Redevelopment of the UBC Botanical Garden and Centre for Plant Research

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PROPOSAL and CONCEPTUAL DESIGN

for the

Redevelopment of the UBC Botanical Garden and Centre for Plant Research

6804 SW Marine Drive, Vancouver BC

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EXECUTIVE SUMMARY

The Botanic Gardens Conservation International (BGCI) recognizes that botanical gardens throughout the world struggle to find their social relevance in modern society. The UBC Botanical Garden and Centre for Plant Research (UBCBG) is world-renowned for its collection; however, UBCBG struggles significantly with its social isolation, funding, and lack of local recognition. These challenges are due primarily to a lack of visibility, accessibility, social awareness, and diverse community integration. As well, some of its practices and operations do not meet UBC's sustainability goals. The major aims of this proposal are to address the issues of visitorship and to redefine UBCBG's purpose, as well as to suggest sustainable strategies for its infrastructure and operations.

Our mission is to inspire community appreciation and recognition of the environmental and scientific importance of the botanical gardens by cultivating sustainable mutual growth

Social involvement is crucial in addressing the immediate funding concerns faced by UBCBG because it can help to increase visitorship and revenue, while also reinvigorate social appreciation of the field of botany and the importance of biodiversity. Upgrades to the UBCBG facility are also essential in order to meet sustainability initiatives of UBC and the BGCI. The proposed redevelopment effort encompasses fifteen separate projects, all of which aim to achieve one or more of the three goals presented. These projects have been strategically grouped into three stages - immediate, short-term and long term - according to their costs, potential return on investment and their construction logistics. This ultimately allows the UBCBG the flexibility to select the projects it deems most important to achieve its short-term and long-term goals.

Immediate solutions include the following projects, aimed primarily at **implementing essential sustainability initiatives**, while also **increasing revenue, access and public interest in the UBCBG**:

1. Provide new stormwater collection and treatment pond at low-point of lawn adjacent main parking area
2. Redevelop existing parking area to minimize surface runoff and incorporate subsurface stormwater collection system
3. Provide new community garden in existing lawn area adjacent main parking lot
4. Construct new covered outdoor eating area off existing walkway, directly in front of main entrance to the UBCBG
5. Redevelop existing cattail pond adjacent Great Lawn to incorporate stormwater mitigation measures and provide new deck area for use by researchers and visitors
6. Add new overflow parking on SW Marine Dr. through joint venture between BC Ministry of Transportation, City of Vancouver and UBC
7. Provide new roundabout at intersection of W 16th Ave. and SW Marine Dr. which will slow traffic along SW Marine Dr. north of the roundabout and improve safety for pedestrians and cyclists, as well as provide an excellent opportunity for UBC to add signage for the University and UBCBG

Short-term solutions include the following projects, aimed primarily at **re-establishing the sense of purpose of the UBCBG and improving visitor experience:**

8. Renovate existing reception centre building to accommodate events such as weddings and conferences, as well as provide location to prepare food for visitors of the UBCBG
9. Provide new maple-leaf-shaped pergola at main entrance to the UBCBG to formalize the entrance to the garden, as well as monumentalize UBCBG's acclaimed collection of maples

10. Establish new bus stop on SW Marine Dr. at entrance to the UBCBG, and provide new UBCBG signage to increase public access and visibility

Long-term solutions include the following projects, which are intended to **further enhance visitor experience, expand research space and implement extensive sustainability initiatives:**

11. Construct new pedestrian bridge across SW Marine Dr. within the UBCBG to 'complete the loop' within the garden, as well as provide an elevated location for new UBCBG signage
12. Provide new reserved/dedicated parking lot off Stadium Dr. near existing maintenance yard for use by event coordinators or special events, or as short-term parking location for visitors of the new multipurpose building or nursery proposed as separate projects
13. Relocate existing nursery activities to opposite side of SW Marine Dr.; incorporated into new multipurpose building (proposed as separate project)
14. Construct new multipurpose building which is capable of hosting concurrent activities, such as private events, lectures and research, as well as acting as a community centre to Wesbrook Village
15. Rework existing maintenance area to suit new multipurpose building, nursery and reserved/dedicated parking area proposed as a separate projects

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1.0 INTRODUCTION

1.1 Background

The University of British Columbia Botanical Garden & Centre for Plant Research (UBCBG) is a botanic garden in the truest sense; as defined by Botanic Gardens Conservation International (BGCI), it is an "institution holding documented collections of living plants for the purposes of scientific research, conservation, display and education." As such, it is an important feature for scientific research in the areas of biology and biodiversity especially. In addition to its scientific importance, UBCBG is enjoyed by the local community and tourists for its green space, recreational opportunities and for the psychological and spiritual benefits it offers.

1.2 Existing Site Description

UBCBG is located in the southwest region of the University of British Columbia (UBC) Vancouver Campus. It is divided by SW Marine Drive into the Asian Garden, on the west side of SW Marine Drive; and the North Gardens, on the east side of SW Marine Drive. The Asian Garden is bounded by SW Marine Drive and Old Marine Drive. The main entrance to the garden and parking lot are located in this section of the garden. Also located within the Asian Garden are an administration building, gift shop, nursery, reception centre and lookout. These buildings are located in close proximity to each other and the driveway roundabout, and are connected by an uncovered wooden walkway. The North Gardens are bounded by Stadium Road to the north, W 16th Avenue to the south and Thunderbird Stadium & East Mall to the east. Within this section of the garden is an amphitheatre, the Garden Pavilion building, the Great Lawn and the maintenance area.

Nearby the UBCBG is the new Wesbrook Village, which is a large residential and commercial development area south of W 16th Avenue, between Wesbrook Mall and SW Marine Drive. UBC Farm is also located in this region. Located west of Old Marine Drive at the base of the cliffs is Wreck Beach, a popular summer daytime destination for many residents of Greater Vancouver. SW Marine Drive is also a popular route for road cyclists for much of the year.

1.3 Current Situation

UBCBG currently runs a deficit and is financially unsustainable. The annual budget gap is due to multiple concerns identified in lectures offered by UBCBG executives during the Fall 2013 semester of CIVL 445 at UBC, and identified by site inspections conducted by members of Group 11. The following conditions are discussed below:

Financial Aspect

The UBCBG spends approximately $2,000,000 each year on wages, maintenance of the garden and various other costs. This cost; however, is offset by annual funding received from UBC in the amount of $1,000,000. Additional revenue is generated from visitors' entrance fees and from purchases made at the nursery. The average number of visitors varies from 41,000 - 48,000/year between the months of March and October; these numbers are much lower in the winter months of November to February due to the weather and climate. UBCBG also receives periodic donations from generous benefactors, some of which have been significant enough to afford the construction of permanent landmarks such as the Roseline Sturdy Amphitheatre in the North Garden.

Recognition/Reputation

The UBCBG also suffers from a lack of recognition. Unlike the Museum of Anthropology and the Beaty Biodiversity Museum - both of which are well-known public landmarks at UBC's Vancouver Campus - the UBCBG is a relatively unfamiliar feature at the University. Public awareness of UBCBG is minimal by comparison to other botanical gardens in Vancouver presumably as a result of the limited marketing and advertising campaign permitted by the tight UBCBG operating budget. Another factor contributing to its limited public awareness is the lack of signage for UBCBG throughout Vancouver and even on campus; UBCBG's main entrance is not well marked for people coming from all directions as is illustrated in Figure 1. As a result of these current conditions, UBCBG is overshadowed by other gardens, such as Van Dusen Botanical Gardens, which offers a better location, reputation and access.

Figure 1: Existing entrance to UBCBG

Audience

Outside of the UBC community of researchers, students, faculty and staff, the current audience is primarily older caucasian women. Visitorship outside this group is comprised of local Vancouver residents and tourists to the city and University, which is relatively low.

Water

Currently, all water used for irrigation at UBCBG is potable water. It was estimated by Dr. Sietan Chieng in a lecture at UBC on November 4, 2013, that UBCBG uses 4 billion litres of potable water annually. The cost of this water is well in excess of $1,000,000, not including the additional costs to manage the resulting wastewater. There are no stormwater capture or greywater treatment and reuse systems in place, which could significantly offset the demand for potable water used for irrigation. Additionally, the water in the ponds is infiltrating into the ground at a rapid rate due to the permeable sand layer underlying the ponds. This water eventually drains out and into the ocean via existing outfalls. Potable water is then used to refill these ponds and the unsustainable cycle repeats.

Anchor Building

The UBCBG lacks a central 'anchor' building that is capable of concurrently supporting a variety of activities, such as workshops, events, recreational activities and research. While the current buildings are able to support some of these activities, the buildings are not all centrally-located within the UBCBG, nor are they connected by a covered walkway. Many events and activities are therefore limited to the outdoors, which is not always favourable or practical considering Vancouver's unpredictable weather.

Parking and Access

UBCBG's main parking area is located off the main entrance to the gardens and its current capacity is estimated to be 84 cars. For large-scale events, such as the annual Apple Fest, most of the parking is used by the event organizers or for the event itself, and visitors are forced to park offsite at great distances or find another means to gain access to the garden. There is currently very little, if any, designated bike parking areas - none of which are covered - and there is no direct bus route to the UBCBG. These unfavourable access conditions may be significant factors contributing to the limited number of visitors.

2.0 PROJECT GOALS

Mission Statement

To inspire community appreciation and recognition of the environmental and scientific importance of the botanical gardens by cultivating sustainable mutual growth

GOAL 1

Increase visitorship

Increased visitorship will increase revenues, which is essential for UBCBG's long-term growth and prosperity. One of the most practical and cost-effective methods of boosting public awareness and potentially increasing visitor counts is to reevaluate the current marketing strategy. This would be the most affordable option to increase visitorship as it would require few, if any, upgrades to the existing UBCBG facilities. A discussion about UBCBG's current marketing plan was held with Douglas Justice, Associate Director of UBCBG and Curator of Collections, at the end of a lecture he gave at UBC on September 30, 2013, at which time he affirmed that there is an excellent marketing team in place and its strategies have proven to be effective. For this reason, changes to UBCBG's current marketing schemes are beyond the scope of this proposal.

Another feasible and affordable option to increase visitorship is to improve visibility and access to UBCBG. New signage provided in and around the large UBC campus will bring awareness of the UBCBG to the UBC community, as well as effectively direct visitors to its location. Upgrades to the current parking and entrance facilities should be performed concurrently with the signage efforts to accommodate an increase in visitors and to enhance their experience.

The following specific projects are proposed to target improving visibility and access to UBCBG:

- redevelop existing parking area
- new roundabout & signage at W 16th Ave. and SW Marine Dr.
- new bus stop & signage at UBCBG entrance
- new pedestrian bridge across SW Marine Dr.
- new overflow parking
- new pergola at UBCBG entrance
- new reserved parking area

GOAL 2

Redefine the purpose of UBCBG

UBCBG has the opportunity to reestablish its purpose among the local UBC and Wesbrook Village communities, the City of Vancouver and worldwide by providing newer facilities for research, tourism and community, and by diversifying its services and attractions.

The new, large-scale residential and commercial development at Wesbrook Village is an excellent opportunity for UBCBG to serve as a centre for community activities. Unlike many other housing complexes on campus which are restricted to students, faculty and staff of UBC, Wesbrook Village is unique in that it offers long-term, affordable residential options to anyone interested in living in the area. This area is especially attractive to families with school-aged children because it is relatively quiet and has several elementary and high schools in close proximity. In addition, the UBC campus houses important cultural attractions, such as the Beaty Biodiversity Museum and the Museum of Anthropology, which are open to the public and are great places for families to visit in the evenings and on weekends. UBCBG is poised to benefit immensely from the influx of families to the area if it can attract them regularly for leisure, education and recreation. This is of paramount importance for the long-term prosperity of the garden because children who grow up visiting and loving UBCBG will inevitably become vested in its future and hopefully will pass its legacy onto their children, the next generation.

In addition, as was mentioned by Doug Doyle, Associate Director of UBC Infrastructure and Services Planning, in a lecture at UBC on October 7, 2013, the University aims to be able to house fifty percent of its student body by the year 2030 (approximately 22,500 permanent residents on campus). This is another significant consideration for the redevelopment of UBCBG. The provision of more diversified services and activities at UBCBG has the potential to attract more of the UBC community to the garden, solidifying a sense of ownership and pride in UBCBG.

The following specific projects are proposed to target improving facilities for research, tourism and community (some projects overlap those targeted for other goals):

- new community garden
- new outdoor eating area
- redevelop existing cattail pond in North Gardens
- renovate existing reception centre
- new nursery
- new multipurpose building
- redevelop existing parking area
- new pergola
- new pedestrian bridge across SW Marine Dr.
- relocate existing maintenance area

GOAL 3

Achieve UBC Living Lab & sustainability goals through redevelopment of UBCBG

As stated on UBC's Sustainability website, "[UBC] views its entire Vancouver campus as a living laboratory… in which there is freedom to explore the technological, environmental, economic and societal aspects of sustainability." As such, the campus and all its components - including its infrastructure and people, and their interactions with each other, the environment and the community - are a focus of study for students and researchers towards the advancement of sustainability. As part of this initiative, UBC aims to integrate research with its campus operations; partner with the public and private sectors, and non-governmental organizations (NGOs); use its resources and infrastructure in a financially-sound manner; and pass on to the greater community the knowledge it gains from these efforts. The redevelopment of the UBCBG is an excellent opportunity to contribute to the UBC Living Lab initiative, especially by incorporating sustainable materials, practices and systems into its existing infrastructure and operations. Not only will this effort serve as a model for future sustainability-upgrade projects on and off campus; more importantly, it will optimize the function of the UBCBG which will hopefully lead to its financial success independent of UBC subsidies.

In addition to achieving UBC's Living Lab goals, UBCBG - as a world-renowned botanical garden - has an obligation to comply with Longwood Gardens' Sustainability Index which aims to "promote environmental stewardship practices, and drive innovation and continual improvement in the sustainability performance of the public gardens sector." The redevelopment of UBCBG has the opportunity to adopt more sustainable operations, and in doing so become a leader in defining and implementing metrics to gauge the success of these operations considering their environmental, economic and social impacts.

All projects proposed as part of the UBCBG redevelopment effort are intended to be designed to meet UBC's Living Lab and Longwood Gardens' Sustainability Index initiatives.

3.0 CONSTRAINTS

1. **Location.** The location of the gardens is on the precipice of the cliffs above Wreck Beach and the soil conditions in the region prevent the construction of large, permanent structures within 300 metres of the cliff.

2. **Plant protection.** All existing plants must be preserved. Should some clearing be required as part of the redevelopment, plants needs to be relocated.

3. **Staffing.** UBC employees are part of a labour union and the current operating budget for the UBCBG is not sufficient to warrant the addition of new staff. Unless projects which require additional staffing generate positive income to support additional staff, they will likely not be approved to move forward.

4. **Funding.** UBCBG's current operations are running under a budget deficit, and UBCBG therefore does not have reserve funds to proceed with new infrastructure or renovation projects unless they generate net positive income to justify their expense.

5. **Campus as a Living Lab.** All rehabilitation and new projects proposed for UBC facilities must adhere to UBC's Living Lab vision for its Vancouver campus, which is to become a complete sustainable community. This includes sustainable use of materials, energy, and water, among other resources, and the optimization of building operations.

4.0 STANDARDS & DESIGN CONSIDERATIONS

The following standards and considerations serve as the basis for the proposed solution procedure, and should be used to gauge success of the rehabilitation effort:

1. Longwood Gardens' Sustainability Index, target score of 40/50
2. Design solutions are focused on meeting specific sustainability initiatives determined by UBC which may be eligible for grant or stipend, and on providing new research facilities/opportunities for different faculties which may then allocate a portion of their annual budgets to the garden for research purposes
3. UBC's Climate Action Plan, which aims to reduce greenhouse gas emissions for target years of 2015, 2030 and 2050
4. Botanic Gardens Conservation International (BCGI) mission statement, which is to "ensure the world-wide conservation of threatened plants…"

5.0 SOLUTION PROCEDURE

There have been at least two proposals presented to UBCBG which focused on improving visitorship, redefining the purpose of the UBCBG and/or addressing sustainability goals. In 2001 a Master Plan was presented which included stormwater mitigation solutions, elevated crossing of SW Marine Dr. and new buildings for research and public use. In 2009 a proposal was put forth to upgrade site and buildings near the UBCBG entrance, and included a new brew pub and greenhouse. Some elements of the 2001 proposal were implemented, although the remaining items and 2009's proposal did not proceed, largely due to lack of funding. While some of the improvements presented were exciting and viable options to improve the UBCBG and may have met its goals, they did not satisfy the constraints or provide a significant enough return on investment in the short term in order to move forward.

Considering these past proposals and the reasons they stalled, this redevelopment effort consists of various projects strategically grouped into stages considering their short-term and long-term returns on investment, and their associated construction logistics. During the planning stage of the redevelopment effort, in which more detailed estimates of costs will be assessed, expected revenues should also be assessed for each stage of the redevelopment. These values can serve as revenue targets which, when achieved, will trigger subsequent stages of redevelopment.

Phasing the work will likely improve the success of obtaining funding to implement the immediate solutions proposed. Results will hopefully be visible relatively quickly, which suggests the potential for large financial gains for relatively minimal cost. The comprehensive proposed redevelopment map is illustrated in Figure 2, which shows the locations of the projects associated with each stage of the redevelopment. Numbers shown on the map correspond to individual projects which are listed in the Staging boxes in the lower left corner of Figure 2.

It is important to note that the estimated costs provided for each project include construction materials and labour, and may not include costs associated with design, engineering and permit fees, among other professional services, as may be required for each scope of work. Additionally, the estimated costs were determined using limited cost-estimating resources and tools which may not account for project location, inflation, specialized design features and finishes and/or unforeseeable conditions. The estimated costs should therefore be used as a rough guide only as a means of comparing the relative costs of each project considering their short-term and long-term benefits and potential to generate revenue. Also, this proposal is a conceptual design only, and more detailed pricing and project details are intended to be determined in later stages of design development.

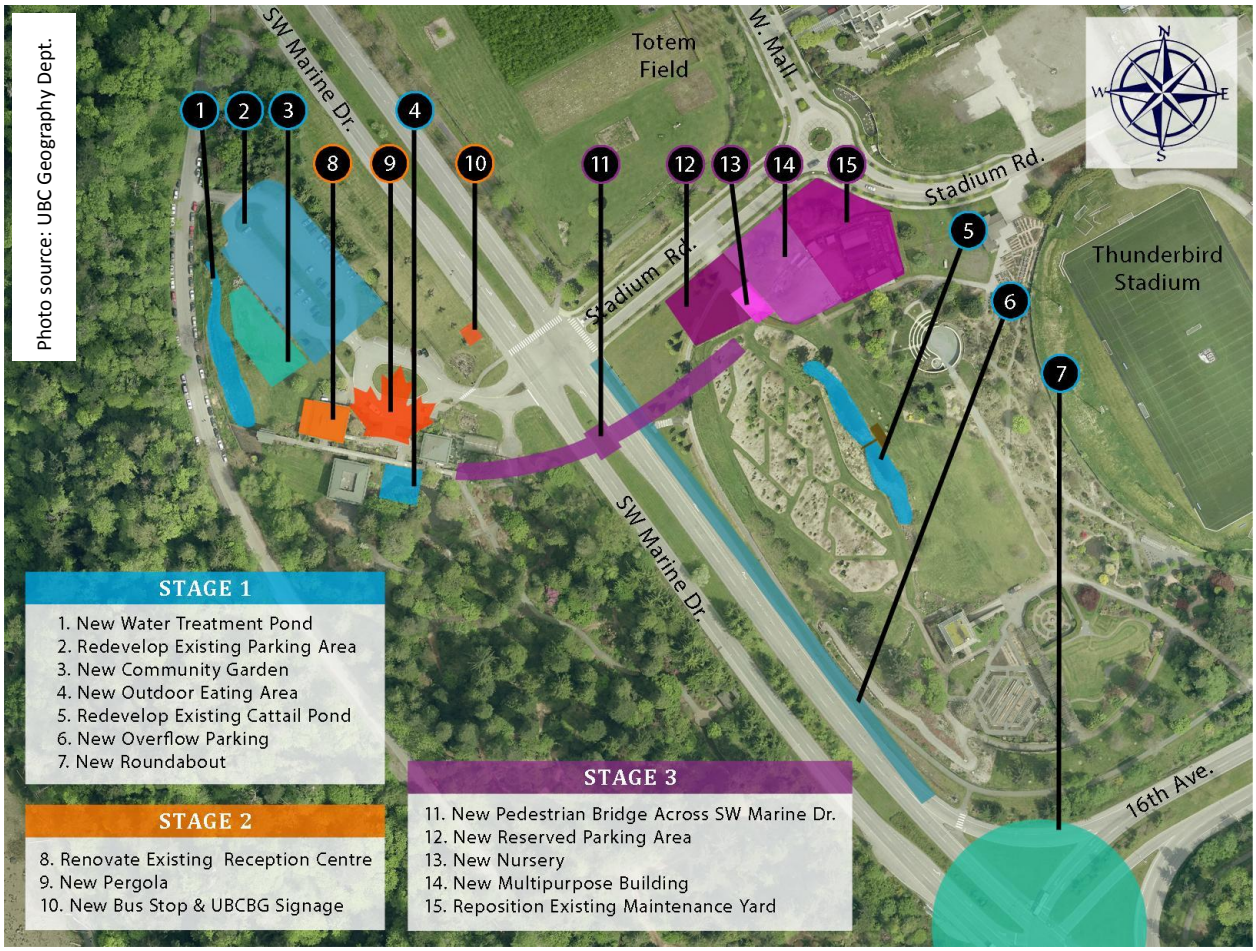

Figure 2: Proposed Redevelopment of UBCBG

1 – New Water Treatment Pond — $ 400,000

Description
Construct new water collection and treatment pond in the low point of land adjacent to Old Marine Dr. fenceline, below and north of the existing lookout and west of the main parking area and lawn. Pond to be designed similar to existing ponds along the Great Lawn in the North Garden, or those recently constructed at the end of University Dr. between East Mall and Main Mall on UBC's campus (as shown in Figure 3).

Strategy
Meet sustainability goals by implementing stormwater mitigation measures**.**

Attributes
New collection pond and subsurface drainage system which diverts stormwater to new pond. System includes pipes, natural gravel filters and bio aquatic filters such as cattails in the new pond. The stored water may be used for irrigation and other garden operations. Additional stormwater capture and storage for the same system is proposed as part of Project #2.

Approximate size and construction activities
L: 80m x W: 9m (max) x D: 2m (max)
Expected construction activities include potential rework of existing subsurface wastewater piping, excavation, compaction, formwork, concrete pour and finish; followed by pond infill and adjacent landscaping.

Impact on everyday garden operations
Existing parking area may be affected throughout construction for equipment staging and construction activities. Alternative parking for visitors should be planned.

Cost justification
Estimated costs are based on RS Means and similar projects completed in the USA.

Figure 3: Example of stormwater mitigation system at UBC Vancouver Campus

2 – Redevelop Existing Parking Area $ 1,250,000

Figure 4: Proposed layout of redeveloped main parking area

Description
Demolish existing main parking area, install new subsurface stormwater capture and storage location, and repave area with new pervious concrete pavers.

Strategy
Increase visitorship by upgrading parking layout; meet sustainability goals by reducing surface runoff, and by providing subsurface storage location for captured stormwater to be reused for irrigation.

Attributes
Pervious concrete paver units similar to Figure 6, which allow through-growth of grass and vegetation. Subsurface storage system to store and filter rainwater for future irrigation purposes similar to Figure 5. Another purpose of the storage system is to replenish the water in the ponds in drought seasons.

Approximate size and construction activities
3,500 m^2 ; capacity for 152 cars (80% increase from existing); stormwater system size to be determined
Expected construction activities include demolition of asphalt over existing parking area (approximately 2,080m^2), excavation, stormwater storage system installation, subsurface piping, infill, compaction, paving; followed by seeding and landscaping.

Impact on everyday garden operations
Closure of existing parking area and potential interruption of access to the entrance of UBCBG throughout construction. Noise impacts may affect guest experience. Construction should be performed during the winter months and alternative parking for visitors should be planned.

Cost Justification

Estimated costs for excavation, infill and compaction activities, and open-cell concrete pavers are based on information retrieved from websites[1,2]. Estimated costs for the subsurface stormwater capture and storage system are based on information retrieved from manufacturer websites[3] .

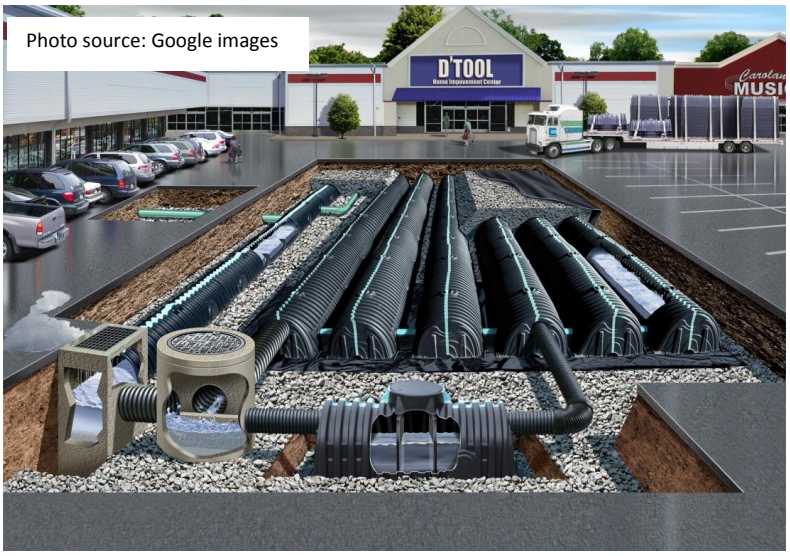

Figure 5: Subsurface stormwater collection system

Figure 6: Example of pervious concrete pavers

[1] http://www.get-a-quote.net/QuoteEngine/costbook.asp?WCI=CostFrameSet&BookId=1&Pattern=Excavation
[2] https://extension.umd.edu/sites/default/files/_docs/programs/master-gardeners/Howardcounty/Baywise/PermeablePavingHowardCountyMasterGardeners10_5_11%20Final.pdf
[3] http://www.stormtech.com/product/mc4500.html

3 – New Community Garden $ 25,000

Description
Convert existing lawn area west of the main parking area into designated community garden space. Garden should be modelled on existing community garden at W 16th Ave. and Oak St. as shown in Figure 7 and include individual above-ground planter boxes, benches and storage sheds.

Strategy
Increase visitorship by providing a new feature for community use; establish garden as community hub of activity and thereby instill sense of ownership in UBCBG as an active community contributor; provide community with the opportunity to grown its own food; meet sustainability goals by using recycled materials and implementing best practices for drainage and irrigation.

Attributes
New individual garden plots for rent, benches, garden shed and facilities for community use.

Approximate size and construction activities
Overall garden area - W: 20m x L: 45m (900m^2); individual plots - 3m x 1m each (approximately 50 total) Planter boxes, sheds and benches may be constructed onsite or offsite. Some minor site upgrades may be required to provide adequate drainage and sources of irrigation.

Impact on everyday garden operations
A portion of the existing parking area may be affected for assembly of planter boxes, benches and sheds; and during site upgrades. Construction should be performed during the winter months so the garden is ready for use in the spring.

Cost Justification
Estimated costs are based on similar projects within Greater Vancouver and information retrieved from websites[4]. Estimated five 8’ x 6’ steel sheds[5], five 6’ x 8’ cedar picnic tables[6], planters constructed of recycled materials[7] and made by volunteers. Costs include basic setup such as land preparation, compost, water connection.

Figure 7: Example of typical community garden in Vancouver (composite photo)

[4] http://former.vancouver.ca/ctyclerk/cclerk//20060516/documents/a8.pdf
[5] http://www.homedepot.ca/product/hamlet-steel-storage-building-8-feet-x-6-feet/804766
[6] http://www.homedepot.ca/product/cedar-picnic-table-6-feet-x-5-feet/916439
[7] http://www.homedepot.ca/product/raised-garden-4-feet-x-8-feet-x-12-inch/951073

4 – New Outdoor Eating Area $ 500,000

Description
Widen the portion of the existing walkway between the reception centre and the gift shop to provide a new covered eating area/gazebo. Extension to be constructed off west side of walkway and be supported by columns above the existing pond below. Food is intended to be provided by UBC Food Services or by catering trucks parked at the entrance roundabout.

Strategy
Increase visitorship by providing eating area separate of UBCBG for use by cyclists, community garden users and general public; improve sense of community by providing meeting spot; meet sustainability goals by using recycled materials and implementing a green roof.

Attributes
Recycled-wood deck and gazebo structure, with glass side panels and green roof.

Approximate size and construction activities
L: 10m x W: 10m
Expected construction activities include onsite construction of deck and gazebo structure, and potential minor excavation where new concrete footings are required to support the columns; followed by landscaping below and installation of green roof.

Impact on garden operations
Main entrance to garden and access between administration building and reception centre will be affected throughout construction. Noise and air quality impacts are expected to affect guest experience. Construction should be performed during the winter months and alternative entrances to affected buildings should be planned, as well as a temporary route between buildings, if required.

Cost Justification
Estimated costs are based on a similar structure constructed as an entrance canopy at the Peter Wall Institute[8]. The Peter Wall canopy is roughly half the size of the proposed covered eating area and does not have a green roof.

Figure 8: Concept for new outdoor eating area

[8] http://www.projectservices.ubc.ca/portfolio/modernization/peter-wall-institute-entrance-canopy.htm

5 – Redevelop Existing Cattail Pond $ 350,000

Figure 9: Concept for new deck at cattail pond

Description

The existing cattail pond adjacent to the Great Lawn in the North Garden is intended to be redeveloped for two reasons: to reduce water consumption by providing impermeable membrane liner which will reduce leakage through underlying soil, and to provide new decking for use by researchers who require direct access to the pond and the plants lining its embankment. There may also be the opportunity to construct subsurface stormwater storage and processing plant below pond during redevelopment effort. Pond is intended to be returned to its existing condition post-construction.

Strategy

Enhance guest experience by providing new deck feature; improve safety for research activities; meet sustainability goals by implementing stormwater mitigation, capture and reuse measures, as well as using recycled materials in the deck construction.

Attributes

Impermeable pond area, including subsurface drainage system which diverts overflow and excess stormwater to existing stormwater system and outfalls. Potential to provide new subsurface stormwater storage and treatment facility for reuse of water for irrigation. Drainage system includes pipes, natural gravel filters and bio aquatic filters such as cattails in the rehabilitated pond. Deck constructed of recycled wood.

Approximate size and construction activities

L: 80m x W: 9m (max) x D: 2m (max)
Expected construction activities include potential rework of existing subsurface wastewater piping, excavation, compaction, formwork, concrete pour and finish; followed by pond infill and adjacent landscaping. Deck constructed onsite during landscaping before pond is refilled.

Impact on everyday garden operations
Closure of Great Lawn expected, as well as potential interruption of access to the maintenance route throughout construction. Noise impacts may affect guest experience. Construction should be performed during the winter months.

Cost justification
Estimated costs are based on RS Means and similar projects completed in the USA.

6 – New Overflow Parking — NOT QUOTED

Description
Convert one lane of SW Marine Dr into overflow parking. This effort is intended to be performed concurrently with or following the construction of the new roundabout at the intersection of W 16th Ave and SW Marine Dr., which is proposed as Project #7.

Strategy
Increase visitorship by providing overflow parking.

Attributes
Asphalt pavement in place. Conversion of lane into parking.

Approximate size and construction activities
530m^2; capacity for 115 cars (estimated)
Repainting of lines.

Impact on everyday garden operations
Closure of lane along SW Marine Dr. Redirection of traffic along road.

7 – New Roundabout $ 3,000,000

Description
Convert the intersection between SW Marine Dr. and W 16th Ave. into a two-lane roundabout, similar to the one recently-constructed at the intersection of East Mall and W 16th Ave. The number of lanes on SW Marine Dr. north of W 16th Ave. will be reduced from four to two. It is expected that this reduction will have little impact on traffic flow rates, as SW Marine Dr. currently narrows north of Stadium Rd.

Strategy
Increase visitorship by improving the traffic environment near the garden, and increase presence of UBCBG within community; improve visibility of UBC and UBCBG by providing signage similar to the existing signage on the roundabout at the intersection of W 16th Ave. and Wesbrook Mall.

Attributes
Signage for UBCBG, and landscaping

Approximate size and construction activities
Diameter: 36.5m; Total developmental area, including redesign of approach roads: 10,000m^2
Expected construction activities include demolition and removal of the current roads, earthworks, fill laying and preparation, asphalt paving, signage (both physical signs and painted signs), landscaping, and installing advertising for UBCBG.

Impact on everyday garden operations
Operation of the garden is not expected to be affected; however, traffic may have to be rerouted and temporary signage may be required. Suggest construction during spring and summer months, when traffic to UBC is minimal by comparison to Fall and Winter semesters

Cost Justification
Estimates are based on the recently constructed-roundabouts on W 16th Ave[9]. Negotiations can be held between UBC, UBCBG, and The Ministry of Transportation to settle the expenditure and contributions.

Background photo source: Google maps

Figure 10: Roundabout and signage concept

[9] http://www.infrastructuredevelopment.ubc.ca/infrastructure/projects/construction.asp

8 – Renovate Existing Reception Centre $ 2,500,000

Descripton
Renovate the existing reception centre building, including upgrades to interior and exterior finishes, modifications to floor plan to accommodate a new commercial kitchen and provide new windows within the east and west building elevations to allow more light to enter this space. The possibility exists in Stage #3 to convert this building into a self-contained restaurant; therefore, the provision of a new commercial kitchen space in this building is justified during the renovation effort.

Strategy
Increase visitorship by improving the existing facilities to host variety of events; meet sustainability goals by improving building envelope and optimizing operations and energy use

Attributes
Interior upgrades include provision of new energy-efficient appliances and fixtures, new flooring, upgraded ceiling LED pot lights, and repainting of the interior walls. Building envelope upgrades should be focused on optimizing energy use.

Approximate size and construction activities
L:23m x W:18m x H: 5m
Expected construction activities include removing existing interior and interior finishes, installing new windows, repainting, buildinging partition walls, upgrading existing electrical systems, and installing commercial kitchen equipment.

Impact on garden operations
The reception center will be closed throughout the duration of the renovation, although the rest of the garden is not expected to be impacted by the construction. A portion of the main parking area may need to be allocated to the construction effort as a staging and storage area. Construction should therefore be performed during the winter months when visitorship is at its lowest.

Cost Justification
Estimated costs are based on a similar renovation that occurred in 2010 at the Marine Drive Residence's Point Grill and Patio[10]. A commercial kitchen and a similar high level of finishes were installed.

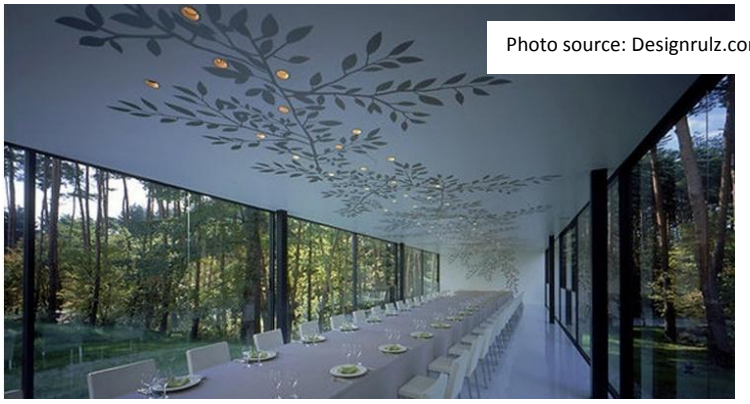

Figure 11: Concept for interior renovations

[10] http://www.projectservices.ubc.ca/portfolio/renovation/point-grill-patio.htm

9 – New Pergola	**$ 600,000**

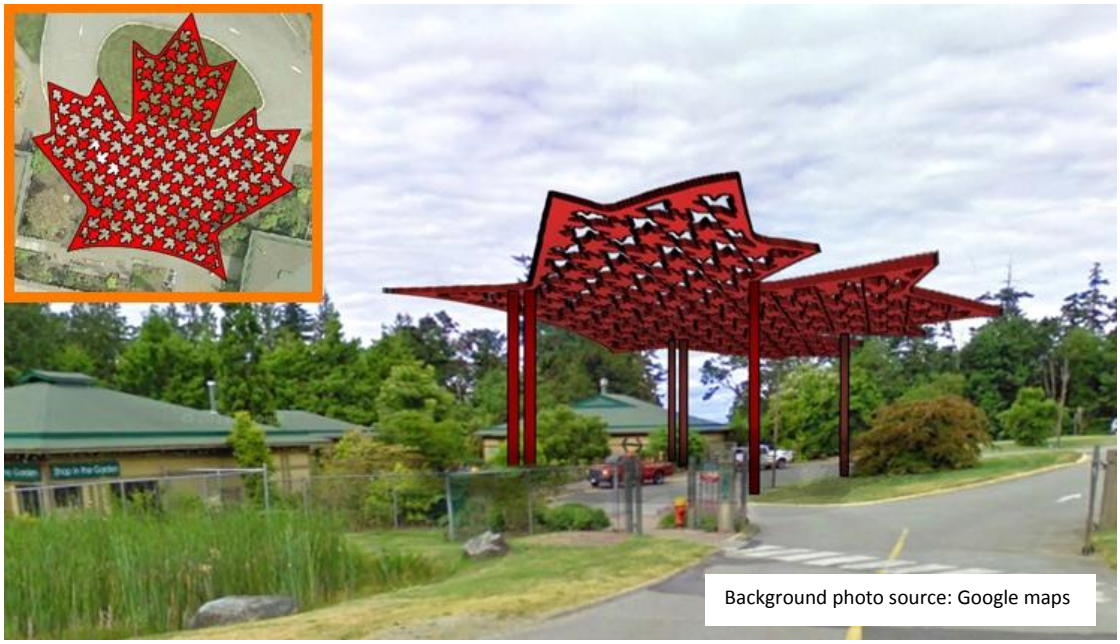

Figure 12: New pergola concept

Description
Provide a new pergola in the shape of a maple leaf at the main entrance to the UBCBG, extending out into the roundabout at the entrance. The pergola is intended to serve two functions: formalize the entrance to the garden, creating a space under which people can meet, socialize and take shelter; and act as a formal space under which open-air events such as a farmers markets or applefest can occur. The shape of the maple leaf is significant as a monument to the UBCBG, which houses one of the largest collections of maple trees in the world. The pattern of the pergola's upper surface is created from interlocked maple leafs, between which are voids of a similar pattern. The intention is that when people look up at the canopy, they will see leaves, and similarly when they look down, they will see shadows of leaves cast on the ground.

Strategy
Increase visitorship by providing a monument of importance; instill a sense of pride and ownership in UBCBG by recognizing one of its most significant scientific contributions

Attributes
Monumental status of the importance of botanical gardens for the world

Approximate size and construction activities
Extents - L: 37m x W: 42m (approximate surface area of 850m^2)
The steel canopy is expected to be prefabricated offsite in modules for ease of onsite assembly and erection. Onsite excavation is required to form new concrete footings for the pergola's columns.

Impact on everyday garden operations
Main entrance to garden and access to main parking area will be affected throughout construction of the footings and subsequent infill of driveway. Assembly and erection of pergola structure is also expected to interrupt access to the main parking and garden entrance; although installation time can be minimized significantly by proper scheduling.

Cost estimate justification
Cost estimates are based on precedent study of the entrance canopy for the Peter Wall Institute of Advanced Studies at UBC[11]; however the new pergola is approximately 8 times the size of canopy at Peter Wall Institute and is highly customized.

10 – New Bus Stop and UBCBG Signage NOT QUOTED

Description
Upon completion of Stage #1 projects and provided they achieve their respective goals, approach Translink with the request to extend one or more of its regular UBC routes to incorporate a new stop at UBCBG. Request provision of new permanent bus shelter and bus stop on the west side of SW Marine Dr. just north of the UBCBG main entrance. At the time of bus stop construction, replace existing UBCBG signage with more prominent UBCBG sign.

Strategy
Improve visibility by providing more prominent signage; improve access by providing regular public transit service to UBCBG.

Attributes
Signage and permanent bus shelter.

Approximate size and construction activities
Approximate area of sign $6m^2$ (W: 3m x H: 2m); size of bus shelter to be determined by Translink
Expected construction activities include installation of appropriate bus shelter footings to prevent uplift.

Impact on everyday garden operations
As the area is outside the garden there will be minimal disruption to the garden. During construction a part of the parking lot may need to be cordoned off to store supplies.

[11] http://www.projectservices.ubc.ca/portfolio/modernization/peter-wall-institute-entrance-canopy.htm

11 – New Pedestrian Bridge across SW Marine Dr. $ 6,000,000

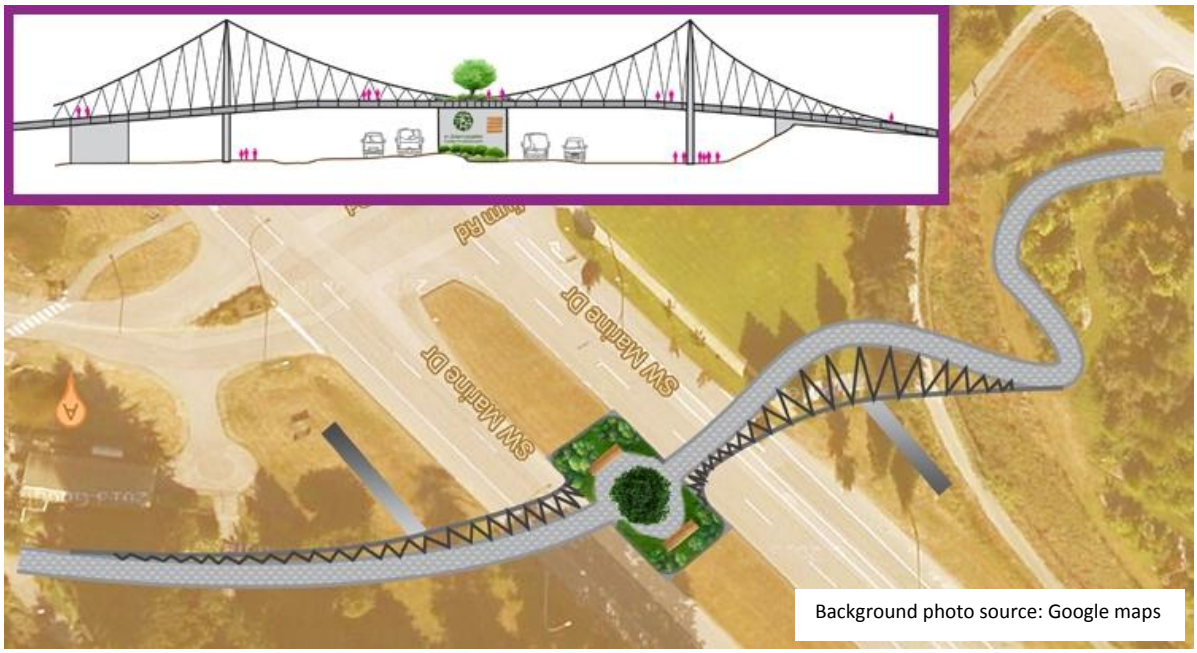

Figure 13: Concept of new pedestrian bridge

Description
Construct new pedestrian bridge over SW Marine Dr. south of Stadium Rd. West end of the bridge is intended to start near the current garden entrance, as an extension of the existing walkway within the garden adjacent the Gift Shop. East end of the bridge is intended to join the existing walkway at the northwest corner of the North Garden. Provide new garden on the bridge itself in the central portion, above the SW Marine Dr. boulevard (median). Provide UBCBG signage on both sides of the elevated bridge span. Existing left turn lane on northbound side of SW Marine Dr. intended to be converted to grass median.

Strategy
Improve visibility by providing signage; improve access for pedestrians inside the garden by 'completing the circle' when used in conjunction with existing tunnel under SW Marine Dr.; meet sustainability goals by using recycled materials (wood) for bridge.

Attributes
UBCBG signage on both sides of the bridge to advertize garden's location and features, recycled wood and minimal-impact materials used in the bridge structure wherever possible.

Approximate size and construction activities
Deck width - 3.5m; total length 230m (two 50m spans); road clearance 7.5m so that the road can remain an emergency route. Pylon height: 22m
Expected construction activities include excavation and backfill of ramps, formwork for the approach ramps, driving of piles, building of main support column and pylons, installation of the prefabricated bridge deck structure, finishing of structure and paving.

Impact on everyday garden operations
Parts of the garden will need to be cordoned off during construction. Narrowing the highway will be required to install the pylons and the central column. Extensive road closures are expected for the installation of the bridge deck structure, but may be minimized by effective scheduling and through careful design of the prefabricated sections.

Cost justification
Cost estimates are based on precedent study of the College bridge built by Ney + Partners[12].

12 – New Reserved Parking Area off Stadium Rd. $ 140,000

Description
Provide new parking lot off Stadium Road near the current location of the maintenance area to accommodate visitors to the new nursery and multipurpose building, proposed as Projects #13 and #14 respectively. Design of surface finish similar to Project #2.

Strategy
Increase visitorship by improving access and accessibility to the new nursery and multipurpose building.

Attributes
Pervious concrete paver units similar to Figure 6, which allow through-growth of grass and vegetation and reduce surface runoff.

Approximate size and construction activities
500m^2; capacity for 23 cars (estimated)
Expected construction activities include excavation (approximately 1,010m^2), infill, compaction, paving; followed by seeding and landscaping.

Impact on everyday garden operations
Closure of part of garden and potential interruption of access to the maintenance route throughout construction. Noise impacts may affect guest experience. Construction should be performed during the winter months.

Cost Justification
Cost estimates consider same factors and are based on same sources listed for Project #2.

[12] http://www.ney.be/en/projects_details/288.html

13 – New Nursery $ (Included in Project #14)

Description
Demolish existing nursery and incorporate new nursery space within new multipurpose building proposed as Project #14. Nursery space is intended to be divided between indoor space and adjoining enclosed outdoor space. The enclosed structure may act as a greenhouse.

Strategy
Increase visitorship by providing retail services; enhance community involvement and integration; meet sustainability goals in the areas of water and energy consumption, and wastewater mitigation.

Attributes
Nursery located near the multipurpose building that incorporates various research opportunities and teaching spaces.

Approximate size and construction activities
200m^2 (approximately 1.5 times larger than the current nursery).
Greenhouse is intended to be simple, light steel frame structure. Construction of nursery intended to be concurrent with multipurpose building proposed as Project #14, therefore similar construction activities are expected, with the inclusion of footings for the greenhouse and an irrigation system.

Impact on everyday garden operations
Due to the location of the nursery the construction is expected to have little effect on the functioning of the garden. If this project is commenced prior to completion of the new maintenance yard there should be no disruption to garden maintenance. This project will likely follow the same timeline as the multipurpose building as it is closely situated to it and dependent on its completion.

14 – New Multipurpose Building $ 40,000,000

Figure 14: Concept for new multipurpose building

Description
A new 3-storey multipurpose building, with basement, will be built in the northern garden near the current maintenance yard. The building will be used to host events, lectures, and multidisciplinary research activity, as well as provide space for the in-house artist. Structure will include basement, green roof area and onsite water collection and treatment system.

Strategy
To enhance community involvement, visitorship and act as a research centre; meet sustainability goals similar to those achieved by Centre for Interactive Research for Sustainability (CIRS) building at UBC's Vancouver Campus. The intent is to emulate the design, operations and sustainability accomplishments of the recently-constructed and world-renowned CIRS Building.

Attributes
20% of the building will be dedicated to research, 60% to events and recreation, and 20% to workshops. The building will house a green roof and green walls, and utilize passive solar design principles. Power requirements supplemented via solar panel cladding. Rainwater will be collected on the roof. Onsite treatment of rain, grey, and black water. Heating supplemented by geothermal.

Approximate size and construction activities
6000m^2 (1,500m^2 x 4 floors)
Expected construction activities include excavation, formwork, placement of concrete footings and walls, infill, installation of steel, concrete, and timber structural components. Placing cladding and finishing interior of building, as well as landscaping.

Impact on everyday garden operations
Closure of part of garden and potential interruption of access to the maintenance route throughout construction. Noise impacts may affect guest experience. Site work and basement/ground floor construction should be performed during the winter months.

Cost Justification
Cost estimates are based on those of the CIRS Building[13] and adjusted based on percentage of size by comparison.

15 – Reposition Existing Maintenance Yard $ 30,000

Description
The current maintenance lot will need to be repositioned to accommodate the new nusurary and multipurpose building. Access to this lot will on stadium road. The lot will be kept separate from visitor parking and be of a comparable size to the current lot.

Strategy
To provide a workspace and storage for maintaining the UBCBG.

Attributes
Maintenance area includes original storage building and maintenance yard for work and storage space.

Approximate size and construction activities
2,120 m^2
Expected construction activities include excavation (approximately 650m^3), infill, compaction.

Impact on everyday garden operations
Closure of part of garden and potential interruption of access to the maintenance route throughout construction. Noise impacts may affect guest experience. Construction should be performed during the winter months.

Cost Justification
Cost estimates are based on general excavation and compacting prices retrieved from websites[14].

[13] http://www.infrastructuredevelopment.ubc.ca/infrastructure/projects/current/interactive-research-sustainability.asp
[14] http://www.get-a-quote.net/QuoteEngine/costbook.asp?WCI=CostFrameSet&BookId=1&Pattern=Excavation

6.0 SUSTAINABILITY INDEX FOR THE PROPOSED SOLUTIONS IN UBCBG

Longwood Gardens' Sustainability Index was used to evaluate the effectiveness of the proposed phased solutions to the UBCBG. The Sustainability Index was marked out of 50 points, depending on various criteria. The proposed UBCBG Redevelopment projects are estimated to earn 40 sustainability index points.

The following tables within this section list each of the sixteen areas of criteria assessed. A check (✓) awards the proposed redevelopment one point, and a dash (-) awards the redevelopment no point. Several assumptions were made in the calculation of the sustainability index score of 40/50, which are listed below:

1. Items 1 and 2: it was assumed that annual monitoring, reduction in consumption, and consumption measurements will be performed. This is a conservative assumption since the process of performing these procedures is not complicated and no special equipment is needed to conduct them.

2. Items 3 to 5: it was assumed that annual monitoring and consumption measurements will not be performed. This is because there is neither the justification, especially in the multipurpose building, nor the ability to perform these measurements.

3. It was assumed that some or all of the UBCBG maintenance staff is trained in various areas of sustainability and safety. For example, staff are expected be trained to effectively implement conservation in horticulture, research, land management, education, and planning at the garden. Specifically pertaining to Item 9: it is assumed staff is aware of the various Health, Safety, and Environment (HSE) Standards of Canada.

4. Item 15: it was assumed that UBCBG managers and staff strive to be more sustainable by developing master plans and integrating sustainability considerations into their decision-making.

It is important to note that the score of 40 out of 50 on the Sustainability Index is only given as an estimate. Deviations may be explained by variations in the phasing implementation and garden operations. It should be noted that the acquired 40 points are based on all of the solutions being implemented.

	x.1. Consumption Measurement	x.2. Reduction in Consumption	x.3. Annual Monitoring & Establishing Targets
1. Water Consumption	✓	✓	✓
3. Wastewater	✓	✓	✓
4. GHG Emission	-	✓	-
5. Non-renewable Energy	-	✓	-
6. Solid Waste	-	✓	-

	7.1. Measure	7.2. Improve
7. Water Quality	✓	✓

8. Plants & Ecosystem Conservation	
8.1. Develop Plant Collection policies, or annually reviews a guide to plant conservation initiatives endorsed by professional horticulture and conservation organizations, and set targets for implementing each section of the strategy	✓
8.2. Monitor, manage, and introduce invasive/non-native species that do not fit into 8.1.	✓
8.3. Document native flora and incorporate conservation of regional plant species and plant communities for education programs and garden plan	✓
8.4. Train garden staff regularly in effectively implementing conservation into horticulture, research, land management, education, and planning at the garden	✓
8.5. Asses and improve the implementation and efficacy of conservation efforts regularly	✓

	9.1. Measurement	9.2. Reduction	9.3. Employee Training
9. Toxic Waste	-	-	-

10. Development & Growth Opportunities for Employees	
10.1. Provide training, development, promotion, and advancement opportunities for employees to support their employability	✓
10.2. Engage employees on all aspects of sustainability	✓
10.3. Provide regular training on the use of the Sustainability Index	✓
10.4. Engage employees on the use of the Sustainability Index Proven Practice Workbook to facilitate the implementation and advancement of sustainability in operations activities and events	✓
10.5. Report annually the percentage of employees trained (refer to 10.1, 10.3, 10.4)	✓

	x.1. Own A Program	x.2. Report Annually
11. External Stakeholder Engagement on Sustainability Policies, Programs, and Targets	✓	✓
12. Community Education and Outreach on Sustainability Initiatives	✓	✓
13. Education and Outreach on Sustainable Community Development (including Health & Safety)	✓	✓

14. Wellbeing of Garden Users, Guests, & Employees	
14.1. Promote increased quality of life (cognitive, physical, mental, social, spiritual) for users, guests, and employees through their overall interaction with the garden as a means of connecting with nature	✓
14.2. Train all employees regularly on enhancing health and safety of all users	✓
14.3. Have a health & safety program in place to meet the safety requirement for U, G, & E	✓
14.4. Target a reduction or elimination of accidents that affect well-being of U, G, & E	✓

15. Financial Planning & Business Management	
15.1. Have a policy to integrate sustainability to financial planning, investments (i.e. socially responsible investment options), employee saving plans, and business	✓

management decisions	
15.2. Develop a business plan to ensure long term viability	✓
15.3. Assess economic viability and sustainability performance against the business plan regularly, and make adjustments to ensure long term viability	-

16. Strategic Planning and Governance	
16.1. Integrate sustainability into master planning and governance	✓
16.2. Designate a manager with overall responsibility and oversight for sustainability	✓
16.3. Include a strategy in the master plan to attract, retain, and train a competent and diverse workforce with the appropriate intellectual capital and skill to ensure long-term sustainability	✓
16.4. Assess sustainability considerations and implement strategic actions to advance sustainability	✓
16.5. Develop and Implement an adaptation plan to consider and manage the impacts of climate change on plants as part of the master planning	✓
16.6. Integrate sustainability considerations into deferred maintenance decisions (e.g. managing aging infrastructure)	✓
16.7. Set sustainability target for strategic plan, and annually assess the progress	✓

7.0 FORESEEABLE DIFFICULTIES AND CONTINGENCY STEPS

Several inherent factors are present for the projects presented in this conceptual design. These factors could potentially hinder the project budget and its timely completion. The most critical factors are:

1. Effective cooperation with the outside organizations
2. Unknown subsurface soil conditions

As previously discussed, the construction of the roundabout (Project #7) and new overflow parking lane (Project #6) consist of a joint effort between UBCBG, the City of Vancouver, and BC Ministry of Transportation. Also the establishment of a covered bus stop and more dedicated route (Project #10) are dependent on input from Translink. Difficulties may arise when coordinating all outside organizations with the timeline proposed for the redevelopment of the UBCBG. This concern should be addressed by involving these parties in the design process and ensuring frequent correspondence.

Similarly, subsurface conditions could severely affect the cost and timeline of larger projects. The foundations for the multipurpose building (Project #14) and footings for the pedestrian bridge (Project #11) will rely on bearing capacity of competent soils. If soils with low bearing capacity exist, required remedy measures could include piles, retaining walls, preloading, and ground densification. This risk could be mitigated by involving a geotechnical consultant early in the detailed design process and preparing a contingency fund for this issue. The consultant should carry out a detailed site investigation to determine soil stratification, bearing capacity, and groundwater characteristics.

8.0 RECOMMENDATIONS

The redevelopment of the UBCBG has been staged such that it allows UBCBG the flexibility to perform some or all of the projects within each of the three phases proposed. In the event that budget constraints impede the completion of all tasks within each stage of the redevelopment, UBCBG may elect to perform only the most important and/or feasible improvements from one or more stages. The level of importance of each project depends on the weight of its contribution to the attainment of the three goals specified for this redevelopment: improved visitorship, redefined purpose of the UBCBG and the achievement of sustainability index and UBC's Living Lab targets.

Projects of highest importance are those which increase revenue and lower operating costs, as this will save money and buy time to make later improvements. Operating costs can be reduced immediately by implementing stormwater mitigation measures, including capture and reuse for irrigation. Furthermore, by implementing stormwater mitigation measures, the UBCBG may be eligible for UBC grant funding regarding sustainability. Revenue may be increased in the short term by improving visibility and access, and by providing new features for the public to enjoy, supplementary to those currently offered by the UBCBG.

In addition to lowering costs and increasing revenue, perhaps the most important goal for UBCBG is to become more sustainable in its water use practices; more specifically its use of potable water - which is a non-renewable resource - for irrigation. In order for UBC to remain true to its claim as a sustainability-focused institution, these changes are mandatory.

It is therefore recommended that the UBCBG proceed with the following projects, at a minimum, listed in order of importance:

1. Cattail Pond (Item #5)
2. Outdoor Cafe (Item #4)
3. Reorganized Parking Lot (Item #2) in conjunction with Community Garden (Item #3) and the Water Treatment Pond (Item #1)
4. Pergola (Item #9)