Urban Green Space: Starting at the Top

A Green Roof Top Report, Feasibility Study & Current Campus Initiatives

Centennial Hall, North West Portion. Photographer: Patrick Carty (2016)

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History, Technology, & Benefits

Introduction

The purposes of this report are to create awareness of green rooftop technologies, provide examples of such technologies being used in Winnipeg and other areas, and discuss what the University of Winnipeg could do to implement green rooftop technology. The report will also touch on the importance of green space in general, and will briefly include a description of other projects that are currently in progress involving green space usage at the university.

The importance of this report in relation to sustainability at the University of Winnipeg involves a number of points: LEED certification of the main campus, the university's overall STARS certification, and the general goals listed in the university's sustainability policy. Ultimately, this report/ feasibility study should provide the foreground to future consideration of implementing green rooftops at the University of Winnipeg, as it continues to be an institutional leader in campus sustainability.

Primary Methods & Information Sources

This report has been derived primarily from a literature review, as well as consultation with local experts and fellow students. Information sources include: multiple studies done in other cities and universities; other green rooftop technology websites; information derived from Xeroflor Canada (a green rooftop manufacturer); consultation with Kyle MacDonald (Building Systems Manager, U of W); the University of Winnipeg's sustainability strategy; and on going discussion with classmates (ENV-4614), Dr. Alan Diduck (course instructor for ENV-4614), and Alana Lajoie-O'Malley and Alexander R. Wieb of the Campus Sustainability Office (U of W). The information sources are included in the work cited at the end of the report, and the personal consultations and discussions are noted in the acknowledgements.

A Brief History of Green Roof Tops

Green roof tops are not new to the world, and have been cultivated throughout history for a variety of purposes. History shows that they were first implemented in ancient Babylon, in the 7th century (Kaluvakolanu et al. 2006). Historians believe they were more like hanging gardens than the traditional green roof tops we see today, and they usually included a vast amount of diverse vegetation. The sheer beauty of the Hanging Gardens of Babylon has led historians to believe that the purpose for them was largely for aesthetic value, as they were one of the seven wonders of the world, although spice gardens were a large part of them (Dinsdale et al. 2006).

There is substantial evidence for beautiful green roofs and hanging gardens throughout ancient Rome and Italy, however the modern roof top came to be in Iceland and Scandinavia long ago. Due to a cold climate much like ours, and a lack of resources, homes were built largely out of peat sod, branches, and twigs. There was similar construction in the 19th century by European settlers in Canada who relied on freely available local materials. These dwellings laid the groundwork for the modern green rooftop, as they were well insulated because of the vegetation layers.

As far as the 20th century goes, at first large green roof tops were few and far between, as there was fear of structural damage, and a high cost of implementation (Dinsdale et al. 2006). Some of the isolated (but impressive) examples include the Casino Patio in Bern, Switzerland, built in 1936, and Derry and Toms department store built in the 1930's in London, UK (Dinsdale et al. 2006). New technologies started becoming available in the 1970's, but until then buildings with flat roof tops were simply not built with a high structural load capacity. Since then, green roof tops have taken off in Europe. Largely due to incentives, Germany has been a forerunner in green infrastructure, making them a world leader. Green roof tops are now built into the majority of new buildings in the country. As for North America, things are slowly taking hold, and green infrastructure is growing. The Ford River Rouge plant, for example, has roughly 10.5 acres of green roof tops, providing insulation for the building and habitat for birds and insects. Ford had the largest green roof top in the world in 2004, and just over 10 years later the extensive type of rooftop they used has become the most common green rooftop technology.

Available Technologies

There are two categories of green roof tops: intensive and extensive. From there, the extensive type forms two sub categories, being modular and pre cultivated vegetation blankets.

Intensive green roof tops are generally characterized by their large variety of vegetation types, including shrubs and trees. Because of this diverse makeup, the soil depth is generally much deeper than an extensive type, and starts at around 6 inches. Intensive rooftops need a large structural load capacity, as greater soil depth and larger vegetation equates to more weight. These types of roof tops require more maintenance relative to extensive types and varying amounts of irrigation depending on the vegetation used. The problems intensive roof tops present are that they cost more per square foot, are more difficult to maintain, and the building must have the structural capacity to support them. The benefits however, are numerous. Intensive green roof tops provide a much greater capacity for carbon sequestration, water retainment, habitat preservation, building insulation, energy conservation, and heat island reduction. They also have large aesthetic value, adding to the health and mental well-being of urban citizens.

Extensive green roof tops tend to have fewer vegetation types than intensive rooftops, largely due to having shallower soil depth. Extensive roof top systems are grown off site and then installed on existing buildings. Their main disadvantage relative to intensive systems is that they offer fewer benefits because they have less biomass. The main advantages of the extensive type of roof top is its lower cost and weight. Because of the reduced soil depth and vegetation types, extensive roof tops weigh a lot less per square foot. This also means they cost a lot less per square foot. The maintenance required is also considerably lower, as extensive roofs usually contain drought resistant vegetation types. Extensive roof tops are usually applied to existing buildings because the structural load capacity requirements are lower compared to the intensive types. For these reasons, extensive technologies have made green roof tops more feasible than they have been in the past.

Subcategories

Modular: These are grid-like systems, grown in a medium off site. Modular systems are grown in trays so they can be arranged in different grids with varying types of vegetation. A modular system is an extensive system because of the ability to grow the vegetation off site, however this system can combine the benefits from both intensive and extensive systems. Generally, soil depths range from 75mm - 300mm (more than vegetation blankets), which allows more vegetation diversity. They are still much lighter than intensive roof tops, and therefore are more cost effective, require a lesser load, and less maintenance.

Pre-cultivated vegetation blankets: These systems are exactly what they sound like: blankets of vegetation that are grown in a medium off site, then implemented on existing buildings. They have layers consisting of a roof membrane, water proofing layer, drainage layer, water retention fabric, growing medium, and finally a layer of vegetation. The vegetation can be a combination of types of sedum and drought resistant grasses. They can literally be rolled up, transported, and then unrolled onto roof tops, and therefore are easy to install. Once installed, they require little maintenance and irrigation. This type of system costs and weighs less than modular systems, ranging from $6-$12 per square foot for materials (Xero Flor Quotation Guidelines, 2010), and weighing as little as 2 pounds per square foot, fully saturated.

Primary Benefits

Storm Water Management: Urban landscapes are dominated by impervious structures such as concrete roof tops, roads, and so on. In the case of stormwater management, green rooftops can increase a building's ability to retain and filter water. The more soil depth and vegetation diversity a roof has, the higher amount of water it will be able to retain and filter. Generally, green roofs can retain 60-100% of the storm water they receive, and this is significant in cities with combined sewage overflow systems, such as Winnipeg. Due to this water retention, there could be a significant reduction in storm water overflows and sewage discharges into fresh water systems. In New York, which also uses a combined sewage overflow system, it is estimated that only 60% of rainfall is collected and treated annually (Rosenzweig et al. 2006). This lack of water treatment ultimately leads to water quality issues. If these water quality challenges could be mitigated by roof top water retention, cities would ultimately save time, money, and water filtration resources. As well as retention, filtration is a positive result of green roof tops. Vegetation and soil can filter out contaminants and break down toxic substances. Urban runoff can often include suspended solids, heavy meals, chlorides, oils and grease.

Air Pollution & GHGs: Studies have shown that green space can help mitigate the negative effects of air pollution, such as particulate matter. There is an urban forestry study that shows 2000m^2 of uncut grass on a roof could remove 4000 kg of particulates from the air (Banting et al. 2005). Greenhouse gases (GHGs) can also be eliminated through carbon sequestration by green roofs and other forms of urban green space. A green roof can also help provide fresh air for a building's inhabitants. An example is the the Manitoba Hydro building, which provides 100% fresh air for Hydro's employees in the building, doors, due in part to the the buildings large amounts of green space.

Energy Conservation: It is hard to give specific numbers for how much energy can be saved with a green roof top, as many factors come into play. That being said, it is clear that green rooftops can provide a general cooling effect of the surrounding air, due to plant respiration, which can reduce overall cooling costs in summer months. In winter months, the vegetation will increase a building's insulation value, leading to reduced heating costs. One study showed standard green roof tops can provide up to a 15% reduction in overall cooling (Banting et al. 2005).

Heat Island Reductions: This category ties in with the previous one, however the urban heat island is generally applied on a larger scale, such as cities as a whole. The more green space, the more overall cooling cities can enjoy because green space tends to increase an urban area's albedo value. Surface albedo has a significant effect on ground temperature, therefore urban green space is important. Vegetation can also provide cooling through the evaporative effect plant transpiration produces.

Green Space Amenity: Often underrated, this category of benefits is very important in the discussion of green rooftops and green space in general. The psychological impact green space has on humans is notable, especially in urban areas. It has been theorized that having a strong connection with nature may be just as important as having interpersonal relationships, and being alienated from nature is a contributing factor in heightened stress levels (Banting et al. 2005). Generally, most urban buildings are in busy areas where access to green space does not come easily, therefore green roof tops could provide psychological benefits to the urban residents. Studies show that having a view of a green roof top in urban areas can not only provide stress reduction and calming effects for workers, it can also increase concentration and work ethic (Banting et al. 2005). Green roof tops also provide a higher aesthetic value for a building, and can in turn increase property values.

Habitat: Green roof tops can provide elevated habitats for insects, birds, and other small creatures, keeping them away from ground predators, traffic, and noise pollution. For example, the Ford Big River Rouge plant, which had the largest green roof as of 2004, provides 10.5 acres of elevated habitat for a diverse amount of birds and insects.

Urban Agriculture: Green roof tops can also be utilized for food production. This can be a time and money saver for restaurants. People are eating local more and more, and food produced in the very building where you are eating truly embodies the seed to table notion. The urbanization of food production is a growing issue in sustainability, as there are limited sources of fresh local food in many downtown city centres. The University of Winnipeg could be an accessible location for downtown residents when it comes to community food production, and this could provide learning experiences for employees, students, and the general public.

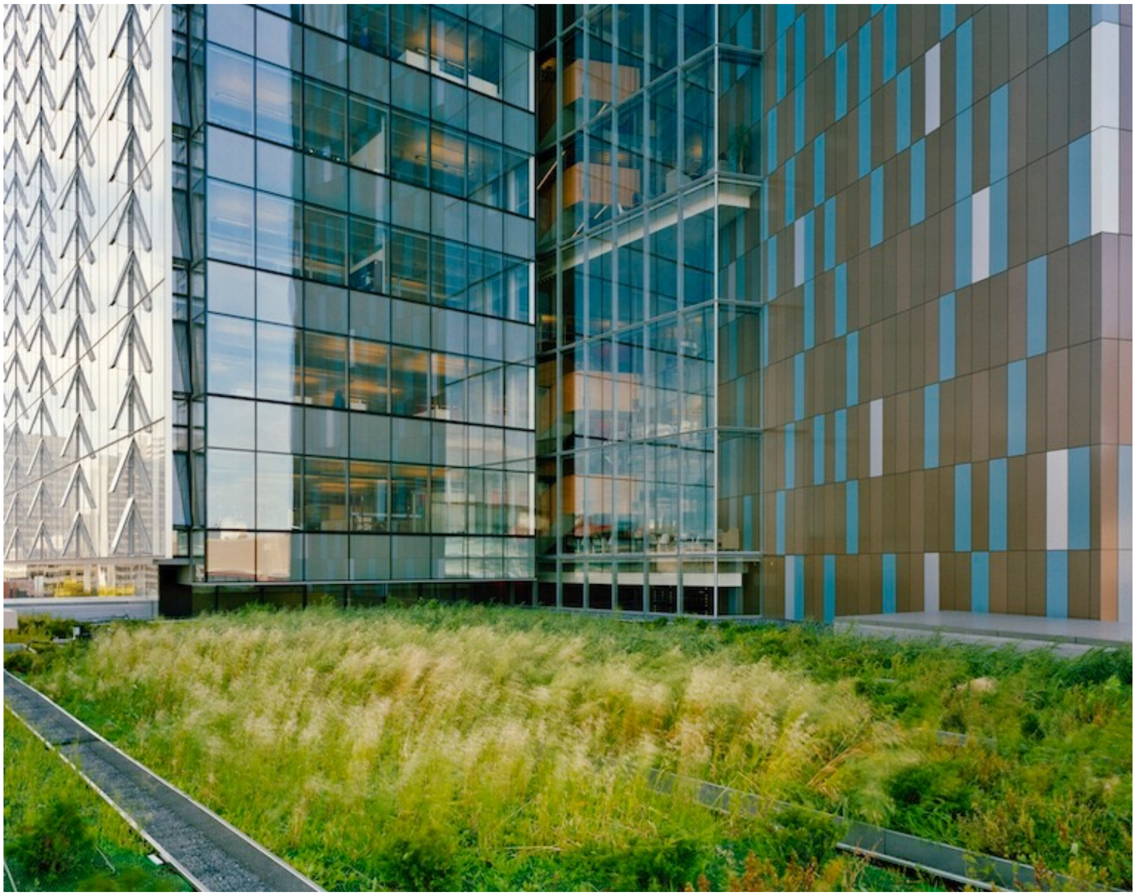
Secondary Benefits

Noise Reduction: For buildings in densely populated areas, noise is a factor that can reduce individual and community wellbeing. The insulation provided by green rooftops can not only reduce heating/cooling costs, but also provide a barrier to the noises of the outside world for the people inside the building.

Roof Membrane Life: Green roof tops can extend the life of a roof membrane by a factor of 2-3. A New York study suggested that a typical roof will have a life span of about 20 years, and following the same model other studies suggest, these researchers believe green roof tops have a life span from 40-60 years (Rosenzweig, et al 2006).

Current Examples

Manitoba Hydro: The Manitoba Hydro building (as pictured below) is essentially like a living machine. All aspects of the building work together to create a sustainable, efficient, and effective work space for employees. One such aspect are the green roof tops, which cover most of the lower roofs. They provide many of the same benefits listed above, including mitigation of the urban heat island effect that is so prevalent in the city centre, where this building is found. The roof tops use indigenous, drought resistant vegetation in a modular system creating little need for maintenance and irrigation (Manitoba Hydro 2009). In addition, from an ariel perspective, the pattern of the roof tops shows an abstract view of Manitoba's southern landscape. Like the entire building, every detail seems to have been considered when implementing the green roof tops, including sun and wind exposure. The roof tops are irrigated using water from the building's cisterns, and if there was ever a drought, they can use water from the condensation that is inevitably collected in the building's fans over the summer months. The trees on the inside of the building provide air filtration, and of course an aesthetic value. Employees in this building have an excellent view of green space while they work. Ultimately, this building is a fantastic and futuristic example of sustainability-related systems that could be implemented at the University of Winnipeg.



North façade green roof (Manitoba Hydro 2009) Photographer: Eduard Hueber

Ford River Rouge Plant: The Ford River Rouge Plant (pictured below) is an excellent example of the pre-cultivated vegetation blankets at work. It is North America's largest green roof top, and provides habitat for birds and insects year round. The building is covered in roughly 454,000 square feet of different types of sedum and vegetation. The company they used is called Xero Flor, and they are a front runner in this type of extensive technology. Birds come to nest at both the Ford River Rouge Plant, and the Manitoba Hydro Building, proving that an elevated habitat is an effective way to mitigate the dangers to birds and insects that urban areas present.

Ford River Rouge Plant. Source: Xeroflor Canada Projects Portfolio

A bird nesting on the Ford River Rouge Plant green roof top. Source: Xeroflor Canada Projects Portfolio

University of Winnipeg Feasibility Study

Introduction

The purpose of this portion of the report is to provide evidence of the feasibility of implementing green roof tops at the University of Winnipeg and offer insight into how doing so would affect implementation of the university's sustainability policy. First, implementing green roof tops can help the university acquire points for LEED certification of main campus buildings and for improving our current STARS rating. Further, the University has made a commitment to reduce its contribution of GHGs and its overall energy use, as outlined in its sustainability strategy (University of Winnipeg 2012). Green roof tops could help achieve these goals. They could also supply the campus with learning opportunities on topics such as campus sustainability, building efficiency, storm water management, horticulture therapy, plant biology, and urban agriculture, and offering such opportunities are in direct compliance with goals outlined in the sustainability strategy (University of Winnipeg 2012).

Contribution to LEED Certification

Green rooftops can contribute to LEED certification points and there are various ways one can earn points. What follows is a credit list taken from the consulting, architectural, and engineering firm Green Roof Technology: Form and Function - **www.greenrooftechnology.com/leed/leed_Greenroofs**. This information is from the U.S. Green Building Council. The potential credits relating to a green rooftop substantiate the benefits listed above. More research will need to be done as to whether or not these credits can be directly attributed to existing buildings on campus.

> **How Green Roofs can Contribute to LEED® Certification**
>
> The wide variety of benefits associated with green roofs is captured in various ways in the U.S. Green Building Council's LEED rating system. While every green roof project is unique, and the extent to which a green roof on any building can help earn credits varies, this guide offers all available credits in achieving LEED-certification with a green roof.
>
> **Sustainable Sites**
>
> *SS Credit 5.1* – Site Development – Protect or Restore Habitat (1 point)

Projects earning SS Credit 2 (Development Density and Community Connectivity) may include vegetated roof surface in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity. Once established, native/adapted plants require minimal or no irrigation; do not require active maintenance such as mowing or chemical inputs such as fertilizers, pesticides or herbicides; and provide habitat value and promote biodiversity through avoidance of monoculture plantings.

SS Credit 5.2 – Site Development – Maximize Open Space (1 point)
Projects in urban areas earning SS Credit 2, vegetated roofs can contribute to credit compliance.

SS Credit 6.1 – Storm Water Design: Quantity Control (1 point)
Specify vegetated roofs, pervious paving and other measures to minimize impervious surfaces.

SS Credit 7.2 – Heat Island Effect: Roof (1 point)
Use alternative surfaces (e.g., vegetated roofs, pervious pavement, grid pavers) and nonstructural techniques (e.g., rain gardens, vegetated swales, disconnection of imperviousness, rainwater recycling) to reduce imperviousness and promote infiltration and thereby reduce pollutant loadings.

SS Credit 7.2 – Heat Island Effect: Roof (1 point)
Install a vegetated roof for at least 50% of the roof or Install high albedo and vegetated roof in combination (Area of SRI roof/0.75) + (Area of Veg Roof/0.50) ≥ Total Roof Area

Water Efficiency

WE Credit 1 –Water Efficient Landscaping (Potential: 2-4 Points)
If this credit is pursued, be sure to design the green roof system without permanent irrigation, or if irrigation is necessary, minimize potable consumption with drip irrigation and/or irrigation with reclaimed water.
Option 1: 2 points for reducing potable water for irrigation by 50%
Option 2: 4 points for no potable water use for irrigation. Temporary irrigation systems for plant establishment acceptable if removed within 1 year to 18 months of installation.

If the percent reduction of potable water is 100% and the percent reduction of total water is equal to or greater than 50%, both Option 1 and Option 2 are earned.

Energy and Optimization

EA Prerequisite 2: Minimum Energy Performance (Required)
Establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use.

EA Credit 1 – Optimize Energy Performance (Potential: Up to 19 Points)
Vegetated roofs can aid in the reduction of the energy demand for the project. Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating.

Materials and Resources

MR Credit 3 – Material Reuse (Potential: 1-2 Points)
Reuse building materials and products to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources.
The sum of reused materials must constitute at least 5% or 10%, based on cost, of the total value of materials on the project.

MR Credit 4 – Recycled Content (Potential: 1-2 Points)
Components like, pavers, edge treatments, and growth media components (compost) are from both pre-consumer and post-consumer materials.
Contributes towards having 10% to 20% of the total value of project materials originating from recycled material
The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

MR Credit 5.1 – Regional Material (Potential: 1-2 points)
10% or 20% of product, depending on the overall percent of materials

extracted, must be manufactured and assembled within 500 miles.

STARS Certification

The University of Winnipeg currently has a silver rating when it comes to the STARS (Sustainability Tracking, Assessment & Rating System) program. STARS is a way of determining how sustainable a university campus is by way of a point system, much like LEED. It, however, relates to all aspects of campus operations and not just building construction and renovation. Implementing green roof tops is another way the University of Winnipeg could boost its rating with STARS, when the institute applies again in 2018 (every 3 years). This information was derived from the STARS forthcoming technical manual (version 2.1 2016).

A green rooftop could gain potential credits in all of the following operations categories:

OP1: Green House Gas Emissions (Current Rating 6.42/10.0)

The University of Winnipeg, after going through the extensive 2009 energy retrofit for main campus buildings, has greatly reduced GHG emissions campus wide. The university has succeeded in reducing emissions below 1990 levels (University of Winnipeg 2012) but still fails to adhere to some categories in the STARS system.Currently, the university does not provide any real carbon sequestration systems. As outlined in the benefits at the beginning of this report, green rooftops can be an effective tool in the mitigation of green house gases, and ultimately the sequestration of carbon. This could be a way to gain more points in this category, which is one of the most important sustainability issues facing the world today.

OP2: Outdoor Air Quality (Current Rating 0.50/1.00)

As stated in the University of Winnipeg's Air Quality Management Policy (2007), the institute has encompassed air quality management within its overall sustainability management system. The goals outlined are quite general such as reducing student transportation. The use of natural vegetation to mitigate air particulates is not outlined in this policy but this is a practical approach that could potentially earn the institute a full 1.00/1.00. As discussed earlier, the vegetation on a green rooftop naturally filters outdoor air, and could provide the campus with cleaner air if strategically placed. Manitoba Hydro, for instance, has lined a bus stop outside its building with trees, which filter the air before it rises upward and into the building.

OP4: Building Design and Construction (Current Rating 1.36/3.00)

The University of Winnipeg meets the Green Building Council standards, but there are other rating systems that the university currently does not adhere to that could gain the institute points in building design and construction. The Living Building Challenge is another opportunity for points in this category, and it involves a certification program that includes sustainable development on all scales. A green rooftop is a vital ecosystem, and thus could potentially address some missing points in this category.

OP5: Building Energy Consumption (Current Rating 1.94/6.00)

Clearly, the University of Winnipeg has points to gain in this area. The university began a major energy retrofit process in 2009 that has greatly reduced the footprint of existing buildings. That being said, green rooftops could contribute to points. Building energy consumption could be reduced by the cooling effect of green rooftops in the summer, and the extra insulation value in the winter.

OP7: Food and Beverage Purchasing (Current Rating 2.60/4.00)

If a rooftop garden was implemented in partnership with Diversity Food Services, the cost of food purchase would ultimately be reduced. There would be human resource expenses involved with maintaining the garden that would however need to be addressed. This could provide more potential points for this area of operations.

OP8: Sustainable Dining (Current Rating 2.00/3.00)

The idea of urban agriculture, which the student group Cultivate UWinnipeg (see page 17) is starting to address, is something that could gain points for the university when it comes to reducing dining related impact. This project does not, however, partner with Diversity, and this poses a challenge because a rooftop garden for the cafeterias and or Elements restaurant would likely be essential for reducing overall dining impact. Diversity already provides the students with local product, but a rooftop garden could certainly reduce food transportation costs, and GHGs associated with transportation. Waste could also be reduced, as compost could be used for the rooftop gardens.

OP9: Landscape Management (Current Rating 1.00/2.00)

The University of Winnipeg has earned points for its Integrated Pest Management program, but can still earn another point for an organic land care standard, or sustainable landscape management program in favour of ecologically preferable materials. An organically procured and managed green rooftop could potentially help gain this last point.

OP10: Biodiversity (Current Rating 0.00/1.00)

If further research is done into whether or not a green rooftop could house an elevated environment for bee-keeping on campus, there are potential points to be earned for protection of biodiversity. A green rooftop also provides a general elevated habitat for native birds and insects.

OP23: Rainwater Management (Current Rating 1.00/2.00)

Under the umbrella of green infrastructure, green rooftops could provide potential points in the category of Rainwater Management, through retainment and filtration processes. A full point is given for an institution having comprehensive policies that cover the entire campus and mandate the use of green infrastructure.

Potential Areas

Centennial Hall: The northwest portion (as pictured below) of the Centennial Hall roof currently looks like it would be the ideal location to implement a green roof top. According to Kyle MacDonald (personal communication 07/03/2016), with a live load of 36 pounds per square foot, and a dead load of 64 pounds per square foot, this portion of the roof would be able to hold any type of pre-cultivated vegetation blanket, as well as lighter modular systems. According to Mr. MacDonald (personal communication 22/03/2016) both roof sections are 38' by 134', equating to just over 5000 square feet of currently under-utilized space. It is also easily accessible from the 5th floor library. Additionally, the roof could provide space for a learning environment, as the types of vegetation could be experimental and ever changing. It could be a space that is utilized for research, class work, a visible example of campus sustainability in progress, and potentially another area to grow community gardens. It could also contribute towards the eventual LEED certification of main campus buildings, and add to the current campus STARS status (silver).

Centennial Hall, North West Portion. Photographer: Patrick Carty (2016)

Bryce Hall: Bryce Hall provides another potential area for a green rooftop to be implemented. According to Mr. MacDonald (personal communication 22/03/2016), the actual structural capacity has not been calculated, but given the 6" concrete roof structure, 150 lbs per square foot is the best guess (which is more than Centennial). It does not have as much square footage, but is more visible from other downtown buildings than most of the university's rooftops, which could add a social sustainability component, and visibly show downtown Winnipeg the forward thinking attitude of this university.

Duckworth Centre: The Duckworth Centre (pictured below) may also provide an area for a green roof top as a small portion of it should have a solid structural load capacity, and is fairly easily accessible (Kyle MacDonald personal communication, 29/02/2016). Unfortunately, the accessible portion is quite small. There is potential, however, to use this part of the roof for edible landscaping, or an experimental plot of some type

Duckworth Centre Roof Top. Photographer: Patrick Carty (2016)

Richardson College for the Environment and Science Complex: Design and architectural documents reveal that the majority of the Richardson College roof would not be able to hold the weight of a green roof top. There is potential that the lightest pre-cultivated blanket system could be implemented, but a structural engineer would ultimately have to be consulted in making that decision. There is an area next to the greenhouse that would be viable, however, there are plans to in the near future build another greenhouse in this area.

What can be done

Ultimately, there is tremendous potential to have green roof tops implemented at the University of Winnipeg and to thereby derive a host of sustainability benefits, as summarized in part one of this report. From a feasibility perspective, considering cost, scale, accessibility and maintenance, it seems most viable to use extensive systems, like pre-cultivated vegetation blankets, and to apply them to either or both of Centennial Hall and Bryce Hall.

Current Green Space Initiatives & Next Steps

Purpose

The purpose of this final portion of the report is to highlight a few things that students are currently doing to make the campus more sustainable through green space initiatives, and to provide a framework for the continuance of this project. Hopefully this can spur further discussion as to whether green roof tops would be accepted by students and faculty, and to excite and motivate anyone who may read this report.

Current Initiatives

The Eco Grant: As stated on the University of Winnipeg's Department of Geography website (2016), the Eco-Grant is a $2000 grant offered to students who submit a project or proposal on how to make the campus more sustainable. It is offered by GESA (Geography and Environmental Studies/Sciences Student Association), and gives students a funded opportunity to create a more sustainable campus. The two projects listed below (Cultivate UWinnipeg/ The Seed Library) were this year's recipients of the Eco-Grant. Student groups like GESA and EcoPIA (Ecological People in Action) are great ways for students to get involved with ongoing eco-friendly projects on campus.

Cultivate UWinnipeg: Hailey Robichaud, Matthew Nguyen, and Daniel LeBlanc are a group of students who have started a project called Cultivate UWinnipeg. They are addressing food security issues with students on campus by starting a sustainable campus garden. According to Hailey Robichaud (personal communication, 24/03/2016), there isn't a grocer in the city centre that offers fresh/local raw fruits and vegetables. Their goal is to bring non-GMO, sustainable ingredients to the student community, while providing gardening experiences for volunteers. Currently, they are planting seedlings, and moving geo planters filled with soil on campus in late April 2016. They can be found on Facebook, and are currently developing a website.

The Seed Library: The UWSA Seed Library is another project that was funded by the Eco Grant this year that relates to campus sustainability and urban green space. The purpose of the Library is to provide students and community members with seeds that they can then save and return after harvest. It promotes sustainability, urban gardening, and non-GMO agriculture. The Seed Library has an online catalogue that can be found on the UWSA EcoPIA page, and updates are posted on the EcoPIA

Facebook page regularly. The actual seeds are housed in the EcoPIA office, where there is a physical catalogue as well. The project was kick started by Maureen Hanlon and Charlie Crow.

Next Steps for Implementing Green Roof Tops

Cost analysis: Due to time constraints, a cost analysis for each type of rooftop system was not completed for this report. In order to figure out the exact costs of a green rooftop, a company like Xeroflor Canada would have to be consulted, with the final location for the project determined.

Determine a location: In order to implement a green rooftop, it is obvious that a location must be chosen. This can be done by using information derived from this report, followed by consulting students, faculty, and Physical Plant.

Choosing a system type: The type of system used will ultimately be determined in the consultation process, but will likely be a variation of a pre-cultivated vegetation blanket, or a modular type system if the structural load capacity can manage one.

Who will maintain it: Moving forward, if a green rooftop is implemented on campus there will be need for maintenance. Whether or not this falls under the umbrella of Physical Plant, a student group, or potentially a combination of both is up for discussion.

Irrigation: Depending on the type of green roof implemented, irrigation may not be a huge issue. However, during dry periods there will always need to be a water source, so the logistics of this will need to be determined. Ideally, rain water would be used from a cistern or rain barrel, so potable water can be spared.

Apply for the Eco Grant: If a green roof top does become a feasible reality, applying for the Eco Grant would provide funding for the initial start up. This is something that could potentially be done in the 2016-17 academic year.

Further STARS and LEED Research: Once a green roof top can be implemented on campus, it would be beneficial to do further research into the exact amount of credits that may be earned through STARS and LEED.

Conclusion

Being the open ended project it is, this section leaves much to the imagination of the reader. A green roof top could mean many things to the university, and could ultimately involve a variety of systems, with a substantial amount of learning opportunities for the campus and surrounding community. There is an opportunity to move bee hives onto a roof top for a more elevated habitat, gaining points toward the STARS program. Urban agriculture and modular systems similar to the ones on Manitoba Hydro's building could be researched more thoroughly. This could include the involvement of Diversity Foods to create a roof top garden. This document is simply an outline of what could be done in the near future.

Moving forward as a sustainable institution does not only mean to adhere to the goals set forth in the suitability strategy, but to constantly be innovating and thinking in a transparent manner. A holistic approach is key to any sustainable initiative, and the same idea holds true with urban green space. The results of this report conclude that though there is much work to be done in cost and consultation, green roof tops are in fact more feasible than one may think. Although the possibilities of implementing a green roof top at the University of Winnipeg are truly endless, one variable remains constant - it all starts at the top.

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