

Low Impact Development Series



The Markham Municipal Green Road Pilot Project

Image courtesy of City of Markham

For over a decade the City of Markham has been working to ensure that its community is a great place to live, work and play for current and future generations. With that ideal in mind the City released *Markham's Greenprint Sustainability Plan* in 2011. This groundbreaking plan set forth a blueprint for the growth of Markham over fifty years, with the goal of making it one of the most sustainable cities in North America. Their vision aligns with current Provincial, Regional, Municipal and Conservation Authority policies, which require new growth to be environmentally sustainable.

Pilot projects are an important part of the *Greenprint* as they showcase innovative environmental technologies which have the potential to improve the City's environmental health, economic vitality and social well-being. Evaluating both the costs and performance of new technologies is encouraged. Understanding long term performance, operation and maintenance requirements must be considered when sites and technologies are being selected. The Markham Municipal Green Road Pilot Project is an ambitious pilot project focused on evaluating the technical and financial feasibility of using green infrastructure on public roads to manage stormwater and create attractive, pedestrian-friendly streets that contribute to community health and well-being.

The City of Markham's goal is to protect the public and respect the natural and built environments through excellence in sustainable community, planning, and infrastructure management programs.



Featured practices:

- Bioretention
- Infiltration trenches
- Permeable pavement

Groups involved:

- City of Markham: Engineering, Planning and Urban Design, Operations and Environmental Services
- Schollen & Company Inc.

Budget:

Total cost of the Road is \$4 million, with the green components adding 25-30% cost to the project

Construction:

Fall 2015 to Spring 2018

STUDY SITE

The Markham Municipal Green Road Pilot Project is located on Vanni Avenue, south east of the intersection of 14th Avenue and Middlefield Road in an area of mixed residential and commercial properties. The specially designed road includes multiple low impact development (LID) technologies to manage stormwater at source, reducing the need for conveyance and end-of-pipe stormwater management measures. If the project is successful the City's Engineering department will develop design criteria and implementation guidelines to facilitate application of the designs in future developments. The road was officially opened to the public in the spring of 2018.



Figure 1. Study site location

Project Objectives

- Establish a new "Green Street" model which will set the standard for street design within the City
- Demonstrate that effective stormwater management can be realized in an urban retrofit context
- Evaluate costs and benefits of a Green Road option with respect to design requirements, capital costs, long-term performance, and operation and maintenance requirements
- Control stormwater runoff quality and quantity at the source
- Maintain infiltration/recharge into the ground to mimic pre-development condition
- Provide a unique landscape aesthetic

PLANNING AND REGULATIONS

Over the last few decades stormwater management has evolved from focusing on end-of-pipe control to the more holistic LID approach. The way stormwater is managed in Markham has followed this evolution by shifting towards a water balance approach which emphasizes source controls and helps mitigate the potential impacts of climate change. In 2008 the City of Markham launched a strategic plan – Building Markham's Future Together - which started the process of creating a safe and sustainable community. Following that came the release of the *Greenprint*, which places major emphasis on environmental sustainability. The *Greenprint* addresses both short and long term initiatives to

reach the City's goal of improving the natural environment and enhancing the quality of life in the City. It describes the importance of pilot projects, noting it's important to learn by doing, and encourages them as a standard practice to promote policy and operational changes. Successful pilot projects will be implemented as standard practice.

Changing the status quo can be difficult and coordination between the various City departments and business units was required to ensure the success of this project. While the City welcomed the idea of a road with lots of trees and plants, the City was also concerned with the ongoing costs of operation and maintenance. During the planning stages regular consultation took place between the groups, which led to design revisions that could satisfy everyone involved. In the end, all groups involved supported the project and the site was constructed as planned and appears to be working well.

DESIGN

A new road was planned to allow access to the Aaniin Community Centre. The planned subdivision south of the community centre was awaiting approvals, presenting an issue for stormwater management and treatment of water in the area. The City evaluated a few options and in the end selected the site for a pilot project where LID would be applied within the municipal right-of-way. Many departments at the City and various business units worked together to design and construct this green road project.

To ensure the site would be easy and cost-effective to maintain, it was designed to be accessible to conventional street sweeping and catchbasin cleaning equipment. The municipal storm sewer within the Green Road may be oversized as most of the flow will be captured by the bioretention. If the LID measure does not perform as anticipated with respect to stormwater control, the system can be converted to a conventional stormwater conveyance system.

For design information on individual LID practices, refer to the *LID Stormwater Management Planning and Design Guide* (TRCA and CVC, 2010).



Figure 2. Inlet to bioretention area (Image courtesy of the City of Markham)

Bioretention

The bioretention areas are located on both sides of the Green Road and are directly on top of the infiltration galleries, separated by an impermeable liner. Runoff from the multi-use path and front yard areas of the adjacent lots enters the bioretention at the road surface. This runoff is expected to be cleaner than road runoff, which can have high concentrations of chlorides in the winter due to road salt application. Once the bioretention is at capacity it overflows to the infiltration gallery below via overflow inlet pipes at the downstream end of each run of bioretention.

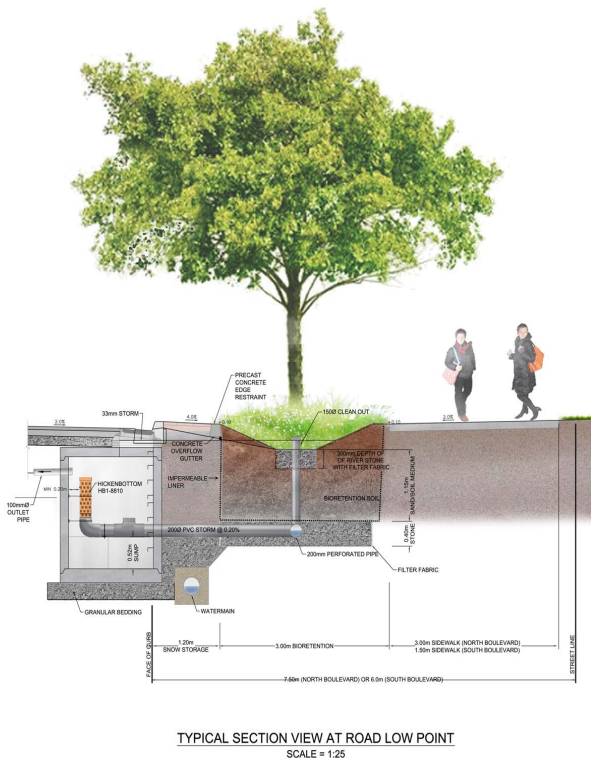


Figure 3. Cross section of the road (image courtesy of Schollen & Company Inc.)

Native plantings

In order to maintain sustainable life cycle cost the original planting plan was revised, significantly reducing the quantity of plant material. In the end the bioretention cells were planted with native grasses and perennials, limiting requirements for frequent mowing and maintenance, and establishing a unique aesthetic signature for the street.

Infiltration galleries

The primary inlets to the infiltration galleries are through conventional catchbasins/manholes at the edge of the road that have a hickenbottom-style riser. This allows the coarse sediment to remain in the catchbasin sump and only directs pre-treated water into the infiltration galleries. As noted above the infiltration galleries also receive overflow from the bioretention should any exceed capacity. If the infiltration galleries reach their capacity the excess water is diverted to the conventional storm sewer beneath the road.

Permeable pavement

A 1-metre strip of permeable pavement was installed on both of the boulevards between the road and the bioretentions. The original design included 1m strips of permeable pavers and asphalt, however due to unavailability of the permeable asphalt (due to non performance), pavers were installed on both sides of the road. During the design consultation process a concern was raised about this strip directing salt/debris laden runoff towards the bioretention so the design was amended to slope the strip back towards the street.

CONSTRUCTION AND COMMISSIONING

The Markham Municipal Green Road Pilot Project was built in two stages, first the developer's road contractor constructed the street, curbs and underground services, then a second contractor was brought in to construct the LID components. In the end this two stage process added to the cost of the project and extended the construction schedule. The second contractor was required to reconstruct some of the works that had already been completed due to issues with grading and the location of inlets and infrastructure.

In order to protect City's interest the contractor was required to provide a 5-year warranty on the trees and the construction contract included a provision for the contractor to maintain the landscape works for a period of five years (until the end of the warranty period). These requirements added to the overall cost of the project but were necessary ensure the City receives a quality end product.

Prior to construction of the permeable strips, the City was informed that permeable asphalt was not performing and was replaced with permeable pavers. The performance of the PICP will be monitored over time to evaluate how well they function given their proximity to the road, meaning they may be piled with snow that has been plowed and subject to winter application of sand and road salt.

OPERATION AND MAINTENANCE

Proper maintenance of LID practices is crucial for optimizing performance, cost effectiveness, and aesthetics, especially during the initial establishment of vegetation. In some cases it is necessary to follow-up with the contractor to ensure that the activities specified within the maintenance agreement are taking place. For specific information on operation and maintenance of individual LID practices, please refer to the *LID Stormwater Management Practice Inspection and Maintenance Guide* (TRCA, 2016).

The City's Operations department is responsible for the maintenance of the site. As part of the pilot project the City will be recording the on-going operation and maintenance

costs for their evaluation of financial feasibility. While it was designed to be maintained with existing equipment and the number of plants were reduced from the original design as part of the design coordination, the cost could potentially be more than a conventionally designed street. As a result, an allowance has been included in the capital budget for additional costs during the pilot project period. The inlet catchbasins will be maintained using the same equipment and schedule as other conventional catchbasins in the area.

ACHIEVEMENTS

Innovative project. The Markham Municipal Green Road Pilot Project is the first of its kind in the City. If successful it will become the standard for street design in the City.

Stormwater management benefits. Incorporation of LID principles results in more sustainable stormwater management.

Aesthetic value. The bioretention will add green space, increasing visual appeal and contributing to an improved community experience.

Joint partnership. All City departments and partners worked together to ensure the success of this project.

LESSONS LEARNED

- It's important to involve all departments at the outset of the project to ensure requirements and concerns are fully understood and evaluated prior to generating the detailed design.
- Using one contractor for all of the works would have been beneficial in terms of cost, timing and effort to administer the contract.
- Streetlight poles located near the bioretention required deeper concrete bases for stability which added to the cost of the contract and increased design fees, as the revision required signoff by a structural engineer.
- An issue arose due to the location of the streetlight poles in relation to the bioretention liner (i.e. did not want to puncture or break it) and the sidewalk. Typically streetlight poles are not constructed in close proximity to the sidewalk as it can pose a risk to maintenance machines. The location of the sidewalk was adjusted to allow for acceptable distances between the three objects.

REFERENCES

Credit Valley Conservation and Toronto and Region Conservation (CVC & TRCA). (2010). Low Impact Development Stormwater Management Planning and Design Guide (Version 1.0). Toronto, Ontario.

Toronto and Region Conservation (TRCA). (2016). Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide. Toronto, Ontario.



Figure 4. Infiltration gallery construction at the Green Road (image courtesy of City of Markham)

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About STEP

The water component of the Sustainable Technologies Evaluation Program (STEP) is a partnership between Toronto and Region Conservation Authority, Credit Valley Conservation, and Lake Simcoe Region Conservation Authority. Contact us at STEP@trca.on.ca.