

Toronto Transit Commission

## **90 % Stormwater Management Report**

Sheppard West Station  
Spadina Subway Extension

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## Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	B. Richert	May 11, 2010	Incorporating City of Toronto comments—on dewatering volumes

## AECOM Signatures



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# 1. Introduction

The stormwater management concept for the Sheppard West Station is based on a review of requirements of the Toronto and Region Conservation Authority, the City of Toronto, Ministry of Environment, and the TTC Design Standards.

## 1.1 Relevant Standards and Design Criteria

The stormwater management plan for the proposed station considers a number of relevant standards and design criteria, including:

- The MOE Stormwater Management Planning and Design Manual (2003);
- The City of Toronto WWFMMP guidelines;
- TRCA Sediment and Erosion Control Guidelines;
- The City of Toronto Green Development Standards;
- Permit and regulatory requirements of the TRCA;
- The Don River Watershed Plan (2009), and Don River Watershed Plan Implementation Guide (2009) from TRCA.

## 1.2 Stormwater Management Objectives

The SWM objectives for development of the site, derived from the above guidelines, include the following:

- Water quality - Level 1, 80% removal of TSS;
- Water quantity - 2 to 100 year pre = post as a minimum;
- Erosion - detain first 5 mm, 48 hour detention of first 25 mm;
- Water balance;
- Preserve existing landforms as much as possible;
- Encourage naturalization in suitable low areas;
- Erosion and sediment control plan;
- Stormwater practices that encourage infiltration and recharge;
- Reduce impervious surfaces areas.

Each of these stormwater management objectives will be met through the overall conceptual design outlined in this report. The Don River Watershed Plan Implementation Guide highlights the study area as a priority basin for onsite source control measures; as a result, the objectives are addressed to the extent feasible through onsite measures.

## 2. Stormwater Management Plan

The stormwater management plan for the site consists of a multi component approach in order to achieve the required treatment and flow rate control objectives. The proposed plan includes minimizing impervious areas, preserving natural landforms as much as possible, and introducing green roof areas. The integration of these management practices into a collective plan allows for the treatment and control of stormwater runoff through an economically and environmentally positive approach. Table 1 outlines the proposed stormwater management practices within the conceptual plan and their individual effectiveness for each of the design objectives.

**Table 1: Summary of Proposed Stormwater Management Practices Effectiveness**

SWMP	Effectiveness			
	Water Quality	Water Quantity	Erosion Control	Water Balance
Minimizing vehicle access	High	n/a	n/a	n/a
Minimizing Imperviousness	Medium	High	High	High
Preserving natural areas	Medium	Medium	High	High
Green Roof Areas	Medium	Low	Medium	Medium
On Site Bioretention	Medium	Medium	High	High

### 2.1 Existing Conditions

The site is located immediately south of Sheppard Avenue West, with CN rail tracks across the middle of the site in a north-south direction. The existing site is undeveloped; the only impervious surfaces consist of a small (approximately 4 m x 5 m) concrete block building, a 200 m gravel access road to this building, and the rail lines crossing the site. Less than 5% of the site is impervious area.

The site itself is drained by a series of constructed swales. Approximately 20% of the site drains westward to a catchbasin near the site property line adjacent to Sheppard Avenue. It is believed that this catchbasin drains directly into the Sheppard Avenue storm sewer. Approximately 30% of the site (the remaining portion west of the rail tracks) drains to internal ditches, draining to an existing 1350 mm storm sewer that runs parallel to and western adjacent to the rail line. This 1350 mm storm sewer flows north, crossing the rail line, then flows eastward along the southern edge of Sheppard Avenue along the north edge of the site. The eastern-most portion of the site, representing approximately 30% of the site area, drains to a deep ditch on the east side of the site. This ditch flows northwest, discharging to the above-mentioned 1350 mm storm sewer along the north edge of the site. The remaining 20% of the site (the remaining portion east of the rail tracks) drains via ditches and a 675 mm storm sewer northward, discharging to the same 1350 mm storm sewer. The Sheppard Avenue storm sewers flow eastward, into a 1650 mm storm sewer flowing in a northeastern direction. Approximately 1 km downstream the storm sewer discharges to an open channel through Garthdale Park, then outlets into the online stormwater management facility on the Don River in G.Ross Lord Park. There are no present concerns for conveyance of existing peak storm surface flows offsite, and no significant water quality concerns for drainage from the site.

**Figure 1: Existing Conditions, Sheppard West Station Location**



**Figure 2: Existing Conditions, Overland Drainage**

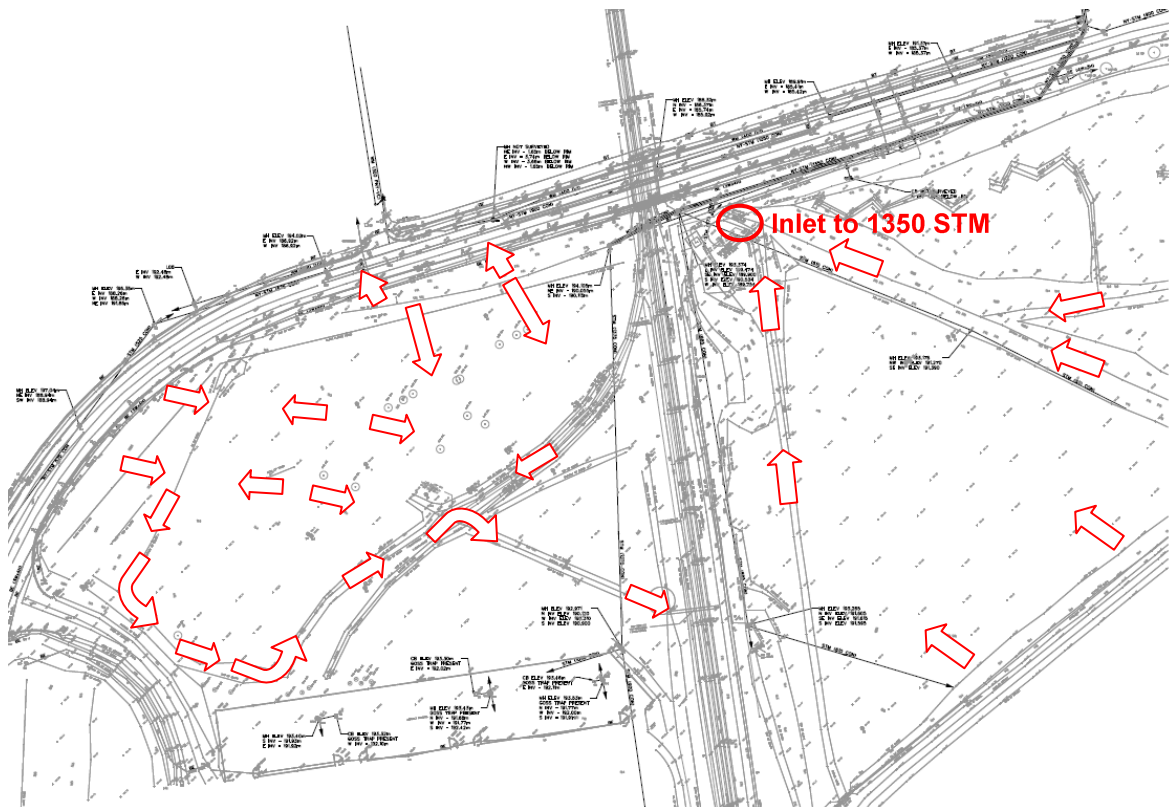
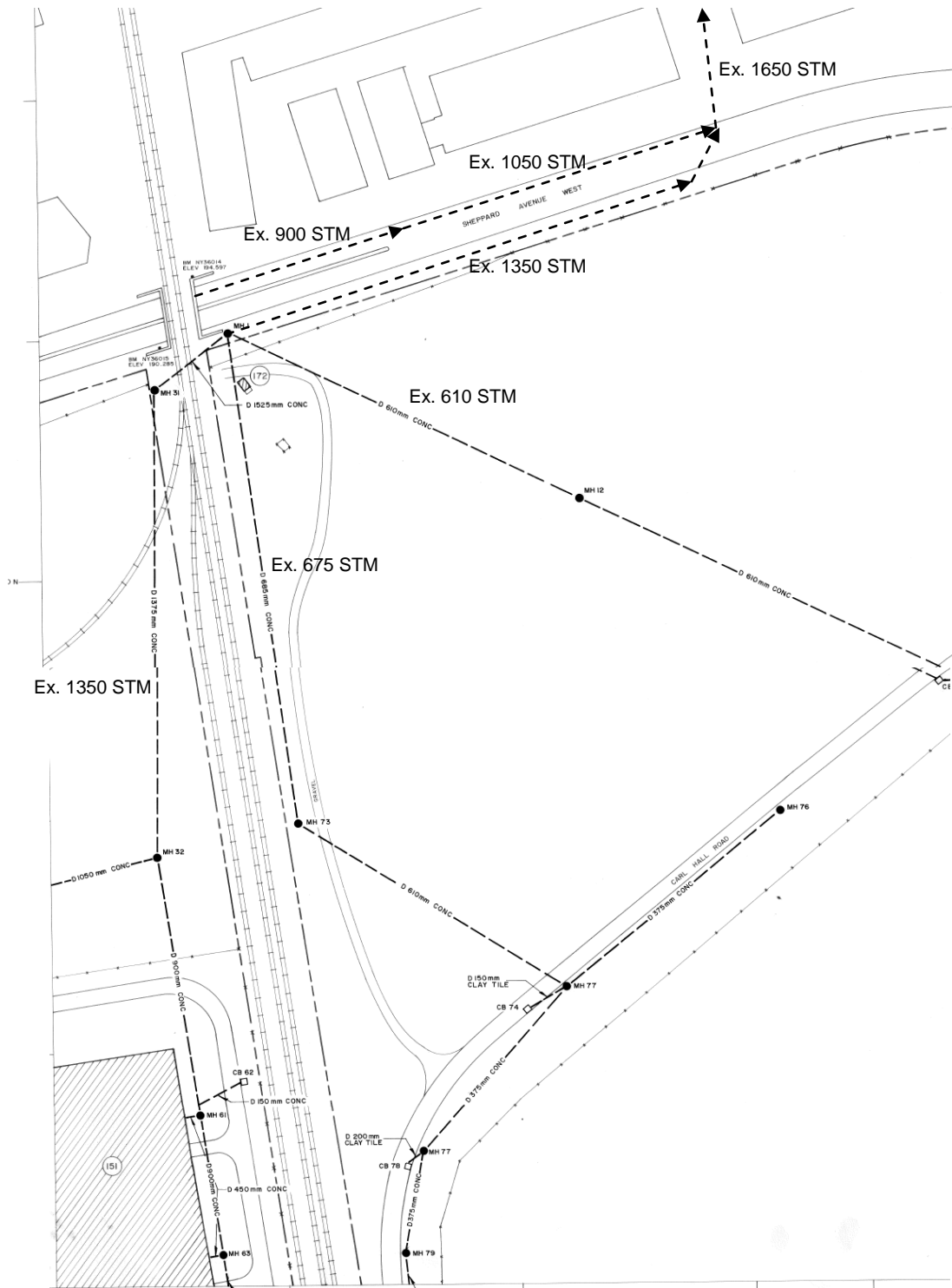


Figure 3: Existing Storm Sewer Drainage, Sheppard West Station Location

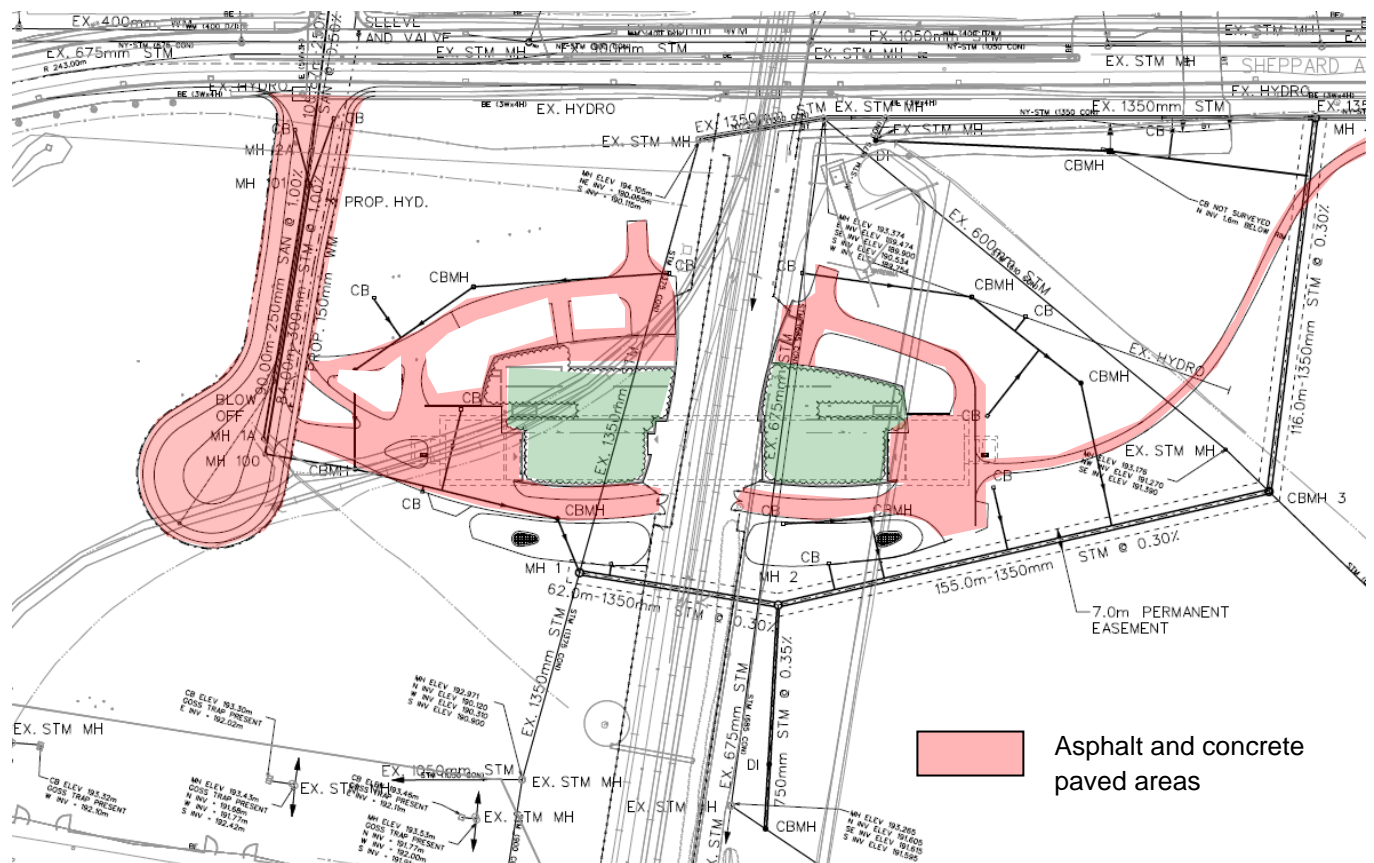


## 2.2 Proposed Conditions

Construction on the site will consist of one station building (approximate footprint 0.8 ha) and various small pedestrian pathways. Much of the roof area of the station building will consist of green roofs. The total impervious area for the site will be approximately 10%.

Construction of the station will require the existing storm sewers to be re-routed around the building. The existing 1350 mm storm sewer on the west side of the rail tracks will be re-routed across the tracks at the south side of the site, crossing to the east side. The new storm sewer will intercept drainage into the existing 675 mm storm sewer on the east side, continue to the eastern limit of the property, and then drain north into the Sheppard Avenue storm sewers. Note that there is no additional drainage into this storm sewer or the Sheppard Avenue storm sewer; the proposed sewer only intercepts existing drainage, and conveys this drainage and current site drainage to Sheppard Avenue, as previous.

**Figure 4: Proposed Site Plan – Impervious Areas**



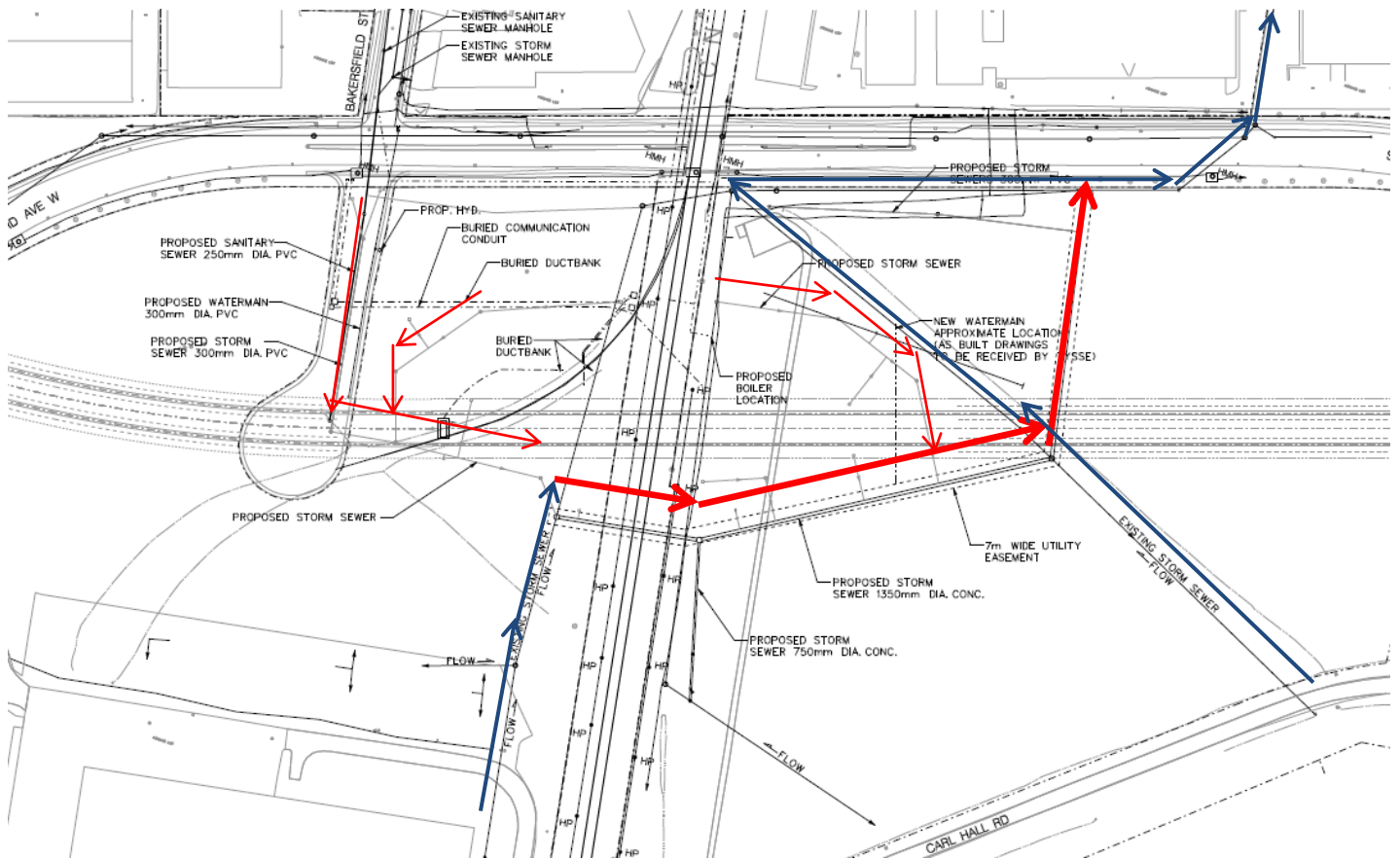
The total site paved areas are summarized as follows:

- Paved walkways, approximately 1500 m<sup>2</sup>.
- Paved cul de sac, approximately 3500 m<sup>2</sup>.
- Paved perimeter of station, approximately 2000 m<sup>2</sup>.

From the above, the total impervious area is approximately 0.7 ha, or 10 % of the site area shown in Figure 1. However, much of this proposed area is not 'directly connected' to the storm sewers on site; the paved walkways will drain onto the surrounding grass areas, and will not represent a change in existing quantity of drainage. The paved areas around the perimeter of the station and the cul de sac will drain to internal storm sewers, which will discharge to the new 1350 mm storm sewer along the south side of the station.

Proposed servicing of the site is shown in Figure 5.

**Figure 5: Proposed Storm Servicing**



## 2.3 Water Quality Control

Enhanced water quality (Level 1, as per MOE definitions) is provided for stormwater control, including design for 80% long term removal of total suspended solids from all impervious areas on the developed site. Due to the small size of the site (less than 5 ha), the small change to site imperviousness, and the fact that there is no vehicle access or parking, a wet pond is not recommended to provide stormwater quality control. Rather, the requirement for water quality control is minimized by reducing the increase in imperviousness on the site, and onsite best practices are identified to provide the required stormwater quality without the use of a pond.

### 2.3.1 Minimizing Imperviousness and Preserving Natural Areas

As discussed above, the impervious areas introduced on the site will be minimized. None of the new impervious areas (rooftops, pathways) will be 'directly connected' to the site storm sewers. Imperviousness of the roof areas will be minimized by introducing green roofs. Overflows from the green roof areas, drainage from the other portions of the roof, and drainage from the impervious pathways will drain onto existing grass areas, providing opportunities to continue to infiltrate as with pre-development conditions.

### 2.3.2 Grassed Swales (Medium Effectiveness)

Through the implementation of grassed swales, water quality will be improved through increased sediment removal and infiltration time of stormwater runoff. Grassed swales and overland drainage can be implemented internally in the site.

### 2.3.3 Green Roof Areas (Medium Effectiveness)

Green roof areas or roof top gardens provide social and environmental benefits where implemented. The inclusion of green roof areas within the stormwater management plan will provide water quality treatment; in concurrence with other environmental benefits such as air quality improvement.

### 2.3.4 Bioretention Areas (Medium Effectiveness)

Bioretention areas would improve water quality and provide additional evapotranspiration and infiltration opportunities for the stormwater.

## 2.4 Water Quantity Control

The Don River Watershed Plan and the Toronto WWFMMP identify unit flow rate discharge targets for areas north of Steeles Avenue. For areas such as the subject site, control is required to pre-development levels up to and including the 100-year storm.

The site peak flow control objective is no increase in peak flow discharging to the Sheppard Avenue storm sewers for all storms up to the 100-year storm. Since site total imperviousness is minimized (approximately 10%), and none of the site impervious areas are directly connected to the storm sewer system, there is

expected to be little increase in peak flow in the storm sewers discharging into the Sheppard Avenue storm sewer. Any increase in peak flow will be attenuated by internal storage in swales or the onsite sewers.

## 2.5 Erosion Control

According to the Don River Watershed Plan, erosion storage requirements are based on the degree of source control, size of the site, and sensitivity of the receiving waters. The emphasis in stormwater management for the subject site is to provide erosion control through source controls.

To address erosion control requirements of TRCA, the design considers the retention of an equivalent of 5 mm over the entire site for most storms, with extended detention for 25 mm of rainfall over the site for approximately 48 hours. The retention of 5 mm of runoff will be achieved through green roof areas. The remaining roof areas and pathways will be designed to drain overland to the existing ground, as with current conditions. Since for small storms there is expected to be no change in either the peak storm runoff or the volume of storm runoff, there is no extended detention storage proposed on site. Erosion control is addressed through discharge of stormwater to the grassed areas on site, and routing overland drainage into onsite swales where feasible.

## 2.6 Water Balance

The Don River Subwatershed Plan identifies water balance as an objective for developing sites; site water balance following new development shall resemble pre-development conditions to the extent possible.

The focus for the subject site is to maintain pre-development infiltration to the extent feasible through onsite measures. Water balance concerns are addressed by maximizing the retention and infiltration / evapotranspiration of runoff from areas of the site with relatively low risk of contamination (roof areas and lightly used ground areas, open space areas). Since for small frequent storms there is expected to be no change in the volume of storm runoff, there is no change expected for the site water balance. Retention of 5 mm of runoff in green roof areas provides added evapotranspiration to compensate for the small additional impervious area. Much of the impervious area is not directly connected, and drains to grass areas. Since this drainage then will evaporate, transpire, and infiltrate for small storms, there is no expected change in the existing water balance.

### 2.6.1 Bioretention Areas (High Effectiveness)

The conceptual design considers the potential benefits of discharging relatively clean runoff from the site impervious areas onto the adjacent grass areas. These grass areas would incorporate bioretention features, consisting of:

- a raised (perched) catchbasin inlet, 150 mm above the bottom of the channel;
- a 2 m wide pre-excavated trench, with a subdrain tying into the catchbasin, backfilled with granular material;
- topsoil and plantings.

The bioretention swales would provide capacity to retain approximately 50 m<sup>3</sup> of runoff, equivalent to 5 mm over the developed portion of the site (0.94 ha).

Other onsite swales, though not designed with engineered bioretention features, will continue to provide evaporation, transpiration, and infiltration for this site stormwater.

The implementation of bioretention swales is not currently identified as a site requirement. The site stormwater management will be reviewed with the City and TRCA; the swales can be added subject to city and agency comments.

### 3. Sizing Requirements

As identified in the previous section, development of the site is not expected to increase peak storm runoff from the site, so detention of stormwater is not currently recommended. As detailed design proceeds and additional details are provided for location of storm sewers, inlets, onsite swales, and overland flow paths, this conclusion will be confirmed. Any increase in peak flow above pre-development flow rates up to the 100-year storm will be mitigated by on site storage in oversized underground pipes.

Existing pre-development flow rates are estimated from the site using the Rational Method, with a time of concentration of 30 minutes and a runoff coefficient of 0.25, and a site area of 6.7 ha.

**Table 2: Pre-development Flow Rate from the Site (Rational Method)**

Return Period	Pre-development Flow Rate from Site (m <sup>3</sup> /s)
2-year	0.17
5-year	0.26
10-year	0.31
25-year	0.37
100-year	0.48

If 0.50 ha of the site is directly connected impervious areas under post-development conditions, this represents an increase in the site runoff coefficient from 0.25 to 0.31. Table 3 shows the change in peak flow estimate, based on Rational Method calculations.

**Table 3: Post-development Flow Rate from the Site (Rational Method)**

Return Period	Pre-development Flow Rate from Site (m <sup>3</sup> /s)
2-year	0.22
5-year	0.32
100-year	0.60

#### *Potential Control of 5-year Flows*

Modified Rational Method calculations indicate that a storage volume of 30 m<sup>3</sup> is required to reduce the site 5-year peak flow to pre-development levels. This could be accommodated by upsizing the last 116 m of 1350 mm storm sewer on site to 1500 mm. Note, however, that the capacity of the 1350 mm storm sewer crossing the site is approximately 2.9 m<sup>3</sup>/s, and the increase in 5-year peak flow associated with the paved areas on site therefore only represents approximately 2% of the sewer capacity. In addition, applying a hydrologic model such as SWMHYMO to the site area indicates that there will be no increase in peak flow due to the relative timing of the responses from pervious and impervious areas. As a result, it is not proposed to provide stormwater detention for quantity control on site for the 5-year storm.

### *Potential Control of 100-year Flows*

Under existing conditions, overland flow collects on site in swales that drain directly into the storm sewer system. This overall surface drainage pattern is generally preserved for post-development conditions, utilizing the existing 1400 mm culvert under the rail tracks to the east side of the tracks, and swales on the east side of the tracks directed to an inlet on the north side of the site to the existing 1350 mm storm sewer.

Existing major system flow patterns are shown in Figure 2.

Modified Rational Method calculations indicate that a storage volume of 65 m<sup>3</sup> is required to reduce the site 100-year peak flow to pre-development levels. There are currently approximately 300 m of storm sewers will exist in the newly serviced portion of the site. If these storm sewers were upsized to 525 mm, the storage of 65 m<sup>3</sup> would be provided in the onsite sewers.

### *Stormwater Management During Construction - Control of Dewatering Flows*

During construction, dewatering flows will be conveyed to the existing downstream storm sewer. The capacity of the existing downstream storm sewers to convey this additional flow can be addressed in the following ways:

- ensuring dewatering pumps do not operate during periods of intense rainfall (i.e. ensuring that they are not operating for design 2-year storm events or larger storms); and
- providing sufficient temporary storage volume in the site storm sewers to offset the potential increase in peak flow due to dewatering for smaller storms.

To address the second point, dewatering volumes are estimated for typical large storms over a duration of 5-minutes, when storm intensities are largest. Typical dewatering rates are up to 15 L/s for trunk sewer constructed in a shallow aquifer. Over 5 minutes, this can produce a volume of 4.5 m<sup>3</sup>. The volume in the new 330 m of 1350 mm storm sewers on site is approximately 470 m<sup>3</sup>. As a result, the additional dewatering flows represent a very small portion (1 %) of the volume in the newly-constructed 1350 mm pipes on site.

The dewatering flows could potentially be retained on site by temporarily restricting the capacity of the outlet by the dewatering rate (15 L/s) during dewatering. The 1350 mm outlet pipe capacity is 2.9 m<sup>3</sup>/s, so the 15 L/s dewatering rate is only 0.5 % of the pipe capacity. A temporary weir (i.e. bricks or sandbags) was initially considered as an option to restrict flows; however, there are no reasonable means of restricting flows by only 0.5%.

As a result, the only provision allowed to mitigate the impact of dewatering flows on the downstream storm sewer capacity is to not operate the pumps during periods of intense rainfall.

## 4. Erosion and Sediment Control

The sediment and erosion control measures to be implemented as part of the construction and servicing of the site will include the following:

- heavy duty silt fencing
- light duty silt fencing
- rock check dams
- strawbale filters
- filter fabric under catchbasins frame and grates
- mud mats

The Grading and Erosion Control plans will provide the details and locations of most of the proposed sediment and erosion control measures and will form part of the approved engineering. Any proposed modifications to the sediment and erosion controls detailed as the aforementioned engineering drawings must be approved by the applicable agencies.

A temporary sedimentation pond will be constructed to provide sediment control during construction. The temporary sediment pond will be sized to detain 125 m<sup>3</sup>/ha of runoff from the upstream construction area. Regular monitoring of the temporary sediment pond will have to be undertaken in order to assess when it will have to be cleaned.

Temporary ditch inlet catchbasins will be located throughout the site to provide temporary drainage of the undeveloped portions to the storm sewer system. All disturbed areas will be restored with either a hard surface (i.e. asphalt or concrete) or with topsoil and hydroseed/sod. The use of a bonded fibre matrix (BFM) will be implemented during the construction to promote germination and to protect exposed surfaces from possible erosion.

There are no environmental significant or sensitive areas on the site. Any temporary storm drainage discharge to the Sheppard Avenue storm sewers will be properly filtered through rock check dams and or strawbale filters.

The installation of the storm sewers will require some dewatering specifically with regards to the deeper sanitary servicing. The proposed dewatering program will be reviewed by Golder Associates to ensure that the dewatering will provide for adequate installation conditions and will not result in any detrimental effects any local wells or aquifers. It will be determined if a permit to take water will be required based upon his proposed dewatering program.

All topsoil stripping stockpiles will be located in strategic locations to allow for easy access for removal of excess topsoil while also ensuring that that the stockpiles are protected with light duty silt fencing on the downward gradient sides of the stockpiles. All disturbed areas left inactive for 30 days or more shall be revegetated in order to minimize erosion.

During the period when the servicing contractor is on site the day to day maintenance of the sediment and erosion controls will be undertaken by the servicing contractor. Once the servicing contractor has left the site then the day to day maintenance of the sediment and erosion controls will become the responsibility of the

owner (TTC). TTC will be made aware of the need to maintain the sediment and erosion controls and be prepared to address any immediate needs caused by significant runoff events such as large rain storms or snow melt.

The owners engineer will be required to ensure that the sediment and erosion controls are implemented during construction and are then subsequently decommissioned appropriately once the need for the sediment and erosion controls has lapsed.

A record of the sediment and erosion control implementation should be maintained from the initial stages during the storm/sanitary construction stage to the day to day maintenance and monitoring of the sediment and erosion controls. Such record keeping would include a submission of a certificate certifying that the sediment and erosion controls were installed and maintained during the initial servicing stage and then subsequent semi annual submission of inspection reports detailing how the sediment and erosion controls have been maintained and replaced/repared as necessary.

It will be the responsibility of the site owners to have the sediment and erosion controls measures installed and maintained throughout the development period of the specific site.

## 5. Conclusions

The conceptual stormwater management plan will provide appropriate measures to fulfill the stormwater management objectives while meeting the relevant standards and design criteria. A stormwater master plan for the study area is prepared for the TTC lands south of Sheppard Avenue to evaluate and select the preferred stormwater management practices. The design concepts include:

- preserving natural landforms as much as possible;
- introducing green roof areas;
- limiting the total net imperviousness of the site to approximately 10%;
- limiting the amount of directly connected impervious areas;
- restricting vehicle access and potential high impacts to stormwater quality through site development.

Additional water quality, erosion, and water balance concerns could be addressed by constructing bioretention areas on site to address water quality, water balance, and erosion concerns. These naturalized low lying areas would contribute to runoff treatment and control while maintaining a natural element to the site landscape.

This SWM report identifies that approximately 65 m<sup>3</sup> of storage would be required on site to offset potential increases in stormwater runoff for up to a 100-year storm, controlling flows to pre-development levels. This could be provided by oversizing the site internal storm sewers to 525 mm, or within the above bioretention areas (if implemented).

There is no requirement to introduce structural measures (such as ponds or oil grit separators) to control storm water quality on site, site there is no vehicle traffic on site and few water quality impacts associated with site development.