

UNIVERSITY OF TORONTO MISSISSAUGA
FACILITIES MANAGEMENT & PLANNING

**Project Planning Report for a Biology Greenhouse
at the University of Toronto Mississauga**

October 31, 2013

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Project Planning Report for a Biology Greenhouse

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I. Executive Summary

UTM currently has 169 nasm dedicated to a greenhouse at the rooftop level of the Davis Building. The facility is an important support to both research and teaching. . Areas of researcher that rely upon this facility include: climate change; plant ecology; plant molecular systematics; plant taxonomy; molecular genetics; genomics and bioinformatics; and, insect neuroendocrinology. Undergraduate laboratories using plant material supplied and maintained by the existing greenhouse are associated with many courses within the major and specialist programs in Biology. The greenhouse is managed by a full-time horticulturalist and operated with part-time staff and undergraduate volunteers.

The greenhouse is over 40 years old, and is plagued by operational problems that increasingly render it unreliable. While recent investments in control, monitoring and operational systems have been made, such measures are seen as stop-gap until a new facility can be built. This is particularly important in terms of the role the greenhouse plays in supporting increasingly sophisticated research needs of faculty and the associated activity of both graduate and undergraduate students.

Re-building the existing greenhouse on site has been considered and is not deemed an acceptable option. First, the greenhouse would have to be taken out of service during the re-construction, thereby impacting both ongoing research and the supply of teaching materials. Second, re-building such a facility in the current rooftop location would be prohibitively expensive compared to a free-standing structure. Finally, the current location would not permit any significant increase in overall size to accommodate the increased needs already being experienced, let alone provide for future growth. As noted by the Biology Ad hoc Committee on the UTM Greenhouse, “the current greenhouse provides an important and necessary function in the Biology Department in maintaining plant material for teaching and for research needs”. However, due to the age and limiting design, a new modern facility is urgently needed.

The proposed project includes the construction of a header house (containing support areas, incoming and distribution of services to the rest of the structure) and the first of potentially four glass houses, each of which is further divided into six separately controlled areas. Services will be sized to support future expansion, which will be undertaken as separate projects and as funding becomes available. Priority is being accorded to research support because of the more demanding requirements of activities that must be done on a scale beyond what can reasonable be accommodated in bio-chamber facilities. The existing greenhouse will continue to be used for the provision and maintenance of teaching materials that will eventually be accommodated in future expansion phases.

The proposed greenhouse will be funded by Capital Reserves from the UTM Operating Budget. Provision has been made in UTM’s Operating Budget to cover annual operating costs of between \$140,000 to \$153,600. Plans will be developed to recover a portion of those costs, where appropriate, from individual researchers. It is expected that the project will take approximately 18 months to complete, subject to receiving the necessary environmental and building approvals from local and provincial authorities. Preliminary work on an environmental sensitivity analysis, including species at risk, is currently underway in anticipation of local permit and provincial approval requirements.

II. Project Background

a) Membership

Bryan Stewart, VP Research, UTM
Angela B. Lange, (Chair) Professor & Director of Research, Department of Biology, UTM
Marc Johnson, Assistant Professor, Department of Biology, UTM
Ingo Ensminger, Assistant Professor, Department of Biology, UTM
Peter Kotanen, Associate Professor, Department of Biology, UTM
Christoph Richter, Lecturer, Department of Biology, UTM
Tim Duvall, Assistant Professor, Department of Geography, UTM
Maria Codispoti, Manager Design and Construction, (FM&P UTM)
Stepanka Elias, Assistant Director Planning Design and Construction (FM&P UTM)
William Yasui, Senior Facilities Planner, (FM&P UTM)

b) Terms of Reference

1. Define the present and future needs for a research greenhouse at UTM.
2. Outline operational implication of a research greenhouse (utilities, maintenance, staffing, etc.).
3. Determine a functional layout of the space required for a modular research greenhouse structure.
4. Determine any secondary effects to the project and related resource implications of these effects.
5. Identify all equipment and moveable furnishings necessary to the project and their related costs.
6. Determine a total project cost (TPC) estimate for the capital project, including costs associated with secondary effects and infrastructure.
7. Identify all sources of funding for the capital project and any increased operating costs once the project is complete.
8. Report by October 15, 2013.

c) Background Information

UTM currently has a 169 nasm rooftop greenhouse above the research wing of the Davis Building. The greenhouse is an essential support to UTM's Biology Department, providing a wide variety of plant specimens used in both research and undergraduate teaching. Researchers that rely on this facility specialize in areas such as: climate change; plant ecology; plant molecular systematics; plant taxonomy; molecular genetics; genomics and bioinformatics; and insect neuroendocrinology. While some research activity is conducted in bio-chambers located elsewhere in the Davis Building, a significant amount of increasingly sophisticated research requires access to greenhouse-scale space. The greenhouse is managed by a full-time horticulturalist and operating with the support of part-time staff and undergraduate volunteers.

Now over 40 years old, the greenhouse is plagued by control system and mechanical breakdowns and can no longer be considered sufficiently reliable to support much of the research activity that is housed there. Continued, ad-hoc investments in repairs and upgrading have enabled the greenhouse to continue in operation, primarily in the role of support to teaching activity. Increasingly, it is not able to support the demands of important research activity. Researchers have had to: (i) not conduct certain types of experiments that they would otherwise do; (ii) conduct experiments only in the summer months; (iii) conduct small-scale experiments in environmental chambers; and (iv) over-rely on collaborative arrangements with colleagues at other institutions that have adequate growth space.

As noted by the Biology Ad hoc Committee on the current UTM Greenhouse, “the current greenhouse provides an important and necessary function in the Biology Department in maintaining plant material for teaching and for research needs not requiring environments rigorously controlled for pests, temperature, and lightning”. Due to the age of this facility it is impossible to rely on the conditions within the current greenhouse and to also work in a pest free environment.

Over the past five years, UTM has recruited six plant-oriented biologists and geographers, significantly enhancing strength in plant biology. It has also resulted in increased pressure for improved infrastructure support to their research with a focus on greenhouse functionality. That pressure will continue with additional recruitments: one now underway in Biology for a developmental biologist and an anticipated search for an environmental scientist in geography. It is expected that 14 faculty will make immediate use of the new facility, a significant increase in both the number of users and the breadth of research that will be conducted. In addition, it is expected that 25 to 35 graduate students per year would directly benefit from the greenhouse project and that 30 to 40 undergraduate students per year would receive direct training in plant biology research in the new facility.

The increased demand on greenhouse space, coupled with the decay of the present facility, combine to create a critical need for a new greenhouse, initially to support research activity. The new research greenhouse will ideally have the capacity and technical flexibility to meet research needs for the next 5 years (the period of the academic plan). Our vision for this facility requires it to be sufficiently modular so that further expansion could be facilitated in subsequent planning cycles to support both research and teaching needs. Maintenance efforts to the existing greenhouse will be directed toward ensuring a continued supply of teaching materials until such time as that activity can be decanted to an expanded greenhouse facility.

d) Statement of Academic Plan

It is expected that in the next century, biologists will be leaders in the use of discovery-based science to tackle some of the world’s greatest challenges, including climate change, food security, etc. To support progress in these and other areas related to plant biology and plant-animal interactions, a need to control and manipulate the environmental and growth parameters of our experimental organisms in a reproducible manner is of vital importance. The UTM Department of Biology is therefore engaged in a broad range of activities to enhance the existing and secure additional common or ‘core’ research facilities, including a Research Greenhouse. A *Research Greenhouse* is the first on Biology’s priority list of infrastructure needs in the current Academic Plan (2012-2017).

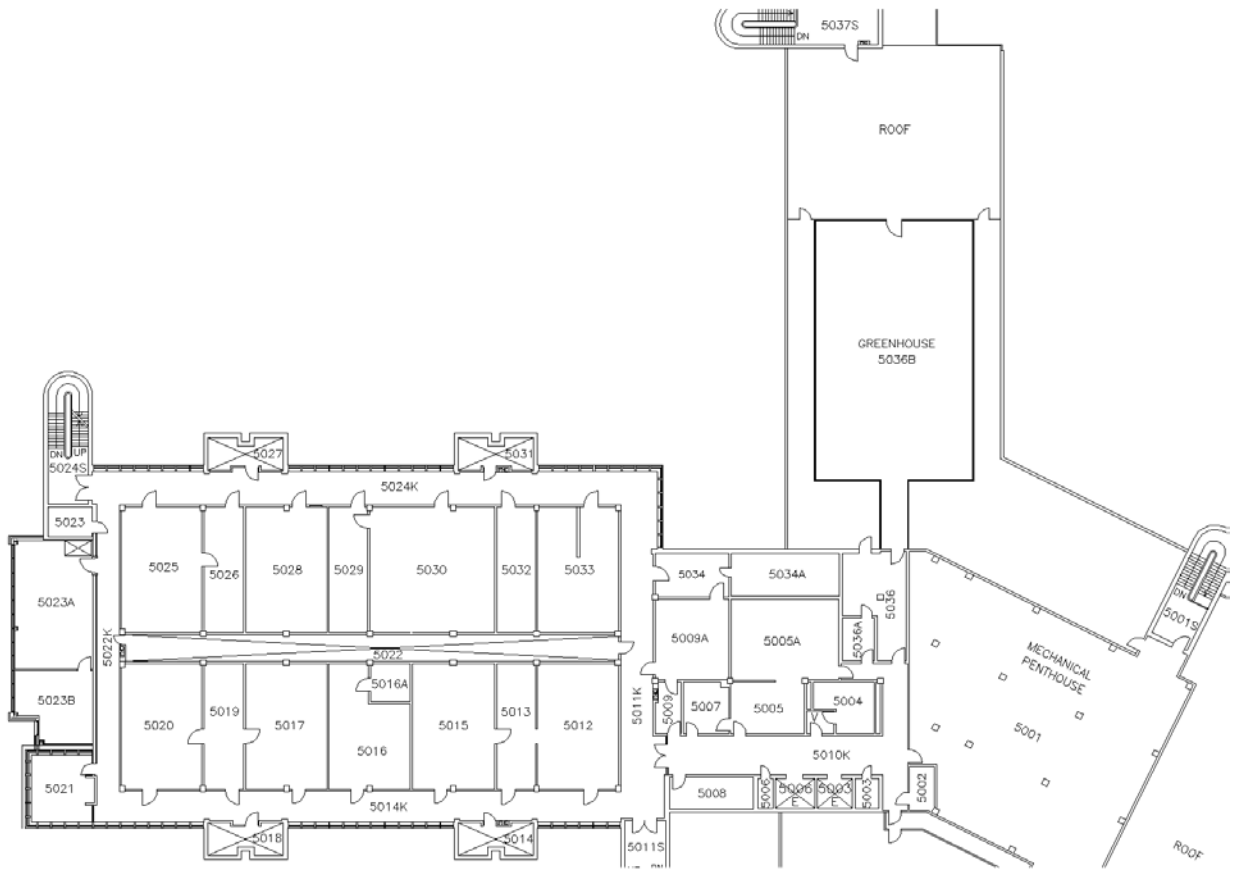
The Department of Biology has long had plant biology and plant-animal interactions as areas of strength among its research faculty; strength that has recently been bolstered by several tenure track hires in the departments of Biology and Geography, all of whom require access to greenhouse facilities for their research and teaching activity. These hires bring the total number who currently use or need access to a greenhouse for their research to twelve faculty members, with more anticipated. This growing intensity in plant research and its increasing sophistication, make it imperative that a new research greenhouse be made available to support current and future research needs. Investments are being made toward the overall research infrastructure to provide the environment needed to retain research faculty and to facilitate the recruitment of others. As noted above, this first phase of the greenhouse facility will support those plans for faculty and for research-related activities of graduate and undergraduate students.

As noted earlier, the new greenhouse will eventually be expanded to support the provision of teaching related materials. In the meantime and with the completion of the first phase of the greenhouse dedicated to research activity, all of the space within the existing greenhouse will be allocated to the support of teaching. Continuity in the supply of such materials is important. In recent years the Department of Biology has expanded significantly and is one of the largest disciplines on the UTM campus. In 2002/03 there were ~1600 FCE students in Biology courses and by 2009/10 there were almost 3200 FCE students. (*source: UTM Dean's Office*). The department likewise offers programs that are in high demand. In 2009/10 there were over 400 students enrolled in Biology Specialist Programs and over 800 in Biology Major programs. (*source: Department of Biology Self-Study 2010*).

e) Existing space:

The existing rooftop greenhouse is located on the 5th floor of the W.G. Davis building. The facility is original to the building (over 40 years old) and beyond its expected service life. As noted above, the greenhouse is increasingly difficult and expensive to maintain. Breakdowns and disruptions to control and mechanical systems are all too frequent, resulting in a facility with an unacceptable level of reliability to support research.

Furthermore, the existing greenhouse was designed as one large open space with common and limited temperature control. It is not an environment that can support increasingly sophisticated and differentiated research activity.



III. Project Description

a) Vision Statement

Plant biology in the Department of Biology at the University of Toronto Mississauga integrates research from genes to ecosystems. This research is heavily based on experimental approaches to address crucial questions such as the effects of climatic change on plant performance, biodiversity, plant-insect interaction, and adaptation to and mitigation of climatic change. For example, there is growing evidence that climate warming will not necessarily linearly extrapolate into a proportional lengthening of the growing season. A better understanding of interactions and feedbacks between vegetation and climate is a key target area of Canada's science and technology strategy ("Mobilizing Science and Technology to Canada's Advantage", Government of Canada, Ottawa, 2007). Ontario's Ministry of Natural Resources aims to develop the capability to assess the impacts of climate change on the province's ecosystems and natural resources (Climate Change and MNR: A Program-Level Strategy and Action Plan, 2007). The new greenhouse will provide a critical and timely contribution to our ability to influence federal and provincial evidence-based policies, because it will support process-based experimental research that will facilitate an understanding of adaptation and acclimation potential to climate change. A highly compartmentalized research greenhouse therefore creates a unique facility that generates vital national and international collaborations for the Department of Biology and UofT.

UTM researchers will be able to test plant performance under highly controlled conditions. Compartmentalization of the greenhouse will provide the means to replicate experiments and conduct simultaneous experiments simulating different growth conditions. This unique feature will also allow testing for species interactions under controlled conditions, e.g. plant-insect interactions in one compartment without hampering experiments in another compartment. The greenhouse is essential to expand the department's existing expertise in plant biology by adding the capacity for sophisticated experiments under highly controlled conditions to evaluate plant performance.

b) Space Program and Functional Plan

The proposed greenhouse will address the current and anticipated research needs and provide for future expansion to support teaching and research in four phases:

- Phase 1 (this project) will consist of the site development, a header house (providing support space, incoming/distribution of services and sized to accommodate future expansion) and construction of a single glass structure, subdivided into six-modular units.
- Phases 2, 3 and 4 (to be brought forward as separate projects as funding becomes available), will each include one six-modular greenhouse unit with a common corridor.

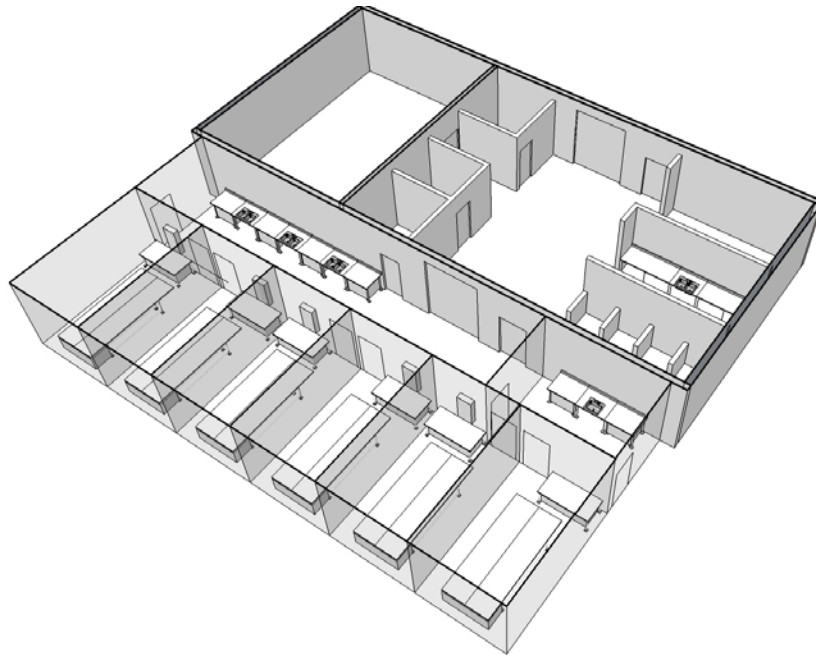
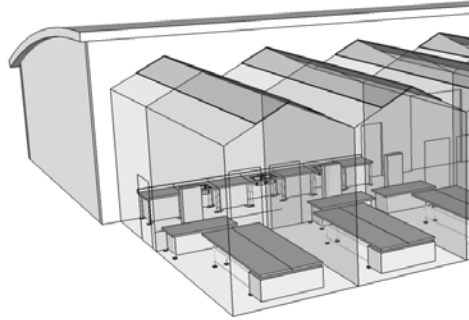
Description	Number	Area		Total	Total
GREENHOUSE		[sft]	[nasm]	[gsm]	[nasm]
Greenhouse (std)	4	240	22.3	89.2	89.2
Greenhouse (special)	2	240	22.3	44.6	44.6
Corridor	1	720	66.9	66.9	—
SUB-total				200.7	133.8

	Number	Area		Total	Total
HEADERHOUSE		[sft]	[nasm]	[gsm]	[nasm]
Office/Control Rm	1	100	9.3	9.3	9.3
Work area	1	220	20.4	20.4	20.4
Storage area	1	220	20.4	20.4	20.4
Receiving	1	680	63.2	63.2	63.2
Washroom	1	100	9.3	9.3	-
Utility (M&E)	1	850	79.0	79.0	-
Soil Clean up	1	220	20.4	20.4	20.4
Cooler	1	100	9.3	9.3	9.3
SUB-total				231.3	143.1

TOTAL				432.0	276.9
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The layout of the greenhouse will be such that it will allow for the future expansion and utilization of the header house for all phases.

Possible layout of the first phase of the project.



Greenhouse Structure: Header house + phase 1

c) **Building Considerations**

Building characteristics and massing:

The proposed site for the greenhouse is located on the University of Toronto Mississauga Campus, northwest of the intersection of Outer Circle Road and Principal's Road. The site is immediately adjacent to a variety of research-related activities including dragonfly and bat research, environmental impact research, a weather station; a fenced, seasonal, outdoor plant growth area and a forensic science burial zone. A number of other locations were considered and rejected because they: (i) presented the potential for significantly higher costs as a result of specific site conditions; (ii) conflicted with identified future building sites as outlined in the Campus Master Plan; or (iii) were not of sufficient size to accommodate the anticipated footprint of the final greenhouse build-out.

As noted above, the proposed development consists of one greenhouse module (201m² or 134 nasm) and a new header house (231m² or 143 nasm) for a total gross floor area of 432m².

Ultimately, it is expected that an additional 3 greenhouse modules (5201m² each) will be constructed on the site (Phases 2-4, which will be done as separate projects). The final development is expected to have a total gross floor area of 1,127m² and occupy an area of approximately 0.4ha.

Structural complexity and built form

The header house can be constructed as either a prefabricated steel building or a masonry structure with lightweight steel framing. Both construction types can accommodate a variety of exterior cladding, roof profiles, exterior openings, greenhouse connections, etc.

Key building components and systems:

Water services to the proposed greenhouse will be provided from existing water main located along Principal's Road.

A new sanitary sewer is being constructed from the Outer Circle Road along Principal's Road to service Lislehurst Residence, the Rock Laboratory, the Grounds Building, and the Artist cottage (now a Forensics Science Crime Scene House). The greenhouse project will tie into that new sanitary sewer line.

The storm water management strategy will mitigate the storm water impacts associated with the proposed greenhouse without adding water to the storm water ponds located on the South part of campus. This strategy includes construction of infiltration trenches to allow runoff from the greenhouse roofs to infiltrate into the soil. This plan takes into account the size of the proposed greenhouse, characteristics of native soil, and City of Mississauga and Ontario Building Code (OBC) regulations.

An underground concrete encased primary service duct bank for primary electrical cables will bring 600-900kW of regular power at a high voltage from Outer Circle Road to an exterior utility-owned pad mount transformer adjacent to the Greenhouse perimeter fence. An exterior diesel 150kVA generator will provide power to the standby panel located in the electrical room of the header house. Battery back-up to meet OBC requirements shall be provided for the fire alarm system. Lighting systems will be designed with energy efficiency in mind while providing environmental control of the

space required satisfying UTM research initiatives. The overall design strategy will include significant attention to features that will mitigate any ambient light to surrounding areas.

Accessibility

The University is committed to students' equitable access to all of the building's facilities. Accordingly, the project must anticipate more stringent legislation under the revised Building Code (2012).

Personal safety and security

The building design will allow students, faculty, staff and visitors approved access as required. The design will be sensitive to the needs of those whose activities require security after hours. Limited areas of this building will be operational throughout the week, 24 hours a day.

Building Access Systems

Card readers will be installed on the main entry doors and on different zones of the greenhouse to manage access, and protect experiments. Any electronic security system will need to have hard key override for use by police, emergency, maintenance and custodial staff.

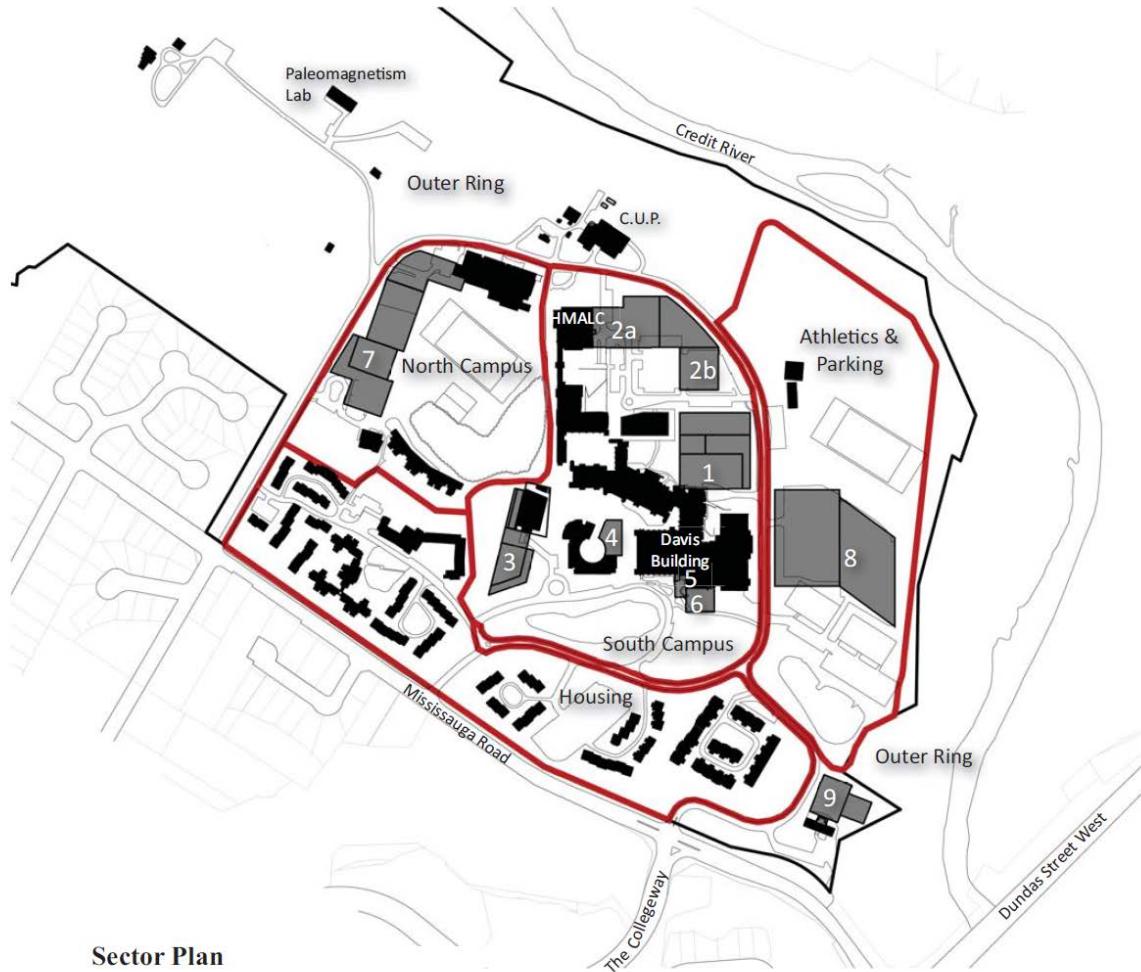
Non-public areas, for example, mechanical/electrical areas, custodial rooms and telecommunication closets, will require standard lock sets: Hard keys will conform to campus-approved Medeco standards. Servicing and Site Access (including garbage and recycling, deliveries)

A gravel driveway will provide access from Principal's Road and will wrap around the building. A loading dock and small parking area for service vehicles will be constructed as part of the project.

d) Site Considerations

Campus Planning:

Campus planning at UTM has evolved with enrolment growth and has been guided by key principles established in the Campus Master Plan of 2000, updated in 2011. Seven major buildings have been added to the inventory at UTM since 2000, and there are two others currently under construction; their siting and massing following the planning principles set out in the Master Plan.



Sector Plan

South Campus

- Site 1 Davis Building science expansion
- Site 2 Hazel McCallion Learning Centre (H.M.A.L.C.) expansion, and new building
- Site 3 Student Centre expansion, and new building
- Site 4 Kaneff Building expansion
- Site 5 Davis Building entry and tower addition
- Site 6 Davis Building student plaza expansion

North Campus

- Site 7 North Campus expansion

Athletics & Parking

- Site 8 Athletics and parking

Outer Ring

- Site 9 Alumni House
- Central Utilities Plant (CUP)
- Paleomagnetism Lab

Housing



Zoning regulations

The campus is identified by the Mississauga Zoning By-law 0225-2007 as Institutional. Further detail is provided under Part 12 of the By-law. The proposed site is well within minimum setbacks and other regulation lines on campus.

Although the Campus Master Plan does not include expansion of any academic, administrative, residential, or athletic facilities on the North Campus outside of the Outer Circle Road, as noted above, the area has been and will continue to be used to support formal and informal exterior research.

Landscape and open space

Landscaping surrounding the greenhouse will include a buffer zone and fencing to protect the glass structure of the proposed greenhouse. Surrounding the fenced area natural plant materials will be installed. Formal landscaping is neither appropriate nor planned: use of this area is limited to research-related activities.

Soil conditions:

Even though this site is at a relatively high point on the campus, high water tables have been found in nearby locations during the recent construction of buildings (e.g., the Instructional Centre) or other construction activities. It is possible that dewatering of the site will be required to control ground-source water during construction but given the slab-on-grade building, ongoing water management is not expected to be required.

e) Campus Infrastructure Considerations

Servicing and fire access:

As noted above, all services required to support the proposed greenhouse will be supplied from Principal's Road which will also act as the emergency access route

Environmental sensitivity:

Most of UTM's development areas lie within the Outer Circle Road (UTM Campus Master Plan 2011). One of the few exceptions are the outdoor research area(s). Numerous research and teaching programs have been taking place throughout the UTM campus for many years.

The area proposed to accommodate the research greenhouse used to be an old orchard, with most of existing growth consisting of lower bushes and invasive species. The proposal to locate the new greenhouse in this area has been endorsed by UTM's Grounds Monitoring Committee and discussed with local authorities, including the Credit Valley Conservation Authority. A study of "Species at Risk" for the entire area of the North Campus is in progress to confirm any sensitive areas, manage UTM's natural environment and prepare for anticipated local permit and provincial approval requirements. The report is expected to be complete by the end of 2013; no issues have been identified in the work undertaken to-date.

f) Secondary Effects

The proposed area is vacant, so there are no secondary effects.

g) Schedule

Project milestones are to be identified for:

- Governance approval– November 2013 to February 2014
- Consultant selection – March 2014

- Design development and contract drawings March – May 2014
- Tender and award June 2014
- Mobilization and construction July 2014 – June 2015
- Commissioning and moving July 2015
- Full operational occupancy by division August 2015

IV. Resource Implications

a) Total Project Cost Estimate

The total estimated cost for the project includes estimates or allowances for the following:

- Construction costs, assuming a construction management contract strategy starting in the Summer of 2014. Construction management style was selected because the project has several independent portions that should be managed separately.
- Contingencies (typical UTM)
- Taxes
- Hazardous waste removal & disposal costs for hazardous materials (an allowance for possible soil contamination during the use of the area as an orchard)
- Site service relocates (N/A)
- Infrastructure upgrades in the sector (significant portion of the project is the construction of new gas service, water service, sanitary sewer, data & phone lines, and electrical service)
- Secondary effects (N/A)
- Demolition (N/A)
- Landscaping (minimal due to the nature and location of the greenhouse facility)
- Permits and insurance (an allowance for permits and insurance based on experience working with local authorities)
- Professional fees, architect, engineer, greenhouse consultant, and project management
- Computer and telephone terminations
- Moving and staging, decommission of labs being vacated (allowance for moving existing research operation from the W.G. Davis building)
- Furniture and equipment (research equipment is outside of the scope of work of this project and will be provided by faculty using the space; the cost estimate includes basic set up for the greenhouse incl. benches, storage shelving, shovels, houses, etc.)
- Miscellaneous costs (allowance for signage, security, other)
- Commissioning
- Donor recognition
- Escalation
- Financing costs during design & construction (no financing required)

b) Operating Costs

It is understood that operating costs for a greenhouse can be significant, so estimates for energy costs, maintenance costs, labor costs, transportation costs were calculated.

Summary Projected Annual Operating Costs:

Sections 1: Energy Costs	\$ 26,000 +
Sections 2: Maintenance Costs	\$ 46,400 – \$ 60,000
Sections 3: Additional Costs	\$ 60,000
Sections 4: Transportation Costs	\$ 7,600
Sections 5: Other Costs	N/A
<hr/>	
	Total: \$ 140,000 – \$ 153,600+

c) Other Related Costs

None identified.

d) Funding Sources and Cash Flow Analysis

The Biology Greenhouse at the University of Toronto Mississauga comprising 134 nasm of a green house space and 143 nasm of header house space, to be funded from Capital Reserves derived from UTM's Operating Budget. Provision has been made in the Operating Budget to fund increased operating costs.

e) Ancillary Projects and Joint Venture Partnerships require Business Plans and Operating Agreements

None identified.

V. Recommendations

Be it Recommended to the Academic Board,

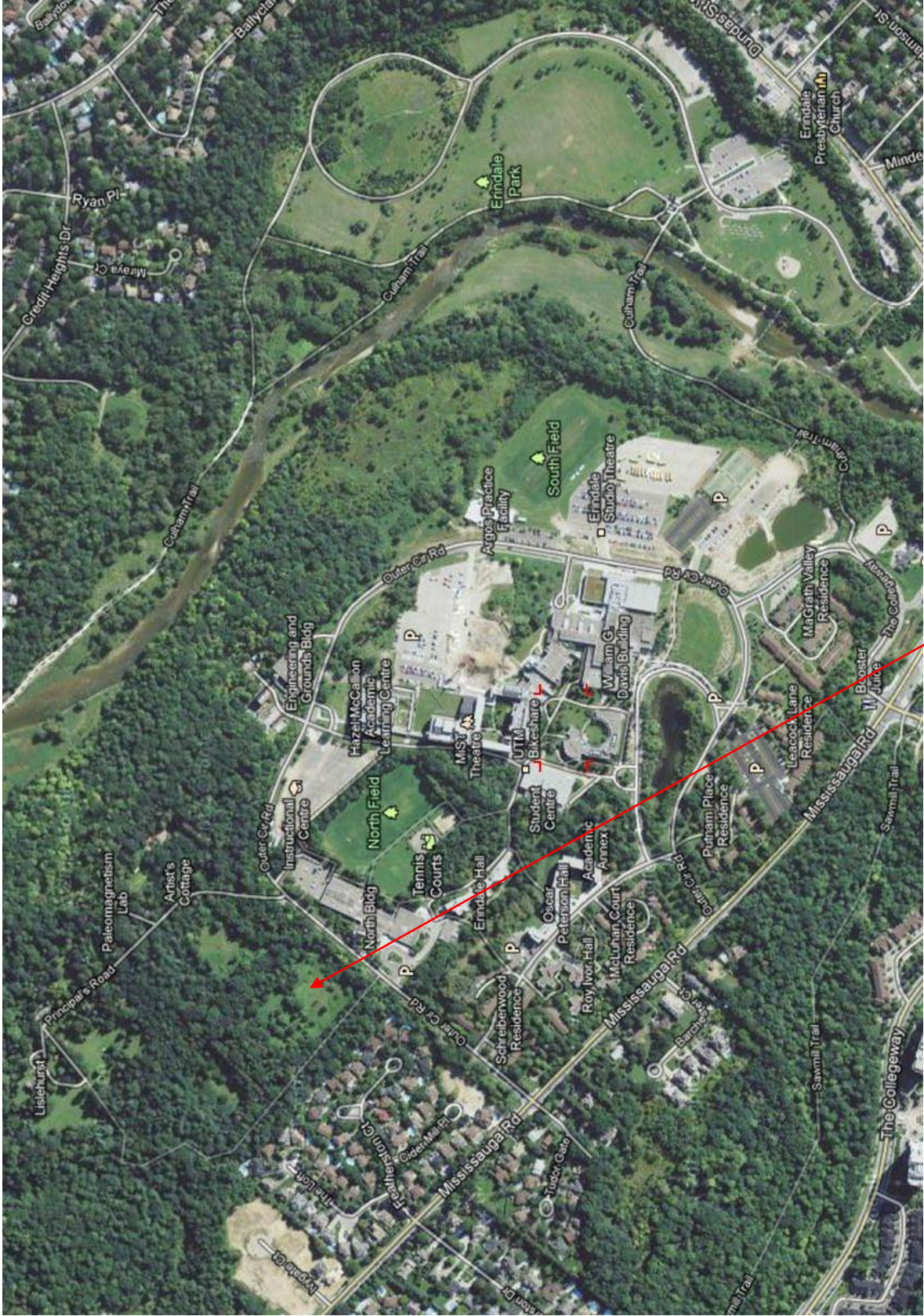
1. THAT the Project Planning Committee Report for the University of Toronto Mississauga Biology Greenhouse, dated October 31, 2013, be approved in principle; and
2. THAT the project scope to accommodate construction of the Biology Greenhouse at the University of Toronto Mississauga comprising 134 nasm of a green house space and 143 nasm of header house space, be approved in principle, to be funded from Capital Reserves derived from the UTM Operating Budget.

APPENDICES:

Appendix A: Aerial Campus Photo showing location of the proposed greenhouse

Appendix B: Total Project Cost Estimate (on request to limited distribution)

Appendix C: Operating Cost Estimate (on request to limited distribution)



Proposed greenhouse