UB CBG Redeve lopment Project: The Complectenium at the Botanical Gardens

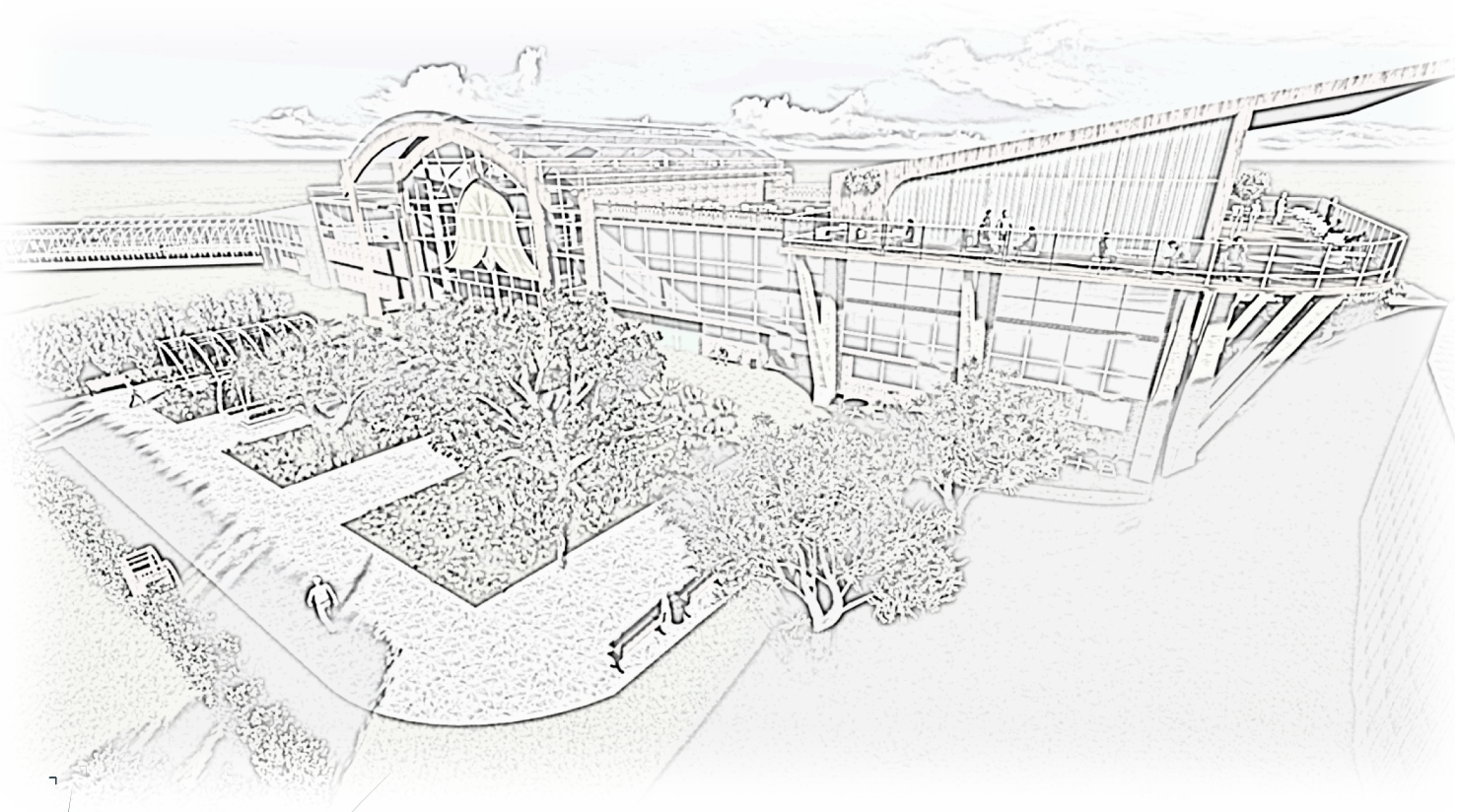
Adam Bodlack, Bill Chen, Laura Bickford, Mark Robinson, Matt Wong, Mike deHart

University of British Columbia

CIVL 445

November 29, 2013

UBCBG Redevelopment Project: The Complectenium at the Botanical Gardens



Civil 445 – Team 18 **November 28 2013**

Laura Bickford
Adam Bodlack
Bill Chen

Mike deHart
Mark Robinson
Matt Wong

BL AM ENGINEERING

UBC

ubcbotanicalgarden
& centre for plant research

Executive Summary- Team 18

UBCBG Revitalization Project – November 28th 2013

The Botanical Garden is a hidden gem at UBC that is completely underutilized by both on- and off-campus visitors. This report proposes that in order to increase the long-term viability and relevance of the Botanical Gardens a major redevelopment of the garden's east side should be undertaken. The construction of a 70,000 square foot multi-purpose building, called *the Complectenium*, that includes leasable industrial space, academic facilities, research laboratories, and food-service amenities will draw a host of new visitors to the garden. This development will drastically improve the services available to the current visitors of the garden and improve the visitor experience.

In concert with the construction of the Complectenium, a series of smaller changes will be undertaken to improve the entire operation of the garden. Paving and lighting of the key walking path will expand the garden's hours of operation and extend the effective open season as well as improve the garden's accessibility to people with limited mobility. Redevelopment of the west side parking lot to incorporate the maintenance yard will bring the operations facilities closer to the larger section of the garden where the majority of maintenance activities take place. Finally, the intersection of SW Marine Drive and Stadium road will be replaced with a roundabout to improve road crossing safety as well as slow traffic down in the vicinity of the Complectenium to improve visibility for the Botanical Gardens.

The estimated total cost for the proposed development is approximately $22,900,000. It is understood that the Botanical Gardens cannot bear the full cost of this project alone, which is why the Complectenium includes academic space for multiple UBC faculties and proposes the possibility of inter-institutional collaboration. The Complectenium is a drastic redevelopment proposal, but a feasible way to make the UBC Botanical Gardens a campus landmark and viable for years to come.

LAURA BICKFORD ADAM BODLACK BILL CHEN
MIKE DEHART MARK ROBINSON MATT WONG

TEAM 18

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1. Background

Since 1916, UBC Botanical Garden and Center for Plant Research has been a fixture on the University of British Columbia's Point Grey campus. Throughout its years in operation, UBCBG has been maintaining a repository of plant species from native and international biomes. Considered a research botanical garden over a contemplative stroll garden, the mission statement of UBCBG reads: "to assemble, curate and maintain a documented collection of temperate plants for the purposes of research, conservation, education, community outreach and public display" (The UBC Botanical Garden and Center for Plant Research, n.d.). Today, the garden boasts over 700 types of plants spread across 30 hectares in its collections based garden (Justice, 2013).

Maintained by a group of dedicated staff and volunteers, UBCBG struggles to operate on a modest budget. Budgetary concerns are always an issue when the garden considers its future and role as a botanical garden. This leads to the main criteria for the design work presented in this report: a method for the UBCBG to become [at least] moderately prosperous must be developed in order to secure the future of the garden. Additionally, this "method" must uphold the values described garden's mission statement.

1.2. Design Process and Criteria

With the requirement that the proposal must provide UBCBG with a "method" to generate positive income in order to be prosperous, two additional criteria have been developed:

a) Income should be generated on a year round basis to provide a steady revenue stream.
b) The burden of cost should be shared between multiple groups, rather than be shouldered by a smaller group. Revenue sources should be varied and could from a range of activities.

With these two criteria in mind, the concept for the Complectenium was born. The name "Complectenium" is derived from the Latin term for "to include all", *complectenium omnes.* This concept of inclusion, both on a time scale (opening the garden for year round use, for example) and as a concept of including as many functions and user groups into the proposal as possible, became the foundation of the project. Furthermore, the use of a Latin derived name reflects the use of Latin phrases in botany and horticulture sciences. It is in these details that the theme of inclusion echoes throughout.

The Complectenium would grow to become a complete development at UBCBG. The spaces provided within the development, satisfying the criteria above, form the platform for which UBCBG can generate positive income, and thus provide the means for UBCBG to remain profitable in the future.

In the development of these spaces, 5 core values, based on the advice from the UBCBG director Patrick Lewis, were implemented. These 5 core values are (Lewis, 2013):

1. Relevance: the proposal must ensure that the gardens maintain or improve its relevance to both the scientific and social communities of UBC, further into Vancouver, throughout Canada and beyond.
2. Sustainability: environmental considerations must have a significant influence on the proposal.
3. Viability: the proposal must ensure the garden is well situated to maintain it's prosperousness in the coming years
4. Accessibility: to ensure inclusion, the gardens must be accessible to all. This includes access to the gardens from elsewhere in the community, accessibility concerns inside the garden, ensuring all people are able to come to and use the gardens without restriction and ensuring that UBCBG has the means and methods to share its collections with the public in an effective way.
5. Visibility: the gardens must be visible in both a physical sense and community (academic, research, social, scientific) sense.

These core values became design objectives that were non-negotiable and were addressed when developing the proposal. To meet the design objectives, a design philosophy was adopted as presented by Dr. Susan Nesbit (Nesbit, 2013). The steps presented by Dr. Nesbit and utilized during the design are outlined below in Table 1.

Table 1: Stages of Design Phase

Stage of Design Phase	Key Feature of Stage
Define	Define the essential problem and determine the criteria for the design
Research	Research what has been done before.
Analyze	Break problem into parts and analyze principals in each part.
Ideate	Generate ideas and consider alternatives.
Evaluate	Does the design meet non-negotiable constraints? Are negotiable constraints met? What can be improved?

2. Identification of Key Improvement Areas

With the recognition that some aspects could not be changed within the scope of the proposal (i.e. proposal limited to the "Four Corners", suggestions of marketing efforts not in scope, location, land or subject matter of gardens not to be changed), key areas of improvement were identified. In each improvement area, consideration has been given as to how the improvement area can best be developed to satisfy the design goals and thus become a solution to the key criteria.

2.1. Relevance to UBC

The proposal should increase how UBCBG is perceived to relate to the main university campus. The gardens should be seen to be a feature of the university, both as a recreational site and as an academic/research site. The space of the gardens should not feel segregated or apart from the university, but rather as an extension of the main campus. Academic and research activities presently occurring on the main campus should have an opportunity to be moved to a garden space if the activity can be related to the garden's mission statement.

2.2. Increased External Involvement

The proposal should provide the infrastructure for a variety of user groups to be involved in UBCBG. Potential new/expanded users include:

- Commercial/private/public/industry research and scientific groups
- A broader range of garden recreational visitors
- External public education providers
- Departments from UBC (College of Agricultural Sciences, Botany, Landscape Architecture, Theatre, Film, Creative Writing, Zoology, Ecology, Visual Arts, Forestry, Music, First Nations)
- Event planners

2.3. Access and Convenience

Facilities and infrastructure to support UBCBG bringing their collections to visitors should be provided. This may look like any number of improvements. Examples include: increased greenhouse space, interpretive displays, improved visitor spaces, administrative and volunteer spaces, garden walking/touring improvements, providing more parking, improving cycling infrastructure or reducing entrance fees for low-income individuals. Visitors will also appreciate increased convenience. For example, the current entrance to UBCBG is not well marked and gives no great impression to those passing by or arriving at the gardens. This should be addressed in the proposal. The current parking (including access for tour busses) is not ideal and should also be addressed.

2.4. Visitor Experience

The visitor experience can be broken into 6 categories: arrival, sitting, moving through, eating, learning and special events (Durante Kreuk Ltd, 2001). To increase attendance at the garden, the experience provided to guests in the above categories should be considered. Similar to other popular botanical gardens, a visitor space with bold architectural vocabulary should be considered to create an anchor that visitors will remember. The current garden conditions are not well suited to experiencing the gardens in the winter or after sunset. Opportunities for visitors to have the option to "purchase" an experience at the garden could also be provided through food and beverage options, or a gift shop.

2.5. Sustainability and Operational Efficiency

The proposal should make sustainability a top priority. Not doing would be in contravention of philosophies of UBCBG and UBC. UBCBG does not have a history of sustainability as a priority and thus a dramatic statement towards environmental stewardship should be made with the proposal. A LEED Gold rating should be considered a minimum that could be provided. The

proposal should consider the current functions of administration and maintenances/grounds keeping facilities.

3. Proposed Design

3.1. Design Objectives

The Complectenium has been designed as an "all inclusive" structure that aims to increase the Botanical Garden's revenue, relevance, academic operations, commercial opportunities and visitor experience. Serving as the new entrance on the east side of SW Marine Drive, the Complectenium is also designed to act as an attractive landmark to increase interest in UBCBG. The structure is proposed to meet a minimum of LEED Gold rating and embraces sustainable design with the use of green roofs and rainwater collection systems. The facility will also incorporate year round income-generating opportunities for the UBCBG such as food and beverage services and an expanded gift shop.

3.2. Design Justification

In reviewing the current available space at UBCBG, two potential redevelopment areas have been identified. One option considered was the redevelopment of the current main entrance area on the west side of SW Marine Drive. The second option considered was to re-purpose the area surrounding the existing maintenance facilities on the east side of SW Marine Drive.

An assessment process was conducted to evaluate the benefits of both development sites. Key considerations included in the assessment process included: development potential, available space, accessibility and convenience, flow of visitors through the garden and visibility. The results from the assessment identified that the development on the east side of SW Marine Drive would be the preferable option.

The locational advantages of developing the Complectenium east of Marine Drive is that it effectively brings the overall garden closer to the core of the university. The new location will provide opportunities for developing new services that can be used by the population of UBC and residents of the surrounding neighbourhoods. In addition, the garden around the

proposed development location is currently somewhat underutilized. A development in this area will add definition to this underutilized space

Access, convenience and safety issues for the proposed location also have advantages over the current entrance location. Pedestrians and cyclists travelling from the campus core will avoid having to cross the uncontrolled crosswalk on SW Marine Drive to gain access to the main entrance. In addition, cyclist visitors are able to enjoy end trip facilities, such as showers and changing rooms, which will be provided in the Complectenium. The overall distance from campus core is also closer for pedestrian and cyclist access. The proposed site is conveniently located near a bus stop on Stadium Road near West Mall. The C20 bus is currently operating on this route to bring visitors to and from the UBC bus loop. The existing public transit route provides a link for campus visitors and public communities to the Complectenium. With expanding residential neighbourhoods in the area, this route may even see improvements in coordination with the regional transportation authority, Translink.

Access, convenience and safety will also be improved the by the addition of a roundabout added to the intersection of SW Marine Drive and Stadium Road. Currently, the intersection is uncontrolled and vehicles typically pass this intersection without noticing the garden entrance. The roundabout will slow traffic, making the intersection safer, and also allows a few extra seconds for those passing by to take notice of the Complectenium, which will now sit prominently on the corner of Stadium Drive. Incorporated into the roundabout design will be improved signage to guide visitors towards new garden entrance and advertise to anyone who does not know of the garden. Slowing of traffic at the intersection will be of great help to maintenance workers who, due the layout off the gardens, have to cross Marine Drive often.

The new entrance location also makes use of the Asian Garden and the Greenheart Canopy Walkway as an attraction anchor to encourage visitor flow. Currently, many of the garden's key collections are placed in the Asian Gardens and key attractions are located close to the existing entrance. Visitors typically may choose to visit and Asian Gardens and leave without visiting the area by Thunderbird Stadium. By moving the main entrance, the Asian Gardens and the Greenheart Canopy Walkway will draw visitors through the garden towards these attractions

thus visitors will have an opportunity to see parts of the garden they may have otherwise not. In addition, by relocating the main entrance to the east side, arriving guests will now enter the garden near the amphitheatre. UBCBG may enjoy an increase in the number of events and performances requested held in the amphitheatre as a result of it's closer proximity to main entrance and the facilities contained within the Complectenium.

It should be noted that prior to 1990, the main entrance for UBCBG was in fact located near the proposed redevelopment site. In 1990, in an effort to consolidate UBCBG offices, the main entrance, along with administration offices, gift shop and reception center was moved to the west side of Marine (Justice D. , 2013).

3.3. The Complectenium Development

The Complectenium is a multi-functional structure designed to improve relevance and viability of the UBCBG. The building welcomes its visitors and users with a stunning welcome foyer, the Atrium, with architectural features including wooden columns and glass view windows. The light-well concept for the Atrium aims to integrate the environment into the functionality of the building. The addition of green roof concepts creates a sustainable, living structure and embeds the natural aspirations of the garden into the building. The structure is designed to achieve minimum LEED Gold standards in compliance with UBC campus development goals. This is aimed to add relevance to UBC's development strategies as well as sharing the promotion of sustainability objectives for Botanical Gardens. Figure 4 shows a general floor layout of the functional spaces in the Complectenium. Exterior 3D modeled views of the structure are shown in Figure 2 and Figure 3. All images can be found in Appendix A- Images. The range of space functions include academic spaces, offices, laboratories, greenhouses, garden welcoming foyer, Garden café, Stadium View Bistro, and event/public spaces on the main floor. Further details and justifications for the proposed design are provided in the following sections.

3.3.1. The Atrium

The Complectenium welcomes its visitors and users with a beautiful atrium with prominent wood columns and structural members with outstanding architectural features. This space is

shown navy blue region in Figure 4. Visitors will enjoy natural light streaming in through the glass roof in the Atrium. The light well concept for the atrium integrates the environment into the theme of the building. The Atrium ceiling is 3 storeys high and has a total floor space of 5300 ft^2. There will be balconies along the west and east walls of the atrium that will serve the offices of the educational and office space.

On either side of the Atrium there will be end trip facilities for respective male and female cyclists. These end trip facilities will provide an opportunity for cyclists to wash up in provided showers and change rooms before socializing within the UBCBG and restaurant.

Within the Complectenium visitor entrance there will be a gift shop that will provide guests an opportunity to purchase gifts and goods. Having an expanded gift shop serves two purposes. Firstly, it will be a source of year round income for UBCBG. The gift shop (in conjunction with the café, discussed below in Section 3.3.5, and the back patio, which is discussed in Section 3.3.6) will also improve the visitor experience for those guests that are perhaps less interested in touring through the gardens by providing an alternative area for these guests to browse through.

3.3.2. Academic Functions

A collection of prestigious classrooms, tutorial rooms, libraries, and multi-purpose educational spaces are designed for the academic functions of the Complectenium. The locations for the academic spaces are shown by the red region in Figure 4. The academic function space, west of the Atrium, is a 3 storey section of the main building with a total of 12,700 ft^2 of floor space for purposing of the various functions identified. Detailed floor layouts for the academic spaces are shown in Figure 5. Green roofing for this section is proposed to add to sustainability, user comfort, visitor experience, as well as provide a space for relaxation. Access to the green roof is located from the top floor of the Atrium.

The inclusion of academic space is aimed to establish a connection between the Botanical Gardens and the academic communities from UBC and other institutions. Currently there is a

lack of academic spaces and limited faculties' involvement; the Botanical Garden's academic functionality is somewhat independent to and isolated from the university. With addition of a high volume learning space, a platform is provided to expand the gardens involvement with other faculties such as the Faculty of Land and Food Systems, the Faculty of Science, or the Faculty of Landscape Architecture. By establishing involvement of the university into the functions of the Complectenium, UBCBG has become more inclusive of UBC, and vice versa. This "creating of relevance" is a high consideration in order to open funding sources from UBC to UBCBG and to bridge its interaction with the university.

3.3.3. Office Space

A collection of offices for UBCBG administration as well as university faculty members is included as a key supporting function to the Complectenium. The allocation of offices is placed in the upper 2 levels of the 3-storey section east of the Atrium. The main floor will be used as student common areas for study and as an entrance to café operations. The office spaces and student common areas are located outside of the Atrium Entrance shown by the yellow region in Figure 4 .A total of 11,200 ft^2 of floor space is available for allocation to offices and common areas. Detailed layouts of office spaces are shown in Figure 5.

The office spaces are added to help concentrate and improve Botanical Gardens management efficiency. A portion of this office space is dedicated for the use of various faculties from UBC as part of "adding relevance" to the Botanical Gardens. There is also opportunity for a green roof to be added to improve sustainability in accordance with the UBC campus development strategies as well as the general promotion of sustainability.

3.3.4. Laboratories

A collection of wet and dry laboratory spaces have been included for botanical and horticulture research. These spaces are for both UBCBG use and for industry partners. They are located on the west end of the Complectenium shown by the violet region in Figure 4. The detailed

layouts of the laboratories are shown in Figure 5. Due to the sensitive research that may be done by the industry partners, care was taken for the state-of-the-art laboratories to safe and secure. These spaces were designed to balance providing a secure space for delicate research that also promotes a warm atmosphere of collaboration. The dry laboratories are office spaces supplied with all the necessary office equipment that botanists and horticulturists may require to do research. The wet labs will be spaces where the botanists and horticulturists tenants will be able to do all of their experiments that require the handling of biological components. These spaces will be modeled after the ones in the UBC Pharmaceutical Sciences Building that can easily be repurposed in a span of an hour. This is made possible by the design nozzle supply connecting the gas, hydro, and electrical equipment that can easily be switched.

3.3.5. Food Services and Dining Experience

Food services and fine dining operations are located on the east end section of the Complectenium shown by the green region in Figure 4. The upper floor of this section is the "Stadium View Bistro" for fine dining experiences. An exterior model of the restaurant is shown in Figure 6. This restaurant could either be run by UBCBG or the space could be leased by the gardens to an independent operator. With amazing outlooks into the Thunderbird Stadium and the garden interior, the sweeping views from the restaurant space are well suited to a fine dining experience. The restaurant is designed to interact visually with the Botanical Gardens with an indoor green space theme. The restaurant could further be incorporated into the garden by utilizing the food garden operations to provide its fresh ingredients. The restaurant has a space of 4300 ft^2 area with a capacity to hold approximately 200 seats. On top of providing year round revenue to UBCBG, the intention of providing fine dining services is to attract visitors to the garden that may not have otherwise attended. However, it is anticipated that some restaurant visitors may decide to pay admission to the gardens upon arrival at the Complectenium. In anticipation of this, provisions for night-time (after dinner) usage of the gardens are discussed below in Section 3.3.9.

In the lower level, a café looking into interior of the garden would provide simpler food services for garden visitors, students, UBC faculty staff, and friends of Botanical Gardens. The floor plan of the café is shown in Figure 5. The remaining lower floor capacity will be used for Botanical Garden workspace, entertaining space, and rentable event space.

The inclusion of the dining and food services plays a key role in creating incremental opportunities for change at the Botanical Gardens. Incomes from food services are year round and sustainable. By having the Complectenium closer to the academic core, the restaurant and café will likely be used by UBC students who are, conveniently, on campus in the spring and fall when revenue from admissions to the garden are typically low. The upper floor restaurant is designed to attract a wider range of the public communities with attractive overviews of stadium games and garden interior. Arrangements could potentially be made through Thunderbird Stadium for use of this restaurant space during events at the stadium. A garden themed fine dining service has good attraction opportunities to Vancouver's growing "foodie" community and to visiting tourists. In addition, the area surrounding the Complectenium is a growing residential neighbourhood, thus the demand for food services is going to continue to increase.

3.3.6. Back Patio and Garden Entrance

There is a back patio located on the southeast corner of the Complectenium. An exterior model of the patio is presented in Figure 7. This space is an extension of the café space and outdoor seating is provided. The back patio is targeted to appeal to guests who prefer a more laid back economic setting versus the fine dining environment provided by the restaurant. Patrons of the back patio will be able to sit outdoors and enjoy the natural beauty of the UBC Botanical Gardens. It is located on the southeast side of the building, so that the patrons will be able to enjoy the slight breeze from the Pacific Ocean during the summer time.

An outdoor area referred to as the "garden entrance" joins the back patio and the Atrium. The garden entrance is the area outside of the Atrium, which welcomes guests to the garden.

Although identified as three separate spaces, the Atrium, the back patio and the garden entrance all act as one unified space for guests to be in and enjoy. The garden entrance boasts a water feature fed with water collected from the roof of the Complectenium. Section 3.5 describes the use of sustainable water sources implemented into the project further. The remaining space in the garden entrance would have plantings and paths done by UBCBG that guide visitors into the existing paths and gardens. The water collection system is shown in Figure 13. The garden entrance is shown in Figure 3 and Figure 8.

3.3.7. Greenhouse/Research Supporting Spaces

On the southwest of the Complectenium there are two greenhouses that will serve UBCBG and could also be leased to industry partners for extra revenue. Each greenhouse will provide 3000 ft^2 of floor space. The proximity of the greenhouse to nearby laboratories and the garden allows for efficient operations by the UBCBG garden workers and industry partners. An exterior view of the greenhouse is presented in Figure 9.

3.3.8. Underground and Tour Bus Parking Facilities

A two level underground parking will be constructed under the footprint of the Complectenium. Access for the parkade is near Area A shown on Figure 4, off of the new roundabout. The parking will provide an additional 136 parking spots approximately. The use of the parking space will be reserved for garden visitors and UBC faculty, staff and students. UBC Parking Services & Access Control will be regulating and managing the parking operations for a consistent pay parking system compliant with campus wide parking systems. A cross-section of the Complectenium showing the two levels of underground parking is provided in Figure 10.

The underground parking facility is aimed to expand the limited visitor parking offered by current surface parking lot. The installation of underground parking is also compliant with UBC campus plans in which no additional surface parking designs are permitted for future development planning. During low flow visitor periods, the parking service is also available for

the use of student and faculty members. The parking space could also be shared with Thunderbird Stadium. Charging “event parking” prices for those parking for stadium events could generate additional revenue.

Figure 2 shows an area in front of the Complectenium designated for tour bus loading and unloading as well as a drop-off zone.

3.3.9. Designated Night Path and Lighting

To allow the gardens to stay open for extended hours a designated night path, which would be illuminated, has been proposed. The designated night path was chosen to incorporate major features of the garden. It is designed as a substantial upgrade to visitor experience and accessibility. It consists of three different illuminated loops with varying lengths. As seen in Figure 11, there is one main loop that travels from the north side of the garden to the south and back again. The main trail guides visitors through many of the botanical gardens significant sections. It first starts on the north side in at the Complectenium and travels into the Carolinian Forest. The trail then skirts past the Garden Pavilion, runs through the tunnel and circles the Asian Garden. Visitors can then choose to head back through the tunnel and up towards the Food Garden or continue deeper into the southern part of the garden. All routes finish through the Alpine garden and amphitheater. The Asian Garden is the main attraction of this trail and the route was selected with objective of introducing visitors to other sections of the garden in order to reach it. The maximum length of the route is approximately 2 kilometers, with 1.5 kilometer and 0.75 kilometer options available. The average amount of time needed to walk these sections is 60, 45 and 20 minutes respectively. The path itself will be a 6 feet wide and paved. This will allow for increased accessibility to visitors that have difficulty walking or are using mobility aids.

The designated night path will be illuminated so guests will be able to use the path in the evening and during the winter. By having this infrastructure, the gardens will be able to stay open later and take advantage of potential guests who are visiting the restaurant or café in the

evening. Lighting was designed to incorporate major features of the garden including specific highlighted locations of interest. In total, approximately 300 lights of 75-watt incandescent equivalent will be utilized for the designated path. This would result in 1 light about every 7 meters. The highlight sections of Figure 11 show the paths that will be lighted.

3.4. Redevelopment West of Marine Drive- Maintenance Yard and Surface Parking

By simultaneously moving the main entrance and parking lot to the east side of SW Marine Drive, the existing facilities west of Marine Drive will be available for redevelopment. The layout proposed layout is as shown in Figure 12. Work will be done to enhance the parking lot for events, relocate the maintenance yard area and repurpose the administration buildings while maintaining the pagoda hut and event hall that overlooks the lawn.

3.4.1. Parking Lot Realignment

The underground parking at the Complectenium will be large enough to serve the daily volume of UBCBC visitor's cars, which will leave the current surface parking lot to handle the overflow during special events. In order to optimize the usage of the space the parking has been redesigned. The first step will be to remove the traffic calming circle at the entrance of the parking lot. The main purpose of this traffic calming circle is to slow traffic down traffic when entering the parking lot. This will no longer be necessary because of the new roundabout at the intersection of SW Marine and Stadium Road will fulfill that purpose. The roundabout is further discussed in Section 3.2. This will provide more parking spaces for the overflow traffic as well as tour bus parking.

The second step will be to remove the asphalt paving and replace it with a permeable surface and add features that will improve on pedestrian safety and aesthetics. The permeable surface will lower the ecological impact of the site by allowing the storm water to flow back into the water table. Examples of permeable design options include open-jointed concrete paving blocks, gravel, or porous asphalt. Along the sides of parking lot will be designated pedestrian

walkways that will have lighting. Having designated pedestrian walkways will increase driver confidence by having pedestrians contained in a predictable and highly visible area. These pathways will be decorated with green foliage that increases aesthetics and absorbs rainwater.

3.4.2. Relocation of Maintenance Location

The existing maintenance yard will be relocated to west of Marine Drive near the area currently used for surface parking. The new maintenance yard location is shown in Figure 12. The space allocated will be about 1.5 times larger then the current service area on the east side. Sections of the parking lot can be closed for storage of garden waste if required. A new greenhouse in this area will replace the existing greenhouse space in the current maintenance yard belonging to the Friends of the Garden.

3.4.3. Repurposing of Existing Buildings

Once the Complectenium has been completed, work to repurpose the current administration and visitor centre buildings will commence. The UBCBG Master Plan's suggestion on repurposing the administration buildings as a "Scholar's Retreat" (Durante Kreuk Ltd, 2001) should be followed. The rental hall and pagoda near the lawn are currently generating good revenue and should not be changed. It will be of utmost importance to maintain the grass field next to the event hall area for visitors to enjoy. This space has an air flow phenomenon of perfectly still air that comes off the Pacific Ocean and rests upon the grassy area. The existing entrance building and entrance gate will need to either be maintained as a secondary entrance or reconfigured.

3.5. Environmental Considerations

In the conceptual development of the Complectenium sustainability has been identified as a core value. In accordance with UBC guidelines, the structure itself will be a LEED Gold minimum, with the goal of achieving Platinum. As this is designed to LEED project, there will be numerous

sustainable systems used in the project. For the level of design in this report, only a few have been described in substantial detail. Sustainable features detailed in this report include:

- Rainwater collection and distribution
- A water cistern (described below in Section 3.5.1.)
- Green, or “living” roof spaces
- Collected rainwater is used in ornamental water features
- High efficiency lighting

The rainwater collection and distribution system can be seen in Figure 13. As can be seen in this image, the rainwater runs off the roof into a gutter system that then connects to a storage tank. This system, in conjunction with a water filtration system, will initially supply the ornamental water features located in the back patio and garden entrance areas, but could eventually help supply the demand for the building. The building itself can also incorporate multiple water saving features such as low flow toilets and motion activated taps.

The water cistern system, shown in Figure 10, will be installed underneath the building. A 2000 m^3 storm water cistern ties into existing storm water infrastructure for irrigation. Green roofs will also be used to help reduce the energy usage of the building for heating and cooling, and could double as a lounge type garden for visitors or supply produce for the in house restaurant. Solar panels could also be installed to reduce the energy demand. The asphalt and concrete used during construction will contain recycled aggregates from previous roads and well as incorporate recycled plastics. Using recycled materials not only reduces the demand for new resources, they also take less energy to place relative to standard practices.

High efficiency lighting will also be utilized for this project. Led bulbs only require 15 watts of electricity to reach the 75 watt incandescent equivalent. The main goal of all of these systems is to reduce energy consumption and demand of resources.

3.5.1. Storm Water Cistern and Storage for Irrigation

In an effort to reduce the potable water usage at UBCBG, we are proposing that storm water and rainwater be captured and used for irrigation and any other non-potable water needs in the Complectenium. The proposed Complectenium sits directly above the location of a current storm water sewer line, and rather than diverting and rerouting these utilities we recommend the construction of a large lined concrete cistern in the underground parking garage of the Complectenium to hold storm water for irrigation. Storm water storage is underground shown in Figure 10.

To avoid the circulation of abrasive material through the building's and the garden's plumbing and pumping systems it is advisable to install a grit separator prior to the catchment basin. The vortex-type grit chamber is recommended as it has a small footprint and can be cleaned without interrupting the flow of storm water. This type of separator is also suitable for the low flows that we might expect during the dryer months of the year and the higher flows that occur in the winter. The tank should have overflows before the grit separator and from the cistern in case of heavy storm water runoff during storm events. Controlling storm water runoff can also reduce storm-induced erosion in the Botanical Gardens creek outflow.

To properly size the cistern additional studies into flow through the storm water lines as well as garden irrigation and non-potable water needs of the Complectenium should be commissioned. Variables of importance include the daily intake amounts (or storm water), the daily water usage of the Complectenium and Botanical Gardens, the residence time in the tank/tanks and the bacterial density in the water. While the need for the first two variables is obvious, the turnover time and the bacterial density are not as straightforward. It is important that the water sitting in the cistern not have excessive bacterial growth, nor turn septic lest it need be treated before use.

Through a preliminary estimate using data collected by a group of UBC students we would suggest a tank size of approximately 2000 m^3 which represents about half a month's water demand during the dry season (Shen & Wong, 2013).

4. Implementation

4.1. Stakeholder Involvement

The concept behind proposing a major development like the Complectenium was not just to build a structure, but also to build a community at UBCBG. While having a large number of end users requires that more needs must be considered during the initial design phase, it serves the end goal of creating a vibrant and diverse community focused at the UBC Botanical Gardens. Since each stakeholder has different requirements of their space, they must be involved in the planning phases of the project to ensure that costly redesigns are not required after the final construction is complete.

In this proposal, spaces with approximate square footages have been provided with the idea that for further detailed design, input from potential tenants and users would be contributed. For example, UBC faculties will determine how much space they would like to have in the new development for offices and research space. The departments of Botany, Horticulture, Food Science, Food and Land Systems, Landscape Architecture and others could all benefit from proximity to the Botanical Gardens and access to new high-tech research space tailored to their needs. The size of these faculties' classes and expected growth in the future will determine the size of lecture theatres that should be constructed off the Complectenium Atrium, whether it be 4 or 5 smaller classrooms or 1 or 2 very large halls.

Faculties with research programs and technical programs from other institutions (SFU, BCIT, Kwantlen Polytechnic University or Langara College, for example) could also be invited to bring their programs to the Complectenium. Collaboration between institutions would only serve to strengthen the reputation of UBC and the Botanical Gardens as a world-renowned centre for plant research. How much space will be allocated to other institutions and the type of contractual agreement that this might entail would be determined at the very early stages of the project.

During the preliminary design phase of the Complectenium project it would be beneficial to target 2 or 3 potential industry partners as anchor tenants for the commercial research wing of the Complectenium. Engaging the industry partners early in the process will aid in determining the laboratory requirements. While it is possible to hire consultants to plan the labs, it is better to get the information directly from the source, and it allows the developers to get firm commitments from tenants in the earliest stages of the project that can help with cash flows and confidence in the financial viability of the Complectenium. A large industry partner may also be interested in sponsoring part of the Complectenium for naming rights.

The UBC Botanical Garden staff and the Friends of the Garden will have a large influence in the design of the Complectenium as they will be a main tenant. Expanded office space and nursery greenhouse space have been allocated to these groups, but how they will be outfitted is best left to the stakeholders to decide.

4.2. Economic Analysis

Below is presented a rudimentary economic analysis of the proposed development including the Complectenium, the path lighting and paving, the west side maintenance yard redevelopment, and the roundabout at Stadium Road and SW Marine Drive.

The estimate was prepared using cost data from the R. S. Means estimating data, the Hanscomb Yardstick, and a report prepared by UBC as well as design data from our own SketchUp model (R. S. Means, 2012). *Upon completion of the preliminary estimate it was found that the Hanscomb data proved less conservative and so was not presented in this report*.

1. The Complectenium

Figure 4 shows approximate square footages of each section as well as section letters corresponding to lettered sections in the cost estimate

To estimate the construction cost of the Complectenium, the building was broken up into 8 distinct sections. They include the 5 lettered sections shown in Figure 4 (section D + E without

the restaurant is considered as one "building" as it's all offices) plus the restaurant, the greenhouse, the underground parking and the Atrium. In order to simplify the estimate, each section was assumed to be a separate building with the adjoining walls removed from the perimeter lineal foot count and then added together. Also, while basic fixtures, furniture, and equipment are included in the R. S. Means cost data, anything beyond the standard (i.e. state-of-the-art) is not included. Much of this will be tenant improvement work, but some of this cost will be borne by the University. The detailed calculations can be found in Appendix B- Cost Calculations.

The final total estimated cost for the Complectenium building itself is $20,000,000.

2. *The Roundabout*

Previous project on the UBC campus and in development by the University for the near future put a reasonable estimate of the cost of a roundabout at SW Marine and Stadium Rd. at about $1.5 Million (University of British Columbia, 2006).

3. *Westside Maintenance Yard*

The repaving and redevelopment of the garden's west side parking lot as overflow parking and new home of the maintenance yard will cost approximately $648,000.

4. Pathway Improvements

Based on the calculations presented in Appendix B, the approximate cost for paving and lighting a 2km walking path in the garden would be $750,000.

Overall Cost

Thus, the overall cost of the project we are proposing would be approximately $22,900,000.00 This is Class D estimate, and should be taken as such (+/- 50%).

4.3. Staging

Based on the way that the Complectenium is laid out, it would be possible to stage not only the different sections of the proposed project, but possibly difference sections of the main building itself. With the Atrium as natural barrier between two buildings (R. S. Means, 2012) with separate purposes, it would be possible to build section A, B, C separately from D, and E and separately from the atrium area itself. The major stumbling block to this plan is that these "independent" building sections share an underground parkade.

It would be possible to build the underground parking first, but this would be a massive initial capital expenditure that is likely insurmountable by the Botanical Gardens alone. Since building only the parking lot is unlikely to draw many additional funders, this may make staging impossible. With proper planning and fundraising a development in stages could be an option.

4.4. Funding Opportunities

4.4.1. Capital Funding

As described in previous sections, one of the main goals of the Complectenium development is the inclusion of a multitude of stakeholders to build a strong and broad-based research community at the Botanical Gardens. That is not the only reason to do this. The Botanical Gardens has only a modest operating budget, and even less of a regular capital expenditures budget. It would be nearly impossible for the Gardens to fund a project of this magnitude alone (an enormous endowment from an estate or benefactor could occur, but obviously cannot be relied on). By including more parties in the concept we can share some of the budgetary load.

Many of UBC's faculties do have a significant capital budget, as evinced by the plethora of new construction on campus. Convincing additional faculties to take part in the development means that they will contribute capital to the construction of the Complectenium and at least partially to the operation of the facility once it is built. Both the faculty of Landscape Architecture and Land and Food Systems are housed in the MacMillan building which is in need of an update.

The Botanical Gardens and the Complectenium project would be relevant and likely interesting to both of these faculties and it appears that these departments have not requested or spent significant capital funding in recent years. These are simply 2 of any number of departments at UBC to which this project could prove attractive.

The same argument can be made for programmes at other local academic institutions. Simon Fraser University and BCIT both have plans for significant growth in the near future, both in number of students and facilities. Access to a brand new facility like the Complectenium could prove to be a boon to these institutions too, especially if the research labs are modern and the industry partnerships are lucrative and relevant.

4.4.2. Revenue Generation

One of the major concerns of the UBC Botanical Gardens is increased revenue generation. The inclusion of ancillary space in the Complectenium allows the Gardens to increase their revenue in both the off-season and the busy season without a great deal of additional overhead expense.

A well-appointed commercial dining space with world-class views would attract a stable tenant to manage the Botanical Garden's new bistro. More than likely the restaurant revenues will be highest during the University's school year, which is effectively the Botanical Garden's low season. This synergy will help the gardens move away from its historically cyclical business cycle. Improvements to the garden paths and lighting will also help improve visitor-ship during the shoulder seasons, allowing the Botanical Gardens to remain open later in the year (and the day) and open sooner in the spring.

State-of-the-art plant research laboratories and greenhouse space will draw commercial tenants to the Complectenium as well. Monthly revenues from leased floor space will help fund the Botanical Garden's year-round operations and allow the Gardens to expand their offerings. It is not necessary for the Botanical Gardens to expand operations personnel, as

much of these additional ventures (industrial tenants and restaurateurs) can be operated by subcontractors.

Working on a very tight budget has not allowed the Botanical Gardens the flexibility to experiment with programming in the past, since financial losses could be potentially catastrophic. Generally expanded revenue streams will allow the staff to generate ideas that will ultimately increase visitors to both the Complectenium and the Botanical Gardens in a symbiotic way.

Appendix A- Images

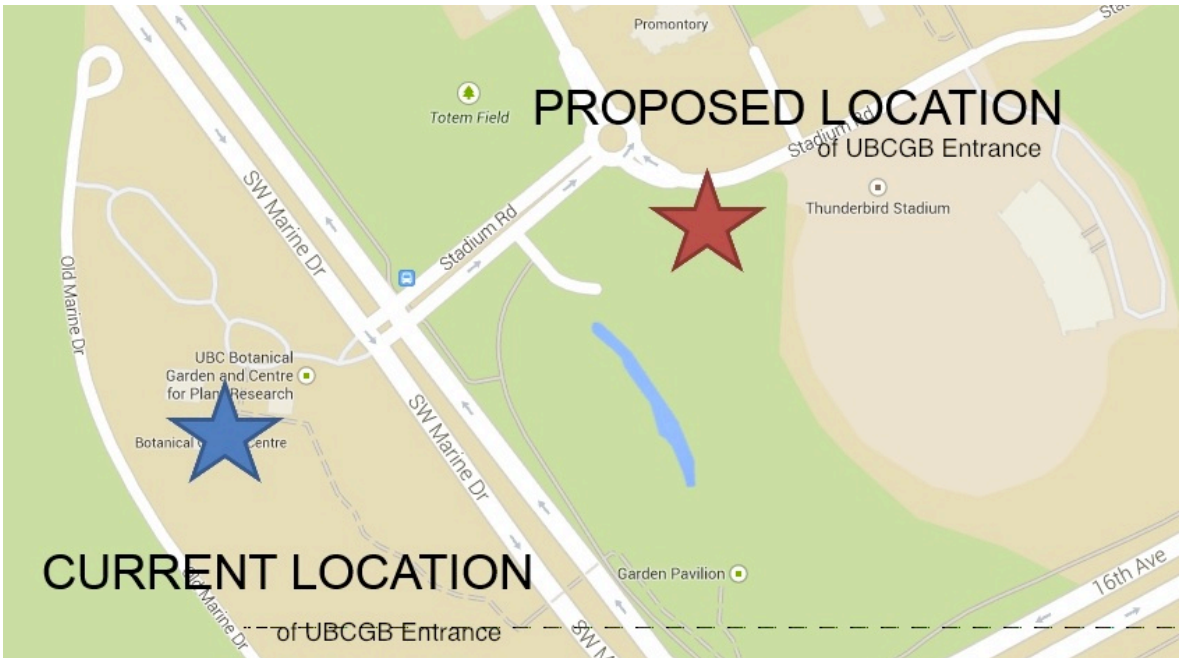


Figure 1 Proposed Location of UBCBG Entrance

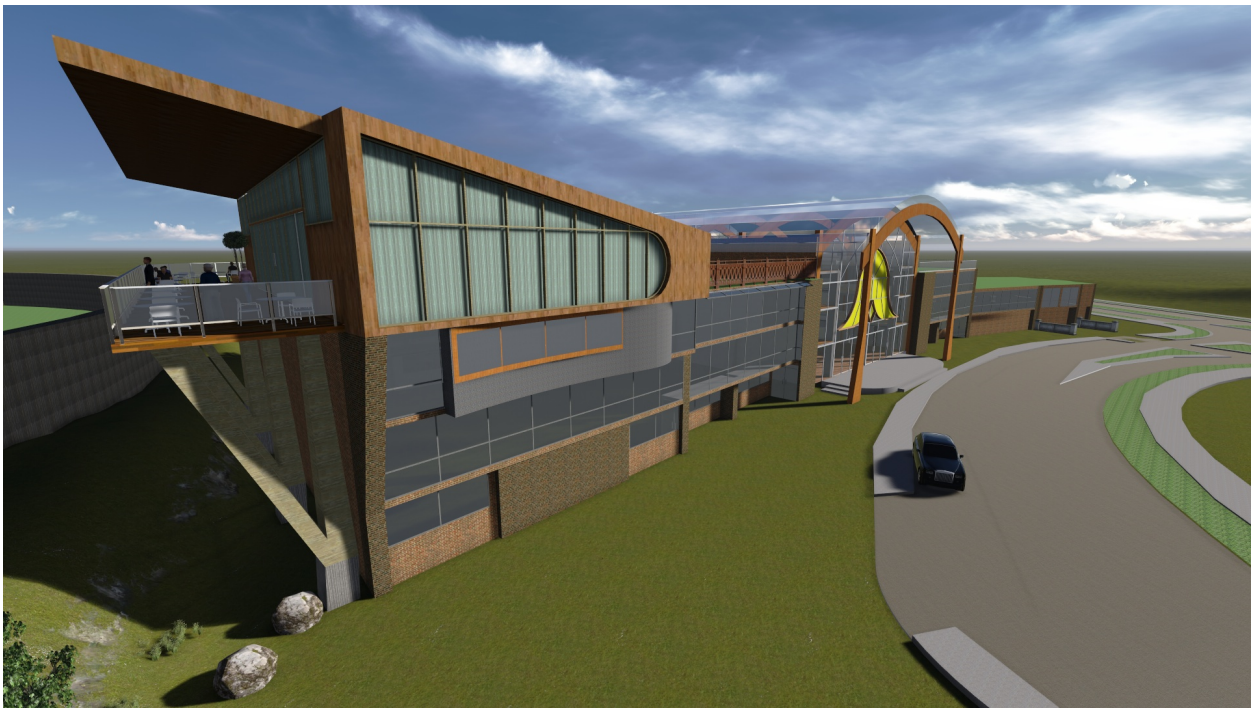


Figure 2 Front Side Exterior of the Complectenium

Figure 3 Backside Exterior of the Complectenium

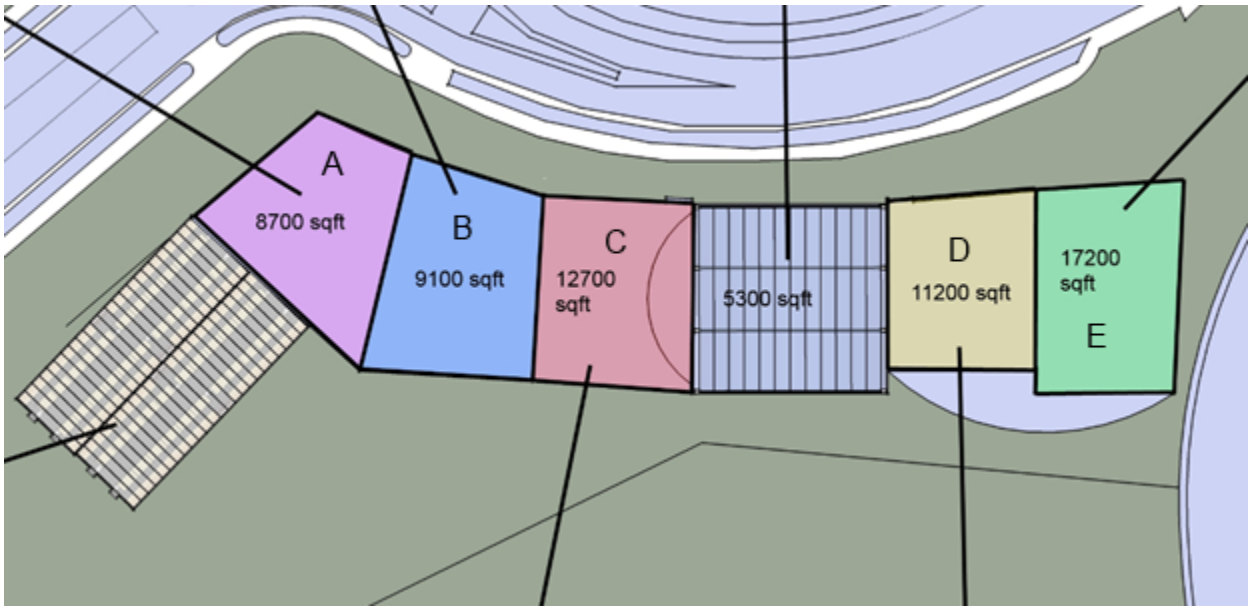


Figure 4 Complectenium General Layout

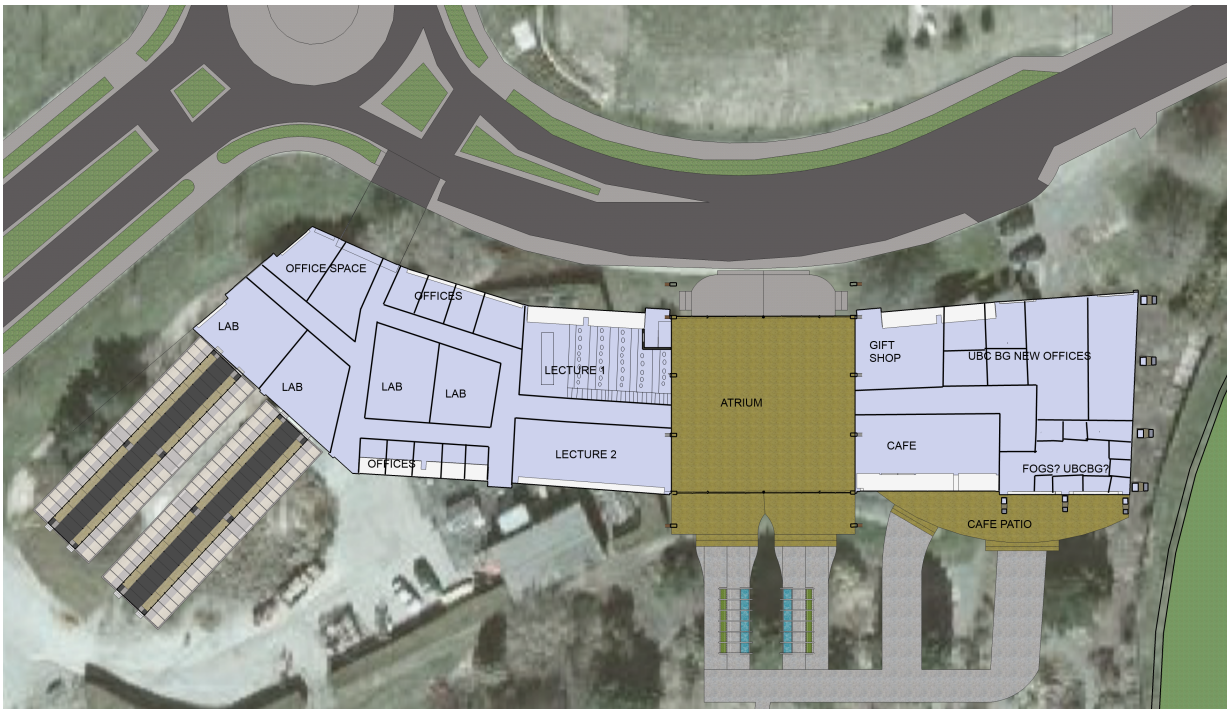


Figure 5 Complectenium Detailed Layout

Figure 6 Exterior Model of the Stadium View Bistro

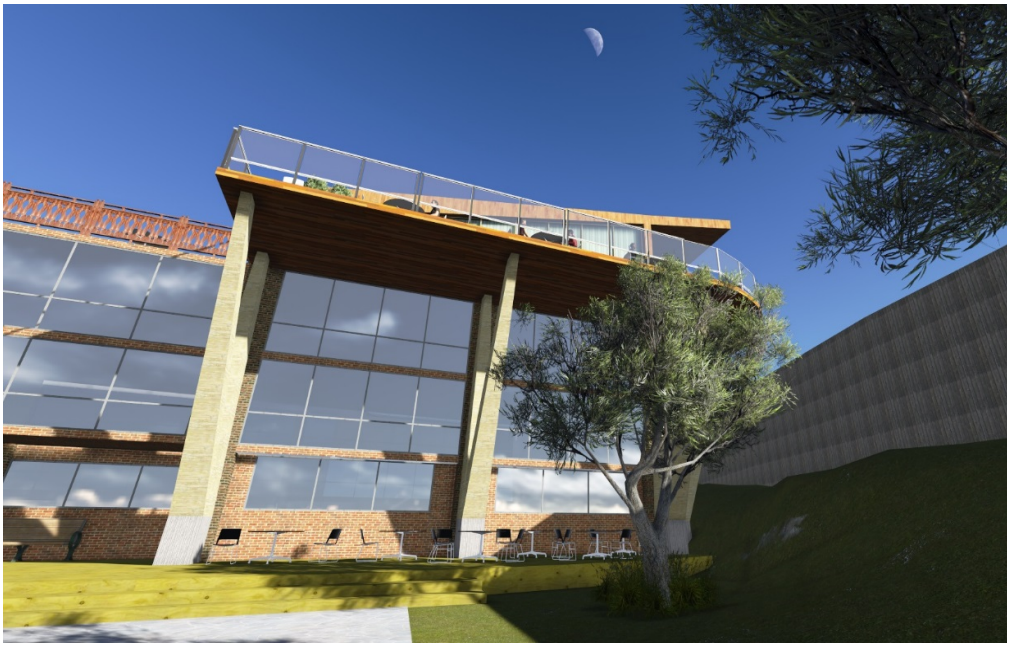


Figure 7 Exterior Model of the Back Patio

Figure 8 Proposed Garden Entrance

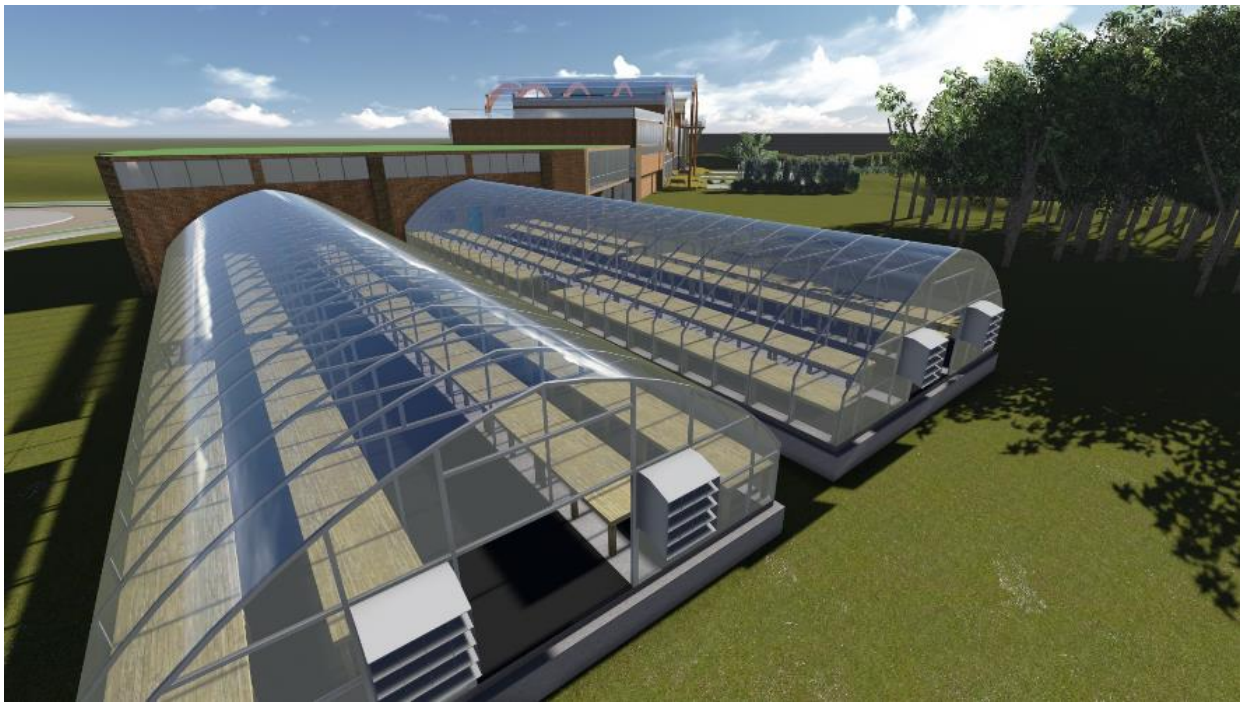


Figure 9 Exterior View of Green Houses

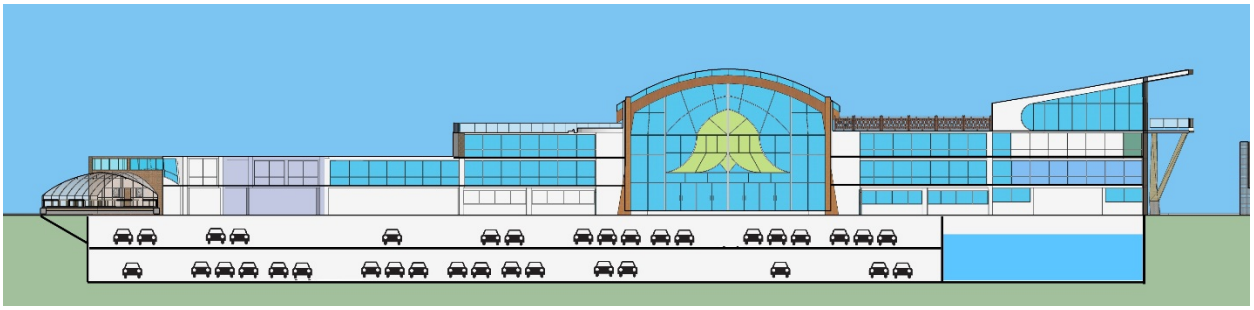


Figure 10 Underground Parking and Storm Water Storage

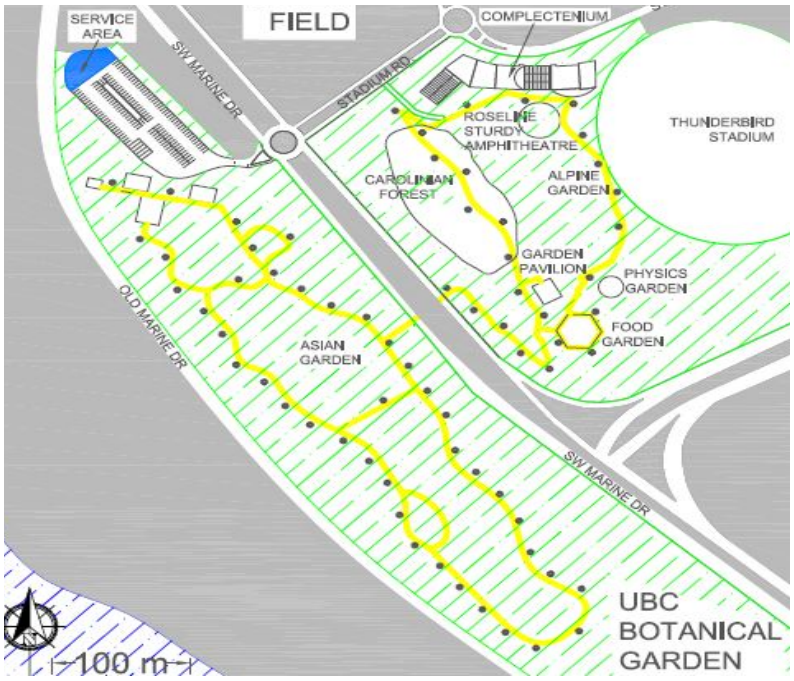


Figure 11 Proposed Designated Night Path

Figure 12 West Side Parking and Maintenance Yard

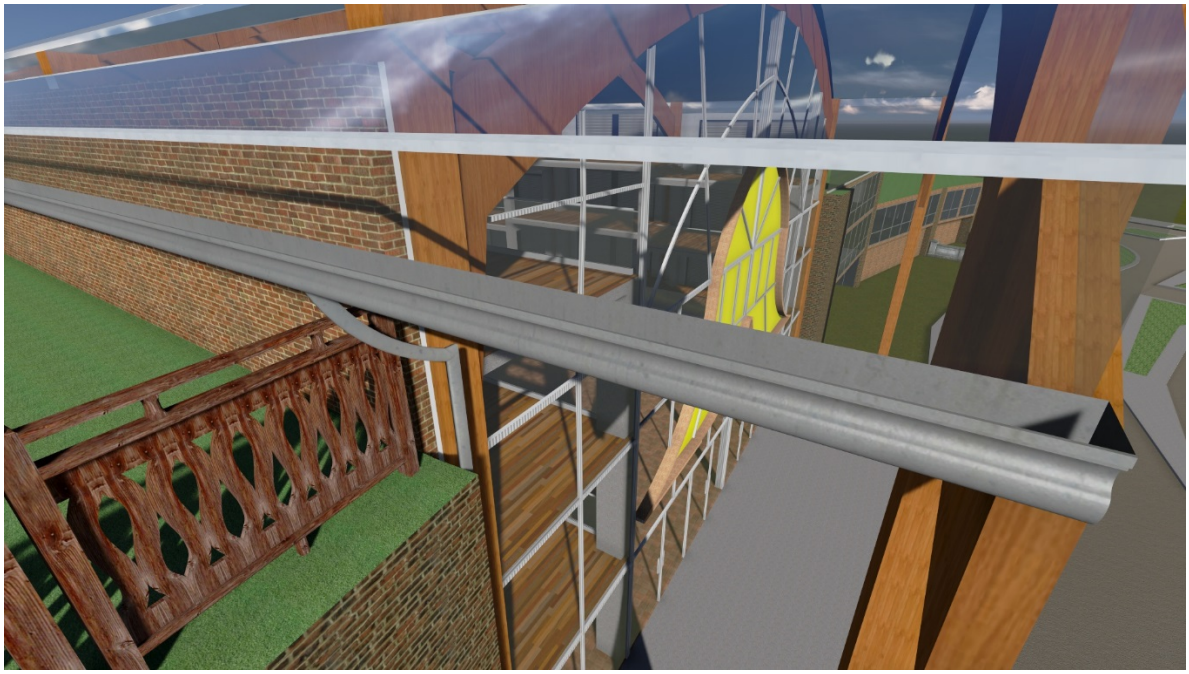


Figure 13 Rainwater Collection System

Appendix B- Cost Calculations

Description	Notes	Value		Unit
Section A	*(4338 sq.ft. /floor, 2 floors)*		8676	sqft
Base Cost	*College, Laboratory (smallest possible building)*		$303.50	/sqft
Perimeter Factor	*RS uses 470', actual 189' = diff of 281'*	-$	*10.75*	/ 100 LF
	Carried -----	-$	30.21	/sqft
Cladding	*Adjust from 75% brick 25% window wall to 25/75*	$	5.00	/sqft
Unit Cost			$278.29	/sqft
Total	= 8676 * 283.29		$2,414,000.00	
Section B	*(4551 sq.ft./floor, 2 floors)*		9102	sqft
(AS LAB)	*Section to be 50% lab space, 50% classroom space*			
Base Cost	*College, Laboratory (smallest possible building)*		$303.50	/sqft
Perimeter Factor	*RS uses 470', actual 115' => diff of 355'*	-$	*10.75*	/100 LF
	Carried -----	-$	38.16	/sqft
Cladding		$	5.00	/sqft
Unit Cost		$	270.34	/sqft
Total	= 9102 * 275.34	$	2,461,000.00	
(AS OFFICE)				
Base Cost	*College, Classroom*	$	225.95	/sqft
Perimeter Factor	*RS uses 350, actual 115 => diff of 235*	-$	*9.20*	/ 100 LF
	Carried -----	-$	21.62	/sqft
Cladding		$	5.00	/sqft
Unit Cost		$	209.33	
Total	= 9102 * 209.33	$	1,905,000.00	
Average	= (2.461M + 1.905M) / 2	$	2,183,000.00	
Section C	(4236 sqft/floor, 3 floors)		12708	sqft
Base Cost	*College, Classroom*	$	225.95	/sqft
Perimeter Factor	RS uses 350, actual 192 => diff of 158'	-$	9.20	/100 LF
	Carried -----	-$	14.54	/sqft
Cladding		$	5.00	/sqft
Unit Cost		$	216.41	/sqft
Total	= 12,708 * 216.41	$	2,750,000.00	
Section D & E	*(3730 + 4306 sqft/floor, 3 floors excluding bistro)*		24108	sqft

Base Cost	*Office Space, 2-4 Story*	$	181.10	/sqft
Cladding	*remove existing exterior costs from RS Means*	-$	27.23	/sqft
	add 100% window wall @ $32/interior sqft + fees	$	42.24	/sqft
Unit Cost		$	196.11	/sqft
Total	= 24,108 * 196.11	$	4,728,000.00	
Restaurant	(4305 sqft)		4305	sqft
Base Cost	*Restaurant, wood siding*	$	209.15	/sqft
Perimeter Factor	RS Uses 300, actual 180 => diff of 120	-$	11.05	/100 LF
	Carried -----	-$	13.26	/sqft
Cladding	Increase percentage of windows	$	5.00	/sqft
Unit Cost		$	200.89	
Total	= 4305 * 200.89	$	865,000.00	
U/G Parking	*Footprint 26,400 sqft, 2 levels, less cistern below bistro*		44200	sqft
Base Cost	*Garage, Underground*	$	97.65	/sqft
Perimeter Factor	*RS Uses 800, actual 870 => diff of 70*	$	4.06	/sqft
Unit Cost		$	101.71	/sqft
Total	= 44200 * 101.71	$	4,496,000.00	
# stalls	*= 44200 / 325*		136	stall
Cost / spot	= 4,496 M / 136	$	33,058.82	/ stall
Atrium	*Solid Window wall, average height 40'*			
Perimeter			292	ft
Roof Area			5255	sqft
Window Wall		$	21.25	/sqft
Glass Roof		$	42.50	/sqft
Total	= 292*40*21.25 + 5255*42.50	$	472,000.00	
Greenhouse	*Total area 5812 sqft*		5812	sqft
Base Cost	*Greenhouse, comm. truss, over 5000sqft, "economy"*	$	16.05	/sqft
Total	= 5812 * 16.05	$	93,000.00	
SUB TOTAL		$	18,001,000.00	
Location Index	*Vancouver*		1.11	
TOTAL	***Complectenium Building Cost***	**$**	**19,981,000.00**	
Path Improvements				
Lighting	*300 lights required*		300	units
Base Cost	*20' alum, 1 arm, installed*	$	2,325.00	each
Bollard	*use 3' bollard instead*	-$	800.00	each
Unit Cost		$	1,525.00	each

Subtotal	= 330 - 1525	$	458,000.00	
Paving	*6' path, 2km (6562')*		6562	feet
Base Cost	*Use 1/5 of Basic Roadway Paving 30'*	$	33.20	/ LF
Subtotal		$	218,000.00	
Location Index			1.11	
TOTAL	***Total Path Improvement***	**$**	**750,000.00**	
West Side Paving	*Repave W side for maint. yard and overflow pkg*		61376	sqft
Base Cost	*Basic Paving cost*	$	5.53	/sqft
Green pavement	*Markup for "green" pavement*	$	3.32	/sqft
Unit Cost		$	8.85	/sqft
Prefab Building	*Friends warmup hut, maint. yard office etc. (2)*	$	15,000.00	each
Modular Grnhouse	*FOG small greenhouse replacement*	$	10,000.00	each
Subtotal		$	583,382.19	
Location Index			1.11	
TOTAL	**West Side Redevelopment**	**$**	**648,000.00**	