APPENDIX B – LOW IMPACT DEVELOPMENT OPTIONS

Staff assessed the methods of incorporating Low Impact Development (LID) characteristics into the design and cost of any potential parking lot, including but not limited to permeable pavement specialized storm water features and potential use of botanical features to reduce runoff.

Analysis

The traditional approach to dealing with stormwater has been to move it away from city streets as quickly and efficiently as possible. This results in large volumes of water entering our waterways at high velocities, carrying the pollutants picked up along the way.

LID, by contrast, deals with stormwater by mimicking natural water cycles. It increases the infiltration of stormwater into the soil, where it can be filtered and/or absorbed by plants. LID is a lower-cost alternative to conventional grey infrastructure and provides a number of ecological, economic and social benefits. Some examples of LID practices that may be applicable to this area are as follows:

- Soakaway Pits/Infiltration Trenches

  These practices promote infiltration of stormwater into the surrounding soils by excavating a pit or trench which is typically lined with a filter cloth, backfilled with coarse granular material and either fed by sheet drainage from the surrounding area or through perforated pipes conveying flows from a storm conveyance system.

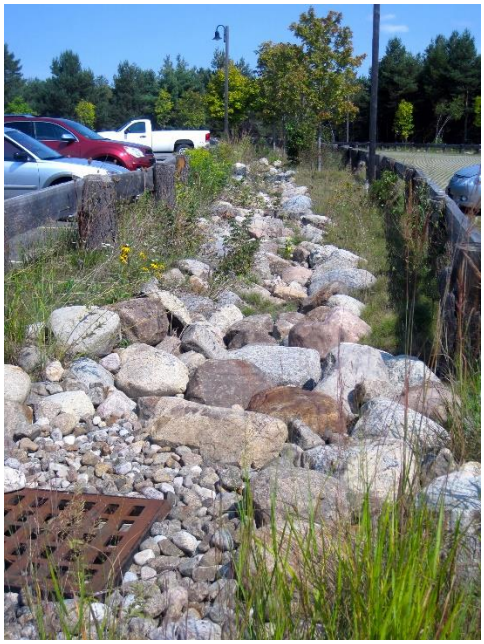

Fig.1. – Soakway Pits/Infiltration Trenches

- Vegetated Filter Strips/Enhanced Grassed Swales

  This practice provide a vegetated area for stormwater flows to be conveyed through which can provide quality benefits by removing suspended sedimentation and promote infiltration as the flows travel over the pervious area.

Fig.2.- Vegetated Filter Strips

- Bioretention/Biofilters

  Functions as a filter to improve stormwater quality and also provide quantity controls by retaining flows and either promoting infiltration, given adequate soil conditions, or conveying flows through a perforated subdrain to a storm sewer conveyance system.

Fig.3.- Biorention/Biofilters

- Permeable Pavement/ Porous Asphalt

  Permeable pavement can be utilized to allow for stormwater flows that would typically run off from the impervious pavement area to drain through the pavement surface to the subgrade as opposed to draining to catch basins or spill ways. From the subgrade infiltration can be promoted, provided adequate soil conditions, or subdrain can be installed to convey flows to a storm sewer conveyance system.

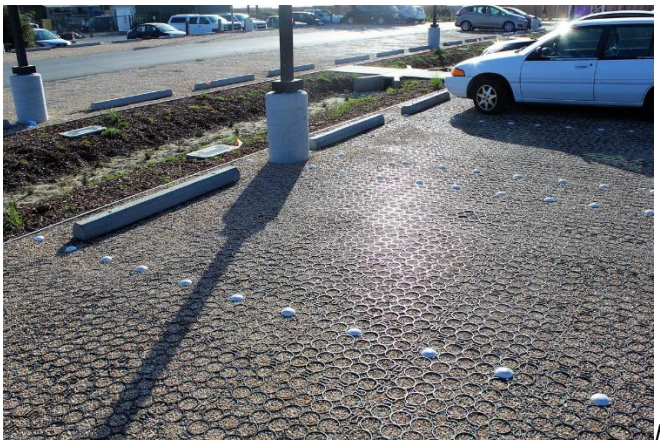

Fig.4.- Permeable Pavement

Fig.5.-Porous Asphalt

- Permeable Stone Pavers

  Permeable Paving Stones continue to be the recommended parking solution for municipalities and it is be the best use case for implementation in the parking lot expansion, however there is a significant cost associated with it vs. conventional asphalt. As a light coloured surface there are also significant heat island benefits and associated improved tree and vegetation health.

Fig.6.-Permeable Stone Pavers

Looking further to permeable paving

Permeable pavements, an alternative to traditional impervious pavement, allow stormwater to drain through them and into a stone reservoir where it is infiltrated into the underlying native soil or temporarily detained. They can be used for low traffic roads, parking lots, driveways, pedestrian plazas and walkways. Permeable pavement is ideal for sites with limited space for other surface stormwater BMPs. The following permeable pavement types are:

- permeable interlocking concrete pavers (i.e., block pavers);
- plastic or concrete grid systems (i.e., grid pavers);
- pervious concrete; and
- porous asphalt.

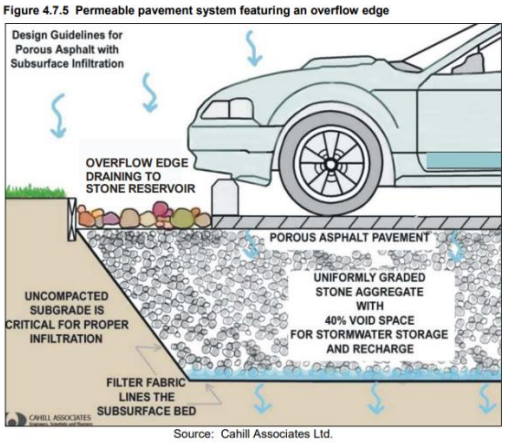

Fig.7. – Example Section

What are the drawbacks?

There are some dis-advantages that come along with permeable pavements. They include:

1. It is more expensive to install as compared to traditional pavements.
2. The maintenance requirements of permeable pavement are quite different. It is prone to clogging if the water in the reservoir isn't drained out properly. The sand and fine particles that can block the space between the pavers must be removed using an industrial vacuum. It can even clog when you sand for ice during the winter. If you do not cater to clogging quickly, it will cause the water and pollutants to run off the surface, defeating the purpose of installing permeable pavement.
3. They aren't as strong as traditional or asphalt pavements. If you put consistent pressure (like heavy vehicle braking) on it, then the pores of the pavement will collapse. Due to this, permeable pavement isn't ideal for building airport runways and highways.

What are the Benefits?

1. Permeable pavements help reestablish a more natural hydrologic balance and reduce runoff volume by trapping and slowly releasing precipitation into the ground instead of allowing it to flow into storm drains and out to receiving waters as effluent. This same process also reduces the peak rates of discharge by preventing large, fast pulses of precipitation through the stormwater system.

2. Permeable pavement can reduce the concentration of some pollutants either physically (by trapping it in the pavement or soil), chemically (bacteria and other microbes can break down and utilize some pollutants), or biologically (plants that grow in-between some types of pavers can trap and store pollutants).

3. By slowing down the process, permeable pavements can cool down the temperature of urban runoff, reducing the stress and impact on the stream or lake environment.

4. By controlling the runoff at the source, such as a parking lot, permeable pavement can also reduce the need for or the required size of a regional BMP, such as a wet detention pond, which saves money and effort.

Cold-weather benefits

5. Another benefit of permeable pavement is the reduced need to apply road salt for deicing in the winter time.

6. Other researchers have found that the air trapped in the pavement can store heat and release it to the surface, promoting the melting and thawing of snow and ice.

Low Impact Developments in Ontario

In Ontario, there are a number of municipalities that have engaged in LID as a green approach to the construction of their facilities. . As an example, in 2013, the municipality of King City was looking for eco-friendly paving materials to help transform their 1300 m^2 parking area into a functional, permeable, and green parking lot for the town's public library. Similarly, in 2016, the Huron Natural Area permeable parking lot project by the City of Kitchener paved way to help tackle climate change and increase environmental sustainability. It also served as a pivotal point to encourage the city for more green projects.

Fig.8.-Township of King Public Library Parking Lot

Fig.9.- Huron Natural area, City of Kitchener

What are the benefits of LID?

LID Provides Many Environmental and Economic Benefits:

1. Improved Water Quality. Stormwater runoff can pick up pollutants such as oil, bacteria, sediments, metals, hydrocarbons and some nutrients from impervious surfaces and discharge these to surface waters. Using LID practices will reduce pollutant-laden stormwater reaching local waters. Better water quality increases property values and lowers government clean-up costs.
2. Reduced Number of Costly Flooding Events. In communities that rely on ditches and drains to divert runoff to local waterways, flooding can occur when large volumes of stormwater enter surface waters very quickly. Holistically incorporating LID practices reduces the volume and speed of stormwater runoff and decreases costly flooding and property damage.
3. Restored Aquatic Habitat. Rapidly moving stormwater erodes stream banks and scours stream channels, obliterating habitat for fish and other aquatic life. Using LID practices reduces the amount of stormwater reaching a surface water system and helps to maintain natural stream channel functions and habitat.
4. Improved Groundwater Recharge. Runoff that is quickly shunted through ditches and drains into surface waters cannot soak into the ground. LID practices retain more rainfall on-site, allowing it to enter the ground and be filtered by soil as it seeps down to the water table.
5. Enhanced Neighborhood Beauty. Traditional stormwater management infrastructure includes unsightly pipes, outfalls, concrete channels and fenced

basins. Using LID broadly can increase property values and enhance communities by making them more beautiful, sustainable and wildlife friendly

What are the drawbacks with LID?

There are some adverse aspects, such as LID projects tend to involve more ongoing maintenance than the traditional pipe-to-sewer stormwater infrastructure.

Another downside is that not all LID projects function the same. Understanding the site specifics is critical for selecting the proper LID. For example, vegetated filter strips can be ideal for small parking lots but not for sites with large drainage areas.

Other potential cons to installing LID:

1. Requires approval from local codes or ordinances
2. Increases maintenance and required landscaping
3. Diminishes pollutant removal if improperly designed
4. Increases erosion during large storm events
5. Increases pavement failure at LID/curb interface
6. Increases liability and safety concerns
7. Reduces performance over time.