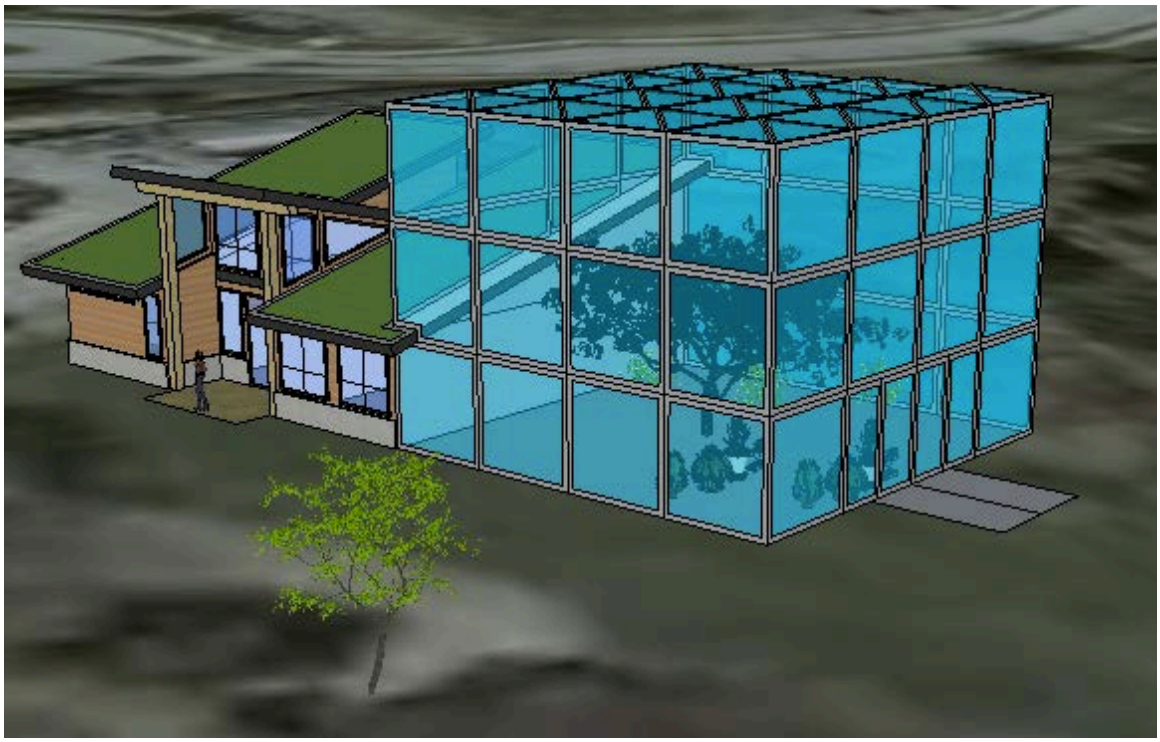

Figure 8: Conservatory and Multipurpose Building

2.3 – Lookout Tower

Description

To help address the needs of the Botanical Garden, a lookout tower has been proposed for construction in the Northeast area of the garden near the Visitor Centre. Meant to resemble a tree, this tower is cylindrical in shape and tapers slightly as elevation increases. 3 viewing platforms at various heights will provide visitors with scenic views of the Strait of Georgia to the West, the Botanical Garden to the South, UBC Campus to the East, and a distant view of the North Shore mountains to the North. The three viewing platforms will be located at 20m intervals with a final tower height of 60m. The Tower itself will be constructed primarily of concrete and will sit on a concrete foundation to ensure stable geotechnical conditions.

Figure 9: Lookout Tower

Approaching the main entrance to the Lookout Tower, visitors will look up and notice the great height of the structure and the viewing platforms. Visitors will also notice the exterior cladding, resembling the bark of the Red Cedar tree that is native to this region. The main entrance juts out of the base of the tower welcoming visitors inside. Crossing this threshold into the tower, visitors will walk into a square room space with approximately 10m long sides. A cantilevered staircase will rise up through the room while hugging the walls, rising in a counter-clockwise helical fashion. The staircase will meet the roof 20m above and disappear into the first viewing platform floor. While climbing these stairs, visitors will have the opportunity to read Information Boards installed onto the walls.

After a 20m ascent, visitors will reach the first viewing platform elevation. The staircase will open up into a high second room with wood flooring. A doorway leading to the exterior will be directly ahead while a new staircase will begin to the right to allow visitors access to the higher

viewing platforms. Stepping outside, visitors will walk onto a circular deck. This deck will run around the circumference of the tower and allow visitors 360 degree views of the area and will be cantilevered out beyond the footprint of the tower. A railing will ensure visitor safety and consist of a metal frame with transparent glass.

Returning into the core of the tower, visitors can continue up the staircase for another 20m ascent. At this point visitors will step onto the second viewing platform. Climbing this staircase, visitors will notice the large south-facing windows installed along the depth of the tower. The second viewing platform will be very similar in design to the lower viewing platform; the interior flooring will be wood and a doorway will allow visitors access to a circular deck running around the outside of the tower. Like the lower deck, this platform will be made mostly of concrete but will have conspicuous wooden highlights to emphasize a natural atmosphere. At 40m in elevation, this second viewing platform will provide visitors with even greater views of the surrounding area.

A third staircase will allow visitors to ascend the final 20m of the tower to reach the top. However, unlike the previous two floors, before the staircase ascends up through the next roof a cantilevered walkway will lead visitors to the geometric centre of the structure. Here visitors will be met with a cylindrical pod suspended by 4 steel rods bolted into the upper corners of the interior of the tower. With glass railings and glass flooring of the walkway visitors will be able to look down at the second viewing platform and out the large South-facing windows.

Upon entering the cylindrical pod visitors will be met with a final staircase winding counter-clockwise around a central axis, inspired by spiral staircases prevalent in many Castles. Climbing to the top of this spiralling staircase, visitors will arrive on a landing with a doorway leading out onto the highest of the 3 viewing platforms. Having the entrance at the center of this upper deck will allow uninhibited views in every direction. This final platform will be located at the very top of the tower and unlike the lower platforms will not cantilever out beyond the tower footprint. Another glass railing will run around the perimeter of the rooftop to ensure visitor safety. At 60m above the base of the tower, visitors will be exposed to spectacular vistas in all directions. Visitors will descend the tower using the same staircase used to ascend, creating a two-way travel situation along the length of each staircase.

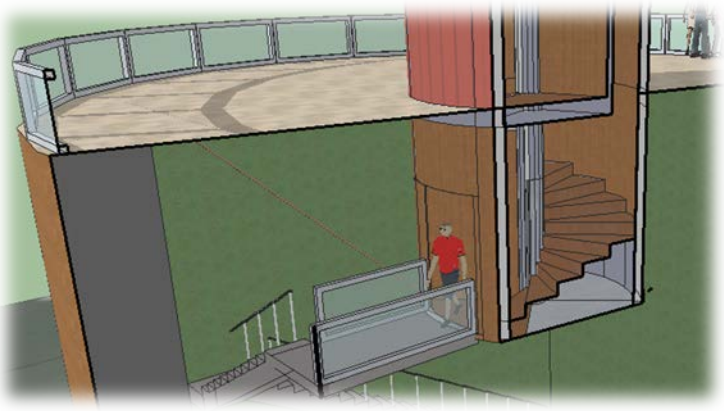

Figure 10: Lookout Tower Interior Spiral Staircase

Sustainability

The lookout tower will be designed to fully meet and, where possible, exceed University of British Columbia sustainability targets and campus plans. In addition, the lookout tower will meet or exceed all criteria to be certified as a *LEED* Gold standard building.

Natural lighting will be used as much as possible to illuminate the interior chambers of the tower. From late spring to early fall the South-facing windows will allow natural sunlight to filter into the tower chambers, fully illuminating the interior. However there will be times when natural sunlight will not be sufficient, for example winter, stormy days, dusk, rainy days and days of heavy overcast weather. As such, lights will be installed at seemingly random elevations within the tower and set back into the walls. Floodlights will be installed around the perimeter of the tower to illuminate the tower in its entirety.

To ensure visitors are comfortable with regards to temperature, heaters will be installed at 4m above floor level on the main floor and upper viewing platform floors and powered by electricity. During summer months these heaters will be turned off to take advantage of the thermal lag provided by the concrete structure. This thermal lag is a natural ability of the concrete walls due to the material's relatively low thermal conductivity and will result in comfortable interior temperatures. The thermal offset works due to the time required for heat to penetrate into the concrete structure. During the morning the sun will shine and heat up the exterior concrete. However, due to the thickness of the walls it will take a number of hours for the heat supplied by the sun to reach the interior of the tower, which will remain comfortably cool. By the time the heat manages to penetrate through the walls, night will have fallen and the ambient temperature will be relatively cool, while the tower interior will finally feel the heat held in the concrete. Through this pattern of heat lag the tower interior will typically be adequately heated and cooled in summer months.

Arrays of solar panels will be installed across the southern hemisphere of the lookout tower. These solar panels will be installed throughout the height of the tower. The solar panels will firstly capture photon energy emitted by the sun then store that energy in batteries. The energy harvested by solar panels will provide the power necessary to power the heaters and interior lights and ideally make the lookout tower a net power generator, providing electrical energy to other parts of the Botanical Garden.

Function and Purpose

The tower has been designed to address two critical needs as identified by leaders of the Botanical Garden. These needs are increased visitor attendance and increased public awareness of the Botanical Garden as an institutional component of the UBC campus.

The construction of a lookout tower will increase garden attendance in a number of ways. Primarily, visitors will be attracted by the stunning vistas offered by the upper observation decks. It is apparent that there is a lack of public access to panoramic views on the UBC campus, with the majority of taller buildings owned by private entities or reserved for student housing, only a small portion of the population will have access. Visitors will climb up through the tower to the

upper viewing deck and marvel at the stunning 360 degree views laid out before them. Sunny days will yield picturesque views of the Strait of Georgia and Vancouver Island, while inclement weather will allow visitors to storm watch from the 3 different observation decks. Visitors will walk away from the Botanical very impressed with the view offered by the tower and will tell others of the UBC Botanical Garden and its lookout tower, spreading word of the Garden and its attractions and thus increasing total visitor attendance in all seasons.

The immense height of the lookout tower will act as a large advertising sign for the Botanical Garden. At 60m tall, the lookout tower will be the tallest building on campus. As a result of this, students walking around Totem Park and Thunderbird Residences, in addition to many other locations around Thunderbird and Agronomy Avenues will see this structure as a beacon to the West. The visual presence of the tower will have a number of affects on students and other persons in these areas. Firstly, those who are unaware of the existence of the Botanical Garden will wonder why such an immense tower has been constructed on the far western portion of campus and spur a significant portion to investigate, eventually stumbling upon the Botanical Garden. Second, those people in the area already aware of the Botanical Garden's existence will know that the tower denotes where the garden is physically located on campus and will always be able to find it.

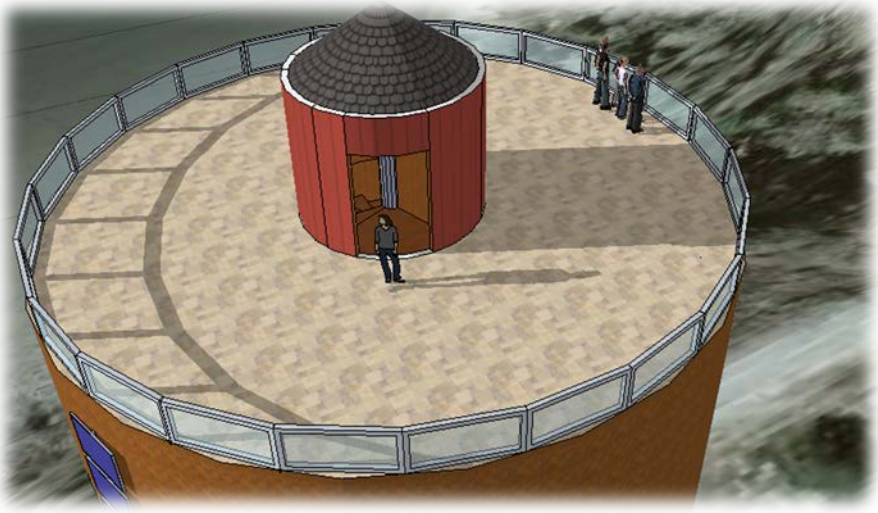

Figure 11: Top of Lookout Tower

The tower will also serve a variety of secondary purposes. Firstly, as mentioned above, the solar panels installed onto the side of the tower will produce excess electricity for the Botanical Garden to use. The tower will redirect all captured rainwater into storage basins within the base of the lookout tower and will be collected by a network of covered gutters running around the tower perimeter. The stored water will then be used for a variety of purposes as set out by the Botanical Garden director, from floral irrigation to use in water features. Due to the great height of the lookout tower it will become a mainstay of the physical characteristics of the university campus, tying the UBC Botanical Garden to the image of the University of British Columbia.

2.4 – Café

Description

To help address the needs of the U.B.C. Botanical Garden, a food venue is proposed for the North garden. The Maple Café will be a great addition to the Botanical Garden. The building will be two stories and each floor will have a floor space of 1500 square feet. The proposed design is displayed in the figure below.

Figure 12: The Maple Café

The maple café will consist of a concrete foundation and frame with large panes of glazed glass used to complete the structure. The structure will contain many sustainable features including a green roof and natural lighting usage. Serving fresh local fare, the sleek modern sustainable design will be a great attraction. The incorporation of glass will allow for a great view from just about any seat in café, which is a key part to the cafés ability of raising awareness to the garden. Although the frame will be constructed from concrete, for sustainability and economic reasons, the building will appear to be constructed from wood by detailing and painting the concrete. This will add to the aesthetics of the building and should help attract customers.

Upon entering the Café one will have the sense they are standing within a building constructed totally of wood due to wooden interior, this will help give the café a lively feel which will comfort customers. The menu will consist of many hot beverages, including coffee, espressos, mochas and lattés. Furthermore, there will be a wide variety of fresh food to order, such as, freshly made sandwiches and bagels, salads, hamburgers and french fries. Many of the menu items will include fresh ingredients from the food garden. In order to illustrate how it might feel to be sitting in the café a snapshot of the first floor model is shown below.

Figure 13: Maple Café First Floor

Once on the second floor, customers will be subjected to the view of the immensely beautiful Botanical Gardens and surrounding area. The Overpass and Lookout Tower will be viewable from the southeast facing window, and the Botanical Garden will be viewable from the south and southwest facing windows. These views are displayed below.

Figure 14: Maple Café South East View

Figure 15: Maple Café South West View

Sustainability

The Maple Café will be an excellent demonstration of sustainable design. It is designed to meet *LEED* gold standards using modern ideas. Due to this, it will fit in well with the natural environment created by the garden and also with the Garden's mission to make the world a more sustainable place.

The Café will utilize natural lighting as much as possible. The modern design technique of using a large amount of glazed glass panes is what allows for this. Studies have shown that artificial lighting can account for 35% of a buildings energy expenses, the use of natural lighting will significantly reduce these costs (Sustainability & the Environment, 2012). This will help minimize operating costs for the Café and in turn will generate more profits for further upgrades. Additionally, Glass is an excellent building material due to its ability to enhance people's health and wellbeing when used in buildings and due to its energy saving properties (Sustainability & the Environment, 2012). All of the glass used in the Café will be made of recycled glass, adding to the Cafés sustainable features.

The main building material to be used at the Maple Café will be concrete. The concrete mix that will be used will be quite sustainable. It will use recycled aggregate in order to utilize renewable materials and also use fly ash to help reduce CO2 emissions from the production of cement.

The Café design also utilizes a modern green roof. The green roof will be constructed on waterproof concrete, which will help provide insulation in order to reduce energy costs. In addition, heat island effects will be reduced, rainwater will be absorbed leading to less storm water run-off and air pollution will be reduced by re-oxygenating the air (Concrete Is Green, 2011). A model displaying what the green roof will look like is displayed below.

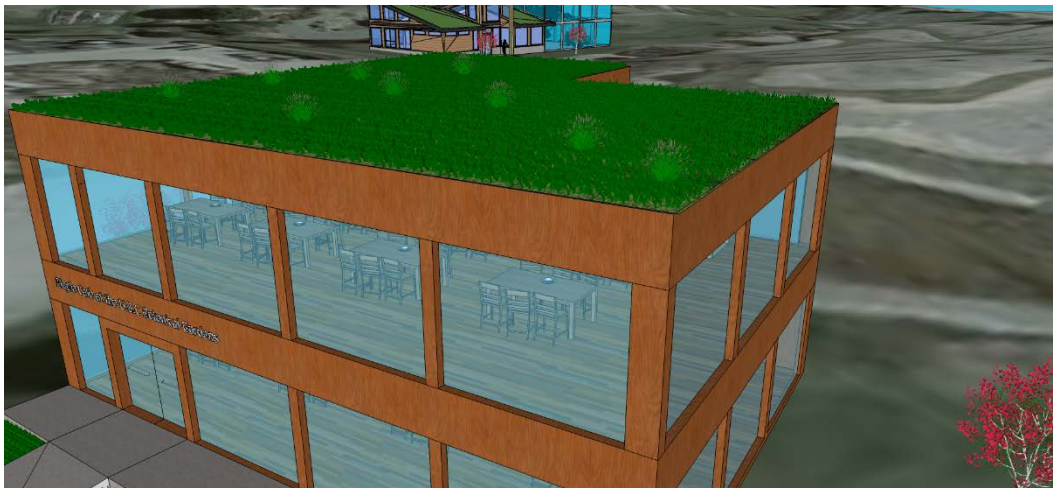

Figure 16: Maple Café Green Roof

Function and Purpose

The Maple Café has been designed to attract students, Vancouver locals and tourists to the Botanical Gardens in order to raise awareness of the garden to new crowds and to generate income for further upgrades.

The Café will increase visitor ship in the following ways. First of all, the design is very appealing and will make people take notice. Being visible from stadium road, people passing by will be enticed upon seeing the Café and will be tempted to come in. Even during the winter months, the Café is sure to attract many people, hot beverages and a great view of the garden on a cold winter day will be a big hit. Once inside, customers will be subject to the view of the Botanical Gardens from the Café, which will raise awareness of the immense beauty of the Garden. This increased awareness is sure to increase garden attendance.

One of the major issues for the Garden is the inability to generate income, the Maple Café will do just that. Being a year round attraction, the Café will generate a steady income for future upgrades. Since the Maple Café will be built before such upgrades as the Lookout Tower, Overpass and Conservatory, the income produced at the Café will help to fund these structures.

2.5 – Access and Sustainability

Description

In order to truly enhance and bring incremental changes to the Botanical Gardens, improvements must be made in how visitors access and interact with the garden. Access and Visibility need to be improved both from the public realm and within the Garden itself.

The Garden has a healthy volume of visitors throughout the summer and hosts regular events during these months, such as the Apple Festival and private functions. In the summer, on weekends and during events, the Botanical Garden is often unable to provide enough parking for visitors, causing major inconveniences for them. As such, it was imperative to increase the number of parking spots available within walking distance of the gardens. Currently, the UBC Botanical Garden provides parking at one of UBC's parkades and rents a shuttle bus for major events. This is inconvenient for patrons and proves quite costly for the gardens. One challenge to increasing the number of parking spaces in this area is a UBC provision which does not allow for more parking areas to be built on the campus.

Therefore, existing space needed to be maximized. The portion of South West Marine Drive from Agronomy Rd to West 16th Ave could be repainted with a new alignment to make way for street parking. This change would have to be discussed with the Ministry of Transportation to ensure this disaster route is kept up to their standards. Driving lane widths, road edges and medians will be kept constant therefore only grinding and new line painting will be required.

It was noted that it is possible to have the southbound portion of SW Marine Drive remain one lane wide until West 16th Ave. The elimination of one driving lane will give way to a bicycle lane and parking spaces. The same approach is applied on the Northbound portion of SW Marine Drive; here only a small portion (~50m length) of a bike lane is eliminated in order to conserve all existing driving lanes, but there is capability for additional parking on the existing shoulder space. It should be noted parking spaces are assumed to be three metres by five metres for design purposes. The plan figure and cross section below illustrate the proposed changes.

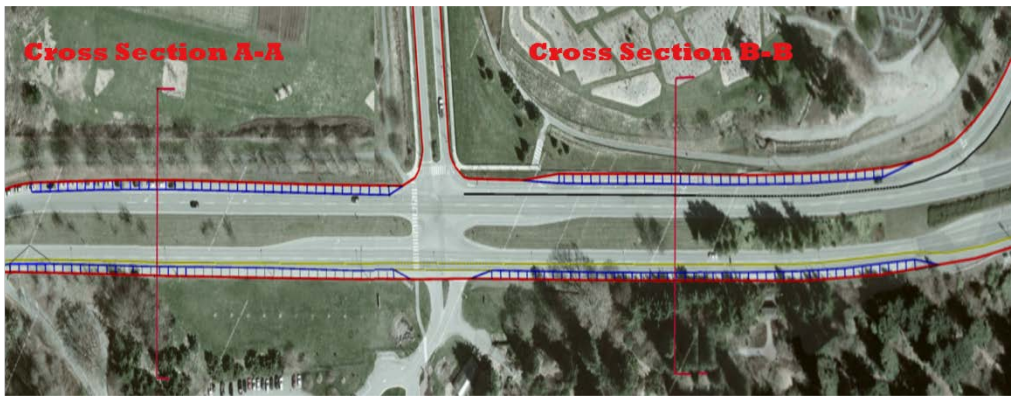

Figure 17: Plan View of New Road Arrangement

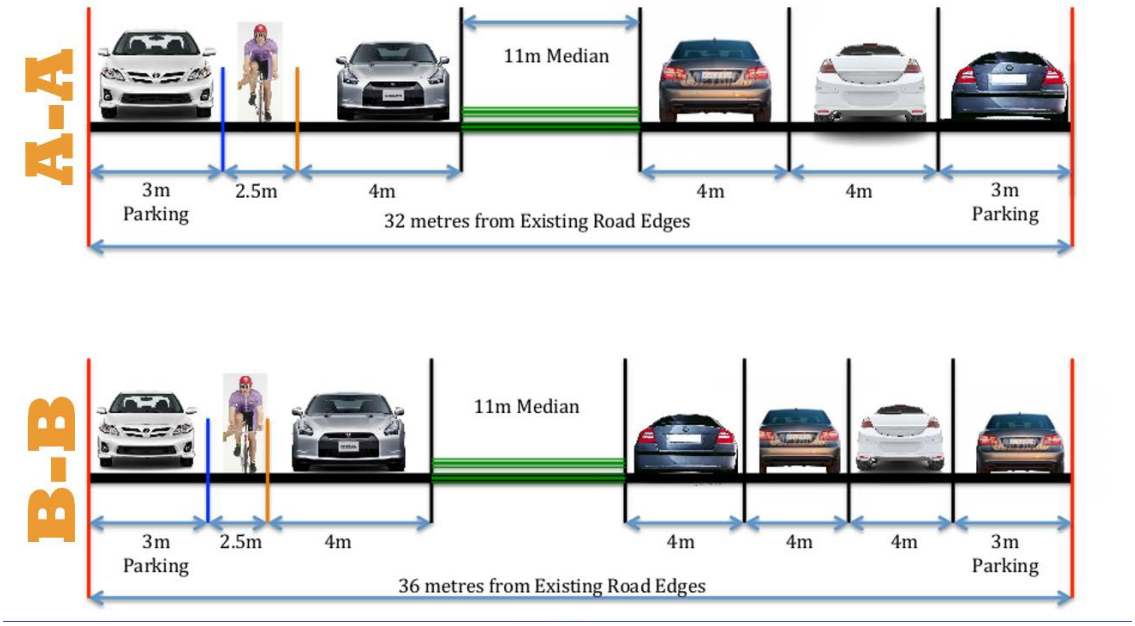

Figure 18: Proposed Road Cross Sections

This proposed repainting of the road will allow for the addition of about 160 parking spaces. These spaces should be metered, have maximum parking limits of about 3-4 hours and no overnight parking. While driving lanes are kept the same width, the addition of parking on the road edges may result in a more constricted driving experience. Given the general location, this stretch of road could be reduced from a 60-80km per hour zone to a 40km per hour zone. This limit will match the condition a driver would be expected to follow if heading southbound from Agronomy Rd. towards Stadium Rd.

In order to improve visibility for the gardens, permission from the Ministry of Transportation allowing the gardens to plant temporary seasonal display gardens in median areas and right of ways will be obtained. Currently these areas exist as green lawns and cover quite a considerable area that could be beautified with bright plantings and landscaping features. Care must be taken to ensure they do not negatively affect driving sight lines and other road conditions. Another measure to improve visibility would be the placement of signs, which could be seen from Thunderbird Stadium during games. This may be as simple as printing an advertisement for the UBC Botanical Gardens on the chain link fence separating the stadium from the gardens. This would be a minimal cost and provide exposure to a large volume of attendants at sporting events.

In terms of pedestrian paths, the Asian (south) garden should be maintained as it is, considering the collections and sizable trees in this area. However in the north portion, a new path system will be designed once final locations for structures have been marked. This path will need to be organic and gently guide visitors from one area to another. The addition of a small wooden walkway crossing the pond near the Native B.C. Garden will make flow more natural towards the north east portion of the garden.

Sustainability

About 160 parking spaces are made available without the addition of more impervious pavement surfaces or even roadwork past simple grinding and line painting. The initial considerations that utilized existing road edges and medians will allow for affordable, quick and environmentally friendly solution to the problem of parking. In addition to this, improving visibility by utilizing rights of ways and medians will provide more plants and again requires no serious construction or even landscaping.

Individual sustainable features are being taken into account in each of our new structures. However as a whole we will accumulate collected storm water and expand on their existing systems. We will add measures such as microdrips or micro irrigation to curb fresh water usage during the summer months. Rainwater catchment will be collected from the roofs of the Stadium's bleachers. Rain water collected at the stadium parking level has a few meters of gravity head and therefore it will be used to micro irrigate certain plants down in the garden which have a higher water demand.

Function and Purpose

Much needed parking capacity is added to the Botanical Gardens by means of the previously described arrangement. This arrangement is flexible and allows for the closure of these parking stalls during the winter if needed. These closures may be deemed necessary if traffic volumes peak when students return for winter session, as botanical garden visitor volume will decline once summer has ended. Improved visibility will attract additional visitors to the Gardens. All initiatives in this section were conceived to be as affordable as possible and to maximize their effect.

By means of relatively cheap new technology we aim to reduce the consumption of potable water utilized in the garden for irrigation purposes. As discussed previously, new structures will collect rain water and store it in localized systems which can be tied to the existing systems and allow for this water to be utilized in more areas of the garden. More efficient methods of irrigating plants will compound savings in potable water, as less water will go to waste. By implementing these measures to increase sustainability the garden will be able to grow while not increasing its footprint on the environment.

3.0 – Cost Estimate

As per Section 1.3 of this report, a detailed cost estimate is beyond the scope of this proposal and will be addressed in more detail in the design and specification stage of this project. The following cost estimate shown below is a general scope of what it would typically cost to build similar structures in British Columbia. The data used was from research of local construction companies and their average construction costs based on the finishing and type of structure and given per square foot (Blue Ocean Construction, 2013).

The costs provided include the design, engineering, building permits and construction costs. They are provided based on assumed areas of the proposed building/structure/concept and using blended unit typical construction costs. The approximate cost of each component described below includes different materials, fixtures and sustainable features. Each one is described in further detail in the following sub sections.

3.1 – Overpass

Approximate Cost to Build per Square Foot: Since this is a complex structure involving all three major building components (steel, concrete and wood) the higher unit cost was used of $400 per square foot.

Approximate Area in Square Feet: 22,500 ft²

Approximate Cost to Build: **$9,000,000.00**

3.2 – Conservatory and Multipurpose Room

Approximate Cost to Build per Square Foot: This structure will incorporate steel, concrete and wood, and will include high end fixtures and state-of-the-art technologies. For this reason the higher unit cost was used of $400 per square foot.

Approximate Area in Square Feet: 3,520 ft²

Approximate Cost to Build: **$1,408,000.00**

3.3 – Lookout Tower

Approximate Cost to Build per Square Foot: Since this is a complex structure involving all three major building components (steel, concrete and wood) the higher unit cost was used of $400 per square foot.

Approximate Area in Square Feet: 12,500 ft²

Approximate Cost to Build: **$5,000,000.00**

3.4 – Café

Approximate Cost to Build per Square Foot: Since this is a complex structure involving all three major building components (steel, concrete and wood), it will included state of the art technology and high end fixtures and thus the higher unit cost was used of $400 per square foot.

Approximate Area in Square Feet: 3,000 ft^2

Approximate Cost to Build: **$1,200,000.00**

3.5 - Access and Sustainability

This cost will be approximated as a budget and will include all aspects of the access and sustainability concept described in the preceding section.

Approximate Cost to Build: **$200,000.00**

3.6 – Total Estimated Cost for Proposed Concept

Over pass	$9,000,000.00
Conservatory and Multipurpose Room	$1,408,000.00
Lookout Tower	$5,000,000.00
Café	$1,200,000.00
Access and Sustainability	$200,000.00
Sub Total	$16,808,000.00
Contingency (10%)	$1,680,800.00
Total Cost to Build Proposed Concept	**$18,488,800.00**

Figure 19: Total Cost for Proposed Concept

4.0 – Environmental Considerations

The proposed concept (pedestrian overpass, café, conservatory, lookout tower, and additional parking spaces) ensures minimum impact on the environment. It neither affects nor poses a threat to UBC Botanical Garden's plant collections in any way. Potential environmental impacts were identified and mitigation strategies were considered in the conceptual design to minimize those impacts.

The leaf shaped pedestrian overpass is designed to attenuate peak flows and delay discharge of surface runoff. This is to mitigate the potential problem with soil erosion in the garden due to fluctuating surface runoff. Additionally, this innovative design ensures minimum disturbed area.

The conservatory, look-out tower and the café locations are located at open unused spaces in the garden. The locations were chosen to have no physical disruption to the garden's plant collections and were designed to avoid visual distraction of the plant exhibits to garden users.

Waste generated from the café, the look-out tower and the conservatory will be properly managed and will undergo regular monitoring to eliminate potential problems with waste contamination. Proper waste management ensures good water quality and, ultimately, a healthy living environment for the plant collections.

Grass swells will be installed in certain areas adjacent to the parking spaces along SW Marine Drive to induce infiltration and decrease surface runoff. Grass swales are a natural and sustainable choice to recharge groundwater. In addition, infiltration and filtration devices including infiltration basins, porous pavement, sand filters, and pond system are potential mitigation strategies to manage storm water sustainably.

Detailed design of mitigation strategies are not discussed in this report. The environmental impacts due to the construction process, will not be discussed in this conceptual design report. However, going forward with this project a detailed environmental assessment, considering social, economic and environmental impacts, can be provided.

5.0 – Construction Timeline

The detailed construction schedule (with critical path and total man-hours) for the proposed concepts is beyond the scope of this project. In this project, as described below, G4 Consulting has provided an overview of a construction timeline for the conceptual design described in the preceding sections. This timeline has been optimized to be the most economical construction process and the chronological order provided allows for the following benefits:

- The proposed concepts built and implemented first will bring in revenue, from sales at the Café and rental income from the Multipurpose Room. The additional revenue will recover some of the design and construction costs as well as provide an investment for the costs associated for the next phase of construction.
- Sustainable practices coupled with state-of-the-art technologies and fixtures are implemented immediately and in turn allow visitors, students, and researchers to benefit from them.

The figure shown below shows the overview of the construction timeline that was optimized by our consultants to meet the scope and requirements of this project.

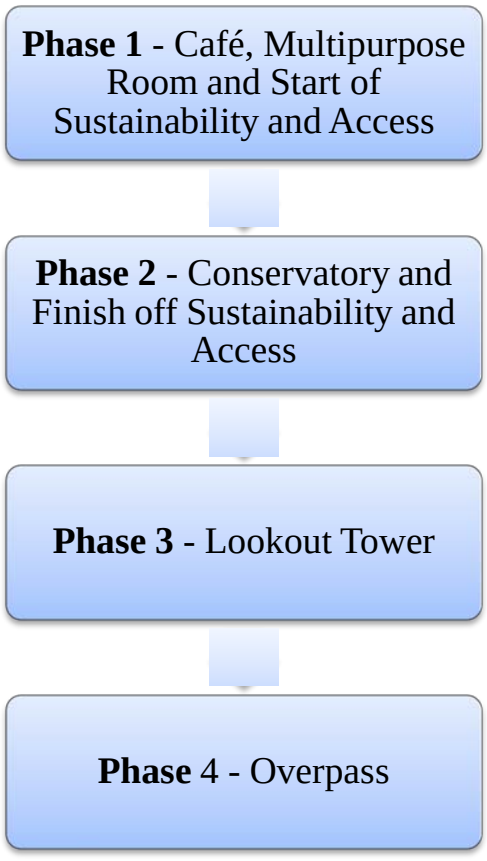

Figure 20: Construction Timeline

6.0 – Conclusion and Recommendations

The conceptual design for the UBC Botanical Garden Revitalization incorporated Structural, Geotechnical, Hydraulic, Transportation, and Environmental Engineering. In addition, a cost estimate and construction timeline were provided. The concept involved five different components; Overpass, Conservatory and Multipurpose Building, Lookout Tower, Café, and Access and Sustainability. These components were chosen by our team of consultants at G4 Consulting because they are the most effective solutions to the mission objectives.

The Overpass, with a unique leaf-shaped roof, will improve accessibility within the garden, attract more visitors and decrease the use of potable water for irrigation and pond displays. At a cost of $9,000,000.00, this pedestrian overpass is projected to achieve *LEED* Certification. The Conservatory and Multipurpose Room is also projected to achieve *LEED* Certification and will function as a lecture or social event hall with affordable rental rates, as well as a year round exhibit of exotic plant species. The costs associated to this concept are $1,408,000.00. The Lookout Tower, a cylindrical tower that resembles a tree, is proposed at a cost of $5,000,000.00. The Tower provides an important benefit of appearance and is a visible landmark from a distance.

The two-storey Café, another building projected to achieve *LEED* Certification, provides exceptional views of the gardens and is the perfect place for students and locals to come grab a bite to eat or a warm cup of coffee. It is projected to cost $1,200,000.00 and will be environmentally friendly. Access and Sustainability have been proposed as the final conceptual design component. This concept is projected to cost $200,000.00 and increases parking spaces, improves visibility and access, and incorporates sustainable practices.

The proposed concepts should be phased to optimize costs while meeting the Mission Objectives. Phase 1 will address Access and Sustainability as well as the development of the Café. Phase 2 will see development of the Multipurpose Room the Conservatory and finish off the Access and Sustainability. Phase 3 will incorporate the Lookout Tower into the Garden. Finally, Phase 4 will add the Overpass.

At a total projected cost of approximately $18,500,000, G4 Consulting is confident that the proposed conceptual design will revitalize the Botanical Garden and concurrently meet the gardens mission statement. We look forward to taking this to the next stage in the Construction Process and will await your decision to start developing the design specifications.

7.0 – References

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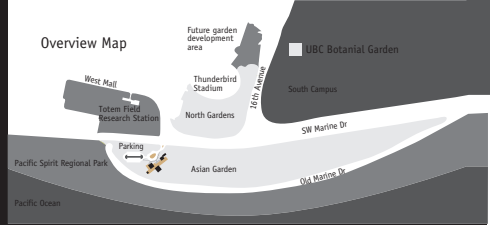
Appendix A – UBC Botanical Gardens Map

Welcome to UBC Botanical Garden

THE UNIVERSITY OF BRITISH COLUMBIA

ubcbotanicalgarden & centre for plant research
AT THE UNIVERSITY OF BRITISH COLUMBIA



North Gardens

A E.H. Lohbrunner Alpine Garden

Organized by continental regions, this is one of North America's largest alpine gardens. Skillful landscape design with rock outcrops simulate native montane and alpine habitats from around the world.

B Garry Oak Meadow and Woodland Garden

Representing the rain-shadow climate of British Columbia's south coast, this is a garden under development that is already rich in spectacular flowering bulbs and herbs.

C Carolinian Forest

This young hillside arboretum displays some of the exceptional diversity of trees and shrubs native to the hardwood forests of eastern North America. Individual groves celebrate early North American botanists and plant explorers.

D Herbaceous Border

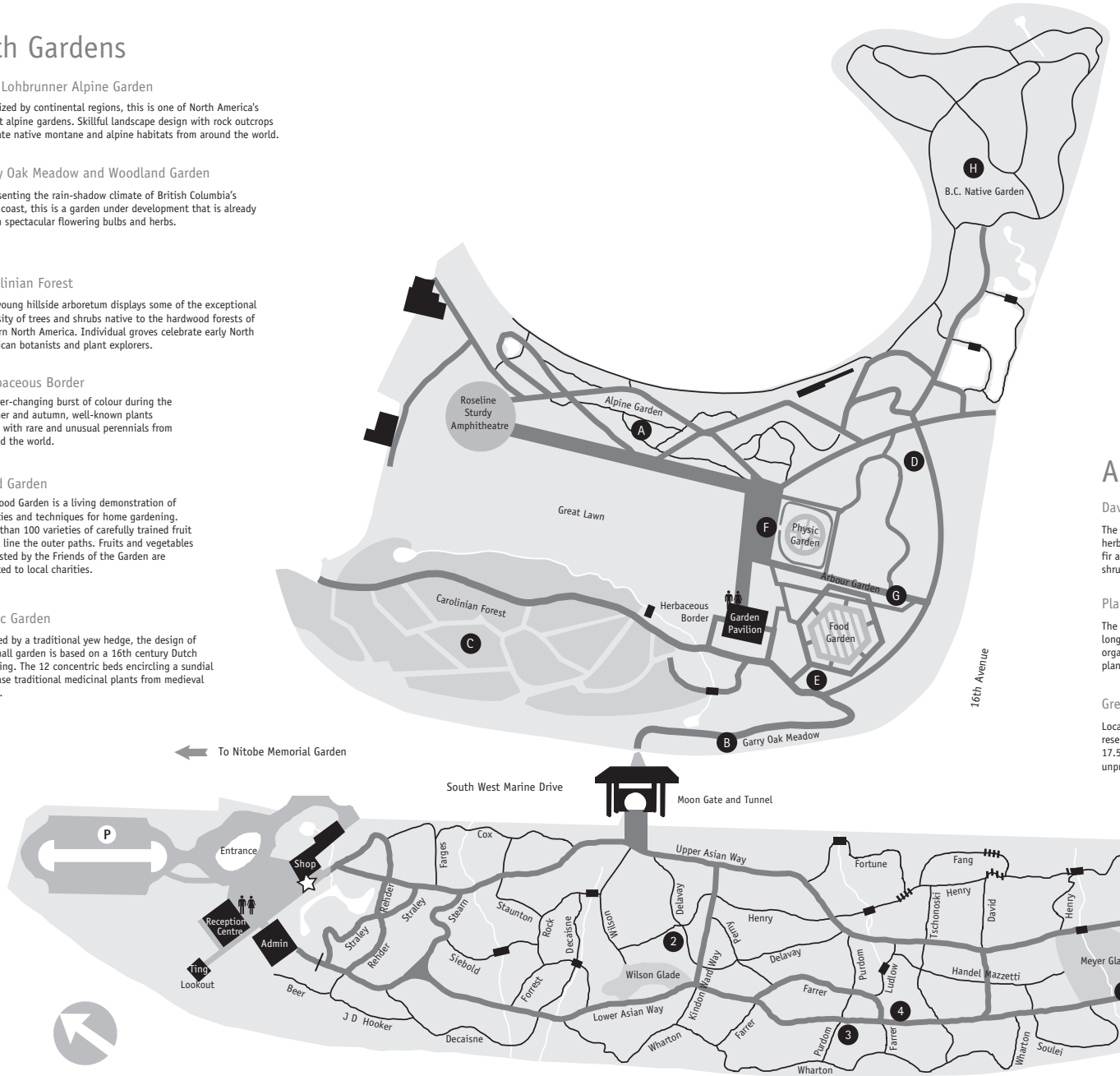
An ever-changing burst of colour during the summer and autumn, well-known plants blend with rare and unusual perennials from around the world.

E Food Garden

The Food Garden is a living demonstration of varieties and techniques for home gardening. More than 100 varieties of carefully trained fruit trees line the outer paths. Fruits and vegetables harvested by the Friends of the Garden are donated to local charities.

F Physic Garden

Enclosed by a traditional yew hedge, the design of this small garden is based on a 16th century Dutch engraving. The 12 concentric beds encircling a sundial showcase traditional medicinal plants from medieval Europe.



G Arbour

Behind the Food Garden, this large wooden arbour displays a variety of climbing plants such as clematis, wisteria, trumpet vine and bittersweet.

H BC Native Garden

Located in the garden's NE corner, selections of BC native species surround a central pond in a coastal forest. Paths and stepping-stones allow better views to explore these boggy treasures. Watch for frogs, insects and birds.

Asian Garden

David C. Lam Asian Garden

The 12-hectare Asian Garden contains collections of rhododendron species alongside woody and herbaceous plants from areas such as China, Korea, Japan and the Himalayas. The canopy of native cedar, fir and hemlock creates a favourable microclimate that shelters shade-loving perennials, rare trees and shrubs and lush ferns below, and climbing wisteria, rose and clematis high above.

Plant Explorers in the Asian Garden

The Asian Garden collections continue to expand, thanks to expeditions by Botanical Garden staff and long-standing relations with scientific institutions around the world. Collaborations with these organizations and other modern-day plant explorers increase the opportunity to bring exciting new plants to the garden. Look for trail names that commemorate plant explorers.

Greenheart Canopy Walkway

Located at the eastern end of the David C. Asian Garden, the walkway is a research and educational showcase for forest biodiversity. Rising to a height of 17.5 m and extending 308 m in length, the walkway provides visitors with unprecedented views through the forest canopy.

1. Glacial Erratic
2. Eagle Tree
3. Hollow Tree
4. Fallen Tree

Appendix B – Overall Plan-View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