
GREEN
FROM
THE
GROUND
UP



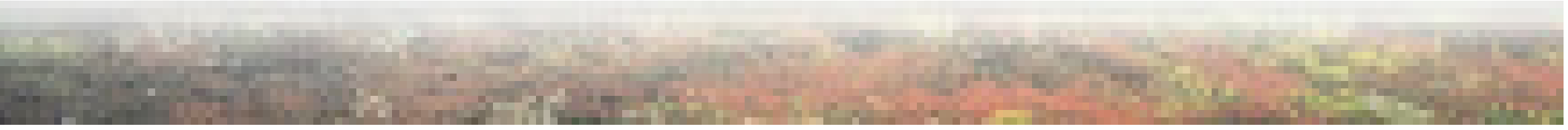

PURPOSE

Installation of green roofs on campus to inspire and educate Western students and faculty, along with community members about the envronmental and economic benefits of sustainable green construction.

Building upon prior works beginning in Winter of 2009-2010, the second phase of our green roof project aims to become more realistic and feasible by networking with relevant stakeholders, local contractors, improving design quality, and working within WWU's annual fiscal budget constraints.

The current Miller Hall renovation project aims to remove bike storage from in front of Miller Hall, relocating storage to the back of the building. In doing so, the core capacity of bike storage is being largely decreased. Our project aims to conserve and build upon the core bike capacity, all while maintaining important design aspects and beautifying our campus.

Our green roof design is feasible for a summer construction project. It will not conflict with classroom use on campus. Also, the design can be completed in-house by Western's architects and construction team.



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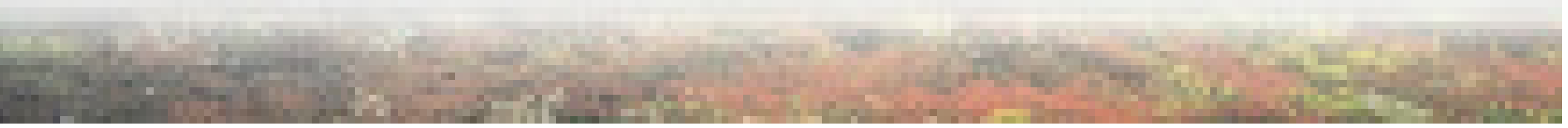
INTRODUCTION

Western Washington University has been an environmental steward for decades, and has led the way for campus sustainability throughout the nation. The Miller Hall renovation has presented Western and the Huxley College of the Environment with a unique opportunity to incorporate green technologies into existing buildings. The future is green.

We propose the installation of a green roof – a roof in which vegetation is grown atop a roof structure over the existing bicycle racks in front of Miller Hall. Our project employs local and regional suppliers. Utilizing the best technology, we plan to create a green roof which fosters important environmental management opportunities and unique educational benefits to the students and faculty of Western Washington University.

The following sections outline the methodology to our research, case studies in green roofs from around the nation, our research and analysis and project-specific findings and recommendations, and the future implications for green technologies, sustainable practices, and this project on Western Washington University.






METHODOLOGY

Our project has built on the previous work of students. Our goal is to improve the design via style, aesthetics, and cost effeciency. Our research has been through a mix of uses, including Internet sources, books, and articles. The book “Planting Green Roofs and Living Walls” by Nigel Dunnet and Noel Kingsbury, has provided background research and has provided us the practical techniques used to design, implement, and maintain a green roof. We also utilized The Association of Sustainability in Higher Education (AASHE) website and GreenRoofs.com to develop our case studies and understand the latest trends in green roof technologies. Additionally, GreenRoofs.com has an accessible database to locate local and national Greenroof suppliers. In addition, Etera has a website with case studies that allowed us to gain hands on knowledge of the local product.

Local suppliers were used in our project design estimate. The concrete roof structures, drainage system, and labor were estimated by Kirkwood Company based out of Redmond. It is a general contracting firm that is involved in a variety of product types, including experience with green roofs. The waterproof membrane, layering, soil, and labor estimate was provided by Pacific Rainier Roofing based out of Seattle. They are an authorized Hydrotech dealer and installer. Hydrotech, a well-respected green roof product supplier, recommended them. They provide the highest quality waterproof membrane and application process in the industry. Etera, a local company based out of Mt. Vernon, provided our vegetation estimate. They are affiliated with Northwest Horticulture and specialize in green roof vegetation. They grow the highest quality SedumTiles, which are squares of sod used on green roofs. They have many varieties, including Color and Shade Resistant, both of which were used in our design. Personal meetings were setup for Kirkwood and Etera. Phone conversations and emails proved sufficient for obtaining the other estimates. We used the lowest estimate in each category to provide the total construction estimate for the project.




METHODOLOGY

Using our knowledge of green roofs applied to this particular project, we are attempting to spread the word across campus. We aim to inform students, faculty, staff, and citizens about our green roof project in front of Miller Hall. We have created an educational board to promote our project throughout the quarter. Our group aims to receive public attention before our final presentations commence. We have begun to achieve this through the school newspaper. Two major articles have been published in the Western Front regarding the Miller Hall Green Roof Bike Rack Project. The first article mentioned our group's efforts in accord with the green roof being constructed in the remodel. The second article was a feature story on our specific project and accompanied a diagram. The article ran May 4th, over a month before our project is set for final presentation. This public knowledge will increase our chances of obtaining funding from the Green Fee, which passed in recent elections. Knowledge is power, and we aim to inform.

We have worked with several staff members on campus to guide us in this great process. Seth Vidana, coordinator of sustainability at Western Washington University, has supported the project from day one and referred us to several staff members. Dale Kraus, construction manager of Miller Hall, has helped us refine the original design to better fit the vernacular of the buildings. The previous design was constructed of wood, which did not fit the design plans of campus in that particular location. From that point, we were able to make the successful conversion to a concrete structure. Tim Wynn, director of facilities management at Western Washington University, also guided us to an obtainable goal. These staff members were invaluable in the design process.




PROGRAM DEVELOPMENT

Collaboration and multi-disciplinary approaches are the foundation of our project development. We seek to include faculty and students in an effort to create an environment of inspiration, education, and increased awareness throughout the entire development process. We want to include our stake-holders early so we can address their interests and needs early and incorporate them accordingly, and work to develop the most cost-efficient, environmentally friendly roof. Our design emphasizes safety and low-maintenace. The roof is low enough not to pose a threat to workers and is designed to need minimal annual maintenace. The self-sufficient design is simple and reliable.

Spring Quarter, our development goal was to engage all of our stakeholders in a meaningful way. This included, but was not limited to, interviews and meetings, email exchanges and group discussions arranged to identify what each stakeholder wants. Second, we wanted to identify the key environmen-tal benefits that the roof will offer – such as storm water remediation, water retention, and pollution reduction. At the end of Spring Quarter, we presented our knowledge on green roofs to inspire future students and faculty to move forward with campus sustainability projects, especially projects that will beautify campus and provide educational opportunities.

Our hope is that our proposal and findings will provide a foundation for the project to be carried on through future Campus Planning Studio projects. We used a past project as a jumping stone and we hope that ours will provide a new and elevated platform from which future students will improve and expand.




ENVIRONMENTAL BENEFITS

There is a wide variety of environmental benefits from green roofs. Protection of roof membrane resulting in a longer material lifespan. According to greenroofs.org, these types of roofs are estimated to last twice as long as conventional construction. Potential for grants related to energy efficiency, and to satisfy regulatory requirements such as LEED, Living Building Challenge and other ratings systems.

Storm water retention is improved. Water is slowed and stored by the soil substrate and then taken up by the plants from where it is returned. Green roofs are capable of holding one gallon of water per square foot. Our project has the ability to hold 1,200 gallons of water. Our structure is designed to safely hold the weight of the water, totalling up to 8,500 pounds.

Storm water mitigation: the vegetation of the green roof absorbs and processes many harmful particulates and pollutants in the atmosphere. The layers of matting, drainage, and vegetation effectively reduce the amount of polluted water runoff. The green roof will reduce stormwater runoff, reducing stormwater fees paid by Western Washington University. It improves quality of runoff and reduces quantity.




ENVIRONMENTAL BENEFITS

Through the process of photosynthesis, plants convert carbon dioxide, water and sunlight/energy into oxygen and glucose reducing the amount of C02 in the atmosphere from anthropogenic rises in green house gas emissions. Green roofs can Remove airborne particulates, at a rate of 2 lbs. per one square meter of roof per year.

Green roofs provide habitat increasing biodiversity and encouraging wildlife refuge for various bugs, birds, and insects within the urban environment. In addition, honey bees are specifically adapted to the Etera SedumTiles. These bees contribute to an overall ecosytem function and biodiversity.




EDUCATIONAL BENEFITS

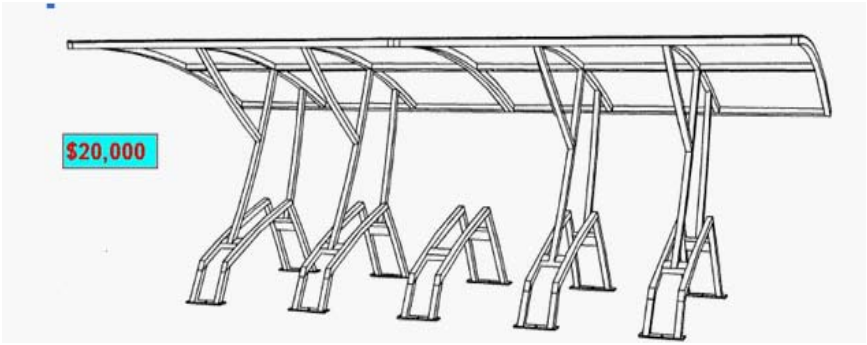
Whatcom Museum Green Roof

The bicycle rack green roof will provide economic, environmental, and educational benefits to WWU students and faculty body as well as the Bellingham community as a whole. While size, climate, and building materials can affect which benefits are received by different green roof systems, the following will be a direct result of the Miller Hall Bicycle Rack compiled from a complete list at Green-Roofs.com

Signs and posters on campus will educate students on major design principles, illustrating environmental and ecological benefits, and Increase student moral and productivity through campus beautification. The vegetated structure will draw the eyes of students and staff. It will improve the aesthetics of the core area of campus. This subtle change will result in a better quality of life. Roof will draw awareness to faculty and staff and serve as a catalyst for support for future green roof projects. The signs and posters should be placed in core areas, such as red square, the Viking Union, and Wilson Library. Increased traffic ensures increased awareness.

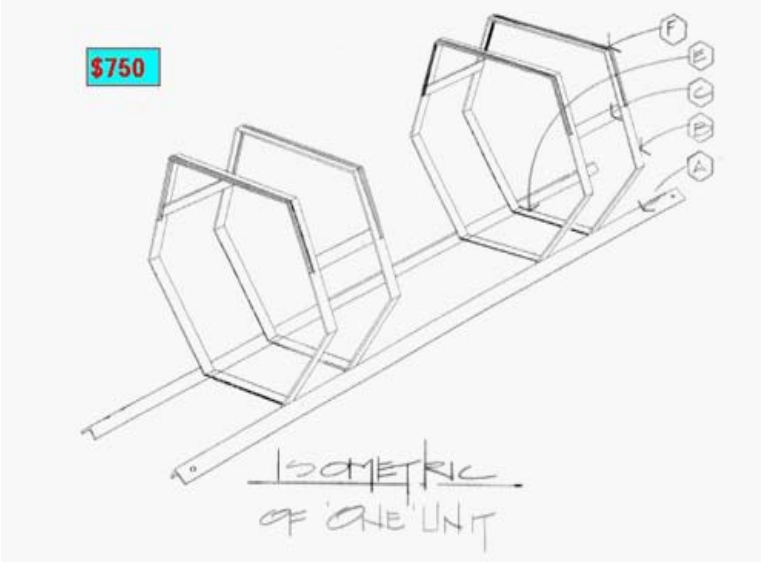



EXISTING BIKE RACKS



The blue bike rack system is the newer model of bike rack on campus. The design includes a cover, but makes it more difficult for taller bi-cyclists to lock up. Furthermore, the material used is too thick to effectively lock up multiple bikes. There has been a reliability issue with the plastic roofing becoming disassembled.

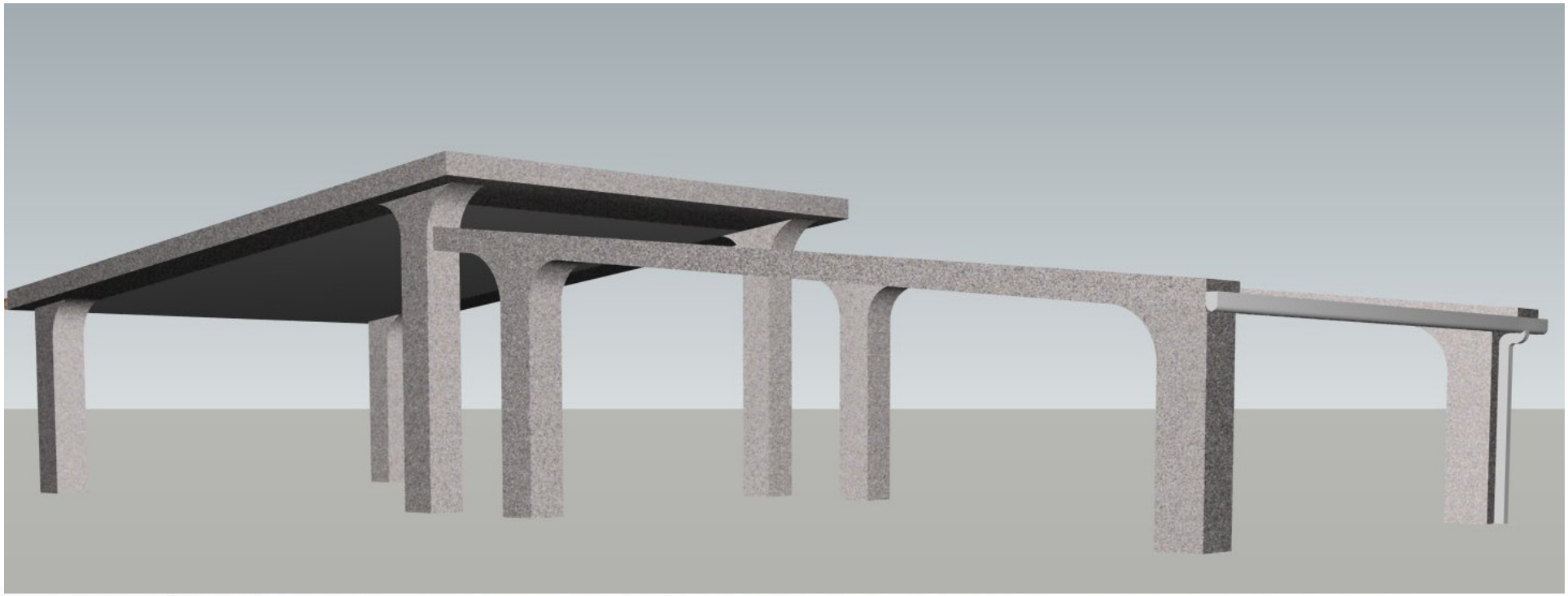
The pre-existing hexagonal bike racks on campus have been exposed for their lifespan. Their design is simple, user-friendly, and space efficient. The robust design is favored by students due to ease of use. These racks are estimated to cost only $188 per bike.






PROJECT DESIGN

Our green roof design is a cost effective, environmentaly conciences, and defining solution to provide covered bike storage in red square. This design uses two pre-formed concrete roof slabs mounted upon concrete pillars. Designing the green roof in this way allows for long term durability and maintenance savings. Furthermore this structure design allows for vernacular finishing in the same form as the other structures in red square thus adding to the identifying architecture. Having to individual roof lines has given the design to mimic the roof slope angle of Miller Hall as well as adding to the structural integrity and providing natural light.



PREVIOUS WORKS

FINAL DESIGN RENDERING




COST ESTIMATE

Concrete Structure (Kirkwood Company)

- $55,000
- Includes labor, steel, concrete, etc.

Drainage System (Kirkwood Company)

- Copper gutter: $45 per foot (40 feet) = $900
- Downpipe: $30 per foot (20 feet) = $600
- Total drainage cost with labor= $2,500

Vegetation (Etera SedumTiles)

- $5 per square foot for SedumTiles
- $7 per square foot including soil and labor
- Total: $8,400

Pacific Rainier Roofing

- Includes Hydrotech membrane, protection sheet, root stop, gardendrain, and filter fabric
- Base bid: $22,765

Total Estimate
$88,665
$74 per square foot




COST BREAKDOWN

MILLER HALL DESIGN 1,200 SQF

TOTAL ESTIMATED COST $88,665

CURRENT BIKE CAPACITY: 56

COST PER BIKE: $1,583

POTENTIAL BIKE CAPACITY: 80 (Providing an addition 24 racks under structure)

COST POTENIAL PER BIKE: $1,100




BILL & MELINDA GATES FOUNDATION CAMPUS GREEN ROOF

In 2009 the Bill & Melinda Gates foundation completed their new campus, incorporating sustainable design strategies into the construction of the Foundation's new campus. This LEED Gold certified extensive green roof is one of the largest in Washington and visible from many downtown Seattle sky-scrapers including the Space Needle.

The Gates Foundation worked with the city of Seattle as well as the state to approve a special sewer district water right which allowed for the installation of the specific water tank. This will serve as a model for other future development and enactment of other similar strategies. The water tank will service restrooms, other water features such as irrigation and reduces the demand on the city water supply by two million gallons. After making contact with the five inches of soil which the vegetation is rooted in, nearly 90% of storm water runoff is treated with only 10% entering the overflow drainage system. Upon drainage after the natural filtration enters a one million gallon rain water storage tank.

The parking garage component of the new campus has replaced 12 acres of surface parking with a 1.4 acre green roof being 60,000 square feet and covering 1,020 parking spaces.

The green roof is planted with native sedum varieties, and is expected to only help the surround-ing area. The Campus as a whole is expected to save 40% of the normal energy required to operate a structure of its size. Other benefits include a reduction the urban heat island effect, and providing natural elements to the urban surroundings.
http://www.djc.com/news/en/12002198




BILL & MELINDA GATES FOUNDATION CAMPUS GREEN ROOF




PURDUE UNIVERSITY SHLEMAN HALL GREEN ROOF PROJECT

After a grant had been supplied to a student-lead organization, the Boiler Green Initiative created in 2006, received a grant of over $68,000 from State Farm Insurance to build Purdue's first green roof. The Schleman Hall Green Roof Project, constructed in the spring of 2009, was a retrofit of an existing 1,750 square foot roof in order to make it more energy efficient, environmentally responsible and aesthetically pleasing. BGI members were responsible for obtaining the funding through writing grants, designing the green roof and helping with construction.

The purpose of the green roof is to introduce environmentally friendly practices to students and the community. The installment will further also act as a "living laboratory" for various studies on green roof including energy efficiency, insect populations attracted to green roofs and storm water treatment. BGI's persistence is expected to carry into the future. Their long-term goal is to install green roofs atop all new campus buildings and retrofit buildings with flat, newly resurfaced roofs. Future plans call for green roofs on the Discovery Park research facility Mann Hall, the Purdue Armory and part of the horticulture building.

The BGI's efforts signify ongoing opportunities for partnerships between student organizations and support from larger well-established corporations such as State Farm Insurance who are willing to fund projects dedicated to community welfare.

http://news.uns.purdue.edu/x/2009a/090220WilsonRoof.html
http://www.aashe.org/resources/profiles/2009/purdue-university




PURDUE UNIVERSITY SHLEMAN HALL GREEN ROOF PROJECT




GRAND RAPIDS COMMUNITY COLLEGE

In August of 2008 Grand Rapids Community College in Michigan installed a two level 17450 sq ft extensive 4” green roof. In spring 2007 Grand Rapids Community College (GRCC) applied for a grant from the Steelcase Foundation for funding their proposed green roof and vegetated plaza, attaining the grant by fall 2007. The green roof technology selected for the project was Liveroof, composed of pre-vegetated modules. The 25,000 square foot green roof can be viewed from a raised viewing platform, and also includes an herb garden which is accessible to the culinary program Heritage Restaurant on campus. The viewing deck is available to the public and students of all ages to encourage learning about the plants, green roof benefits and the concept of sustainability.




FUTURE WORKS

Sustainable beautification projects on campus will become more important as the university continues to work towards a more sustainable campus. This includes installation of more green roofs and living walls around campus. Living walls are another form of beautification that can improve air quality and ventilation as well as solar insulation. Some of these potential installations could be a green roof on top of the bus stop on high street next to the library, the bike racks North of the Communications Building, as well as the Wade King Recreation Center. These three locations represent examples of existing structures on campus that can easily be adapted to support a green roof. The Wade King Recreation Center building was initially designed and built to support a green roof thus installation would take minimal adaptation.

Green walls are another form of sustainable beautification that provide many of the same benefits as green roofs do. Green walls are able to insulate buildings, provide shade to windows and sidewalks, sequester rain run-off, as well as improve the visual quality to the campus. As with green roofs the installation can be adapted to renovations, installations, and new build projects. Most green walls are designed in modular form for the purpose of simple and reliable connection to the wall. Other more intensive projects can have substrates attached directly to the wall creating a Living Wall. Green walls are an effective current strategy to improving the campus beauty and the Universities Stature as an environmental steward.

FUTURE WORKS

FUTURE WORKS




CONCLUSION

The proposed green roof above the bike racks in front of Miller Hall will provide a great variety of benefits to the student body, staff, and citizens of Bellingham. The project's vision is to provide visual stimulation, education, and activism within the college and the city of Bellingham. A project of this scope and nature will ensure that future works are incorporated into campus and the city.

The project has proven itself to be environmentally beneficial. The green roof provides storm water remediation, water retention, a pollution buffer, a natural habitat, and reduces heat reflection. Green roofs have also proven to provide insulation benefits, which will be evident in future projects like the green wall and the Wade King Rec Center roof.

The Miller Hall Bike Rack Green Roof project has also proven itself to be economically viable. The current covered bike racks are cost ineffective when compared to our model. In addition, the green roof design uses existing bike racks and provides far more benefits. The future is bright for green roofs and we hope that our information and presentation will work towards a more sustainable future.

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