APPENDIX D – DRAINAGE AND STORWATER MANAGEMENT ASSESSMENT REPORT

Toronto Transit Commission

Eglinton Crosstown LRT

DRAINAGE AND STORMWATER MANAGEMENT ASSESSMENT REPORT

DECEMBER 21, 2009

TCG Transit City Group

IBI GROUP Giffels Associates Limited | AECOM

Toronto Transit Commission

EGLINTON CROSSTOWN LRT
FROM PEARSON INTERNATIONAL AIRPORT TO KENNEDY ROAD

DRAINAGE AND STORMWATER MANAGEMENT ASSESSMENT REPORT

DECEMBER 21, 2009

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GIFFELS ASSOCIATES LIMITED / IBI GROUP DRAINAGE AND STORMWATER MANAGEMENT ASSESSMENT REPORT
Toronto Transit Commission
EGLINTON CROSSTOWN LRT
FROM PEARSON INTERNATIONAL AIRPORT TO KENNEDY ROAD

1. EXISTING DRAINAGE CONDITIONS

Within the project limits, Eglinton Avenue traverses Mimico Creek, Silver Creek, Humber River, Black Creek, West Don River, East Don River, Wilson Brook and Massey Creek. The location of the watercourses within the project limits is shown on **Figure 1**. At the point where these watercourses cross Eglinton Avenue, the general drainage direction is from North to South. All creeks and watercourses that cross the Eglinton Avenue right-of-way are tributary to three major watersheds which include Mimico Creek, Humber River and the Don River (east and west branches). Wilson Brook and Massey Creek are tributaries of the East Don River, while Silver Creek and Black Creek are tributaries of the Humber River. A portion of the roadway at west project limit drains to Renforth Creek within the Etobicoke Creek watershed system. However, there is no creek crossing within this segment (Renforth Drive to Silver Dart) of the project. Drainage in these systems is southward towards Lake Ontario.

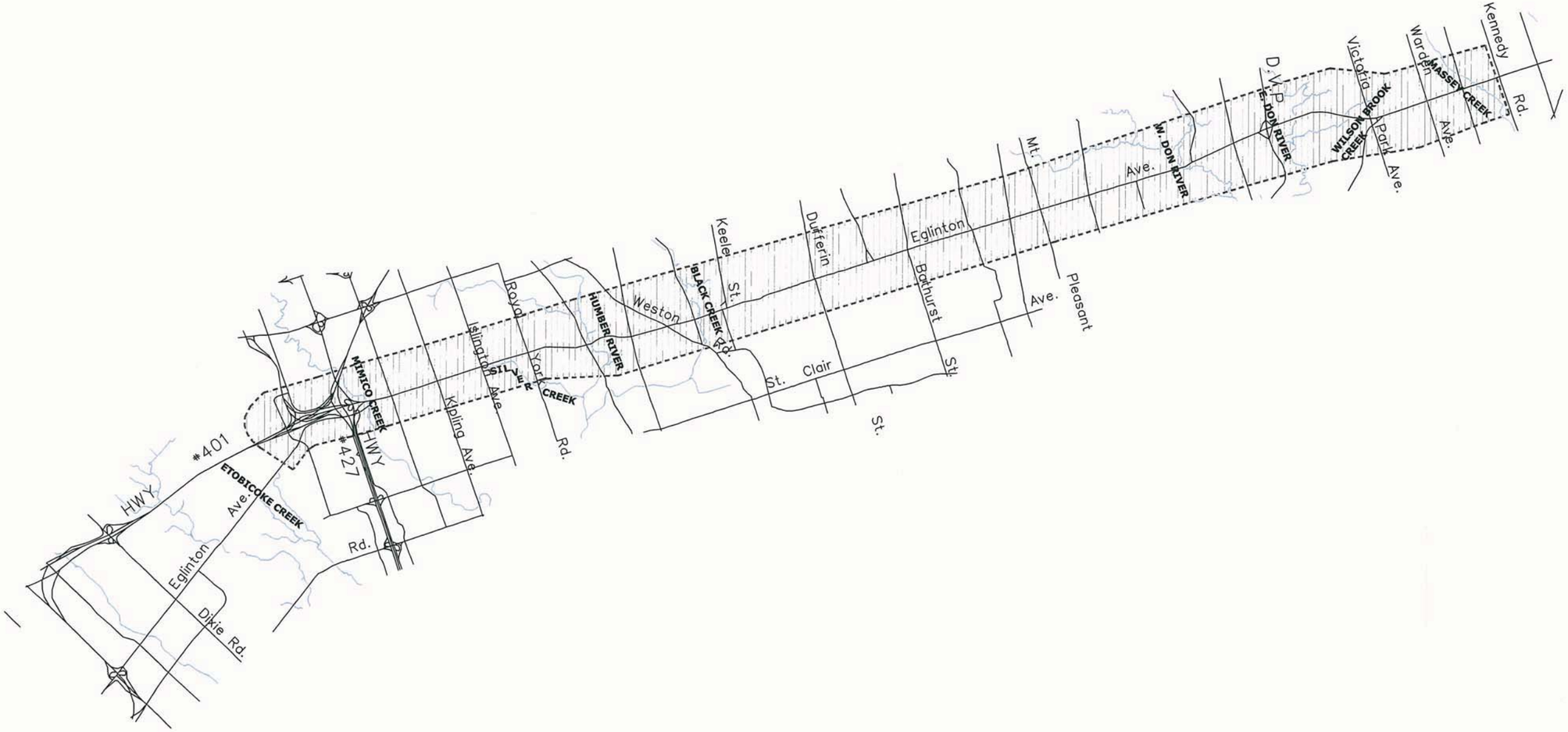
The topography within the proposed alignment varies significantly from west to east. For example, the intersection of Eglinton Avenue and Kipling Avenue is at an elevation of approximately 159 m above sea level (masl); whereas at the Humber River, ground surface is at elevation 108 masl. Further to the east at the intersection of Jane Street, near Old Forest Road, ground surface is about elevation 99 masl. Eastward from that point, ground surface elevations progressively increase to around 180 masl, and then flatten out at that elevation before decreasing to 100 masl at the East Don River; then progressively increases to about 164 masl at Kennedy Road. The Eglinton Avenue road profile and associated variations in elevation are presented on **Plates 4 to 40**.

The site is predominantly located in the Peel Plain and South Slope physiographic region (Chapman and Putnam, 1984). This complex area is characterized by shoreline, beach and lake plain deposits associated with the Pleistocene glacial Lake Iroquois, a predecessor of Lake Ontario.

1.1 Existing Roadway Drainage

Under existing conditions, runoff from Eglinton Avenue is collected by catchbasins and conveyed primarily by storm sewer systems and/or roadside ditches, which eventually discharge to nine (9) separate watercourses i.e. Renforth Creek, Mimico Creek, Silver Creek, Humber River, Black Creek the West Don River, East Don River, Wilson Brook and Massey Creek. The watercourse details and length of roadway segment discharging to each of these watercourses are provided in **Table 1**.

The existing storm water management system does not provide for any significant water quality treatment before discharging to the above noted creeks or river systems. The roadway drainage areas, existing storm outlet locations and associated drainage features within the project limits are shown on **Plates 1 to 40**.



LEGEND

PROJECT LIMITS

WATERCOURSE

TORONTO TRANSIT COMMISSION
ENGINEERING DEPARTMENT

Date: October 2009	Fig. No.
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Table 1 – Drainage Outlet and Watercourse Details

Drainage Area	Road segment		Roadway Segment	Reference Drawing	Drainage Conveyance	Drainage Outlet	River /Creek
	From	To					
1	96+500	97+134	0.13km east of Renforth Dr. to Commerce Blvd.	Plates 4 to 5	Storm sewers	Renforth Creek	Etobicoke Creek
	52+800	54+500	Commerce Blvd. to 0.10 km north of International Blvd.	Plates 1 to 3			
2	97+134	100+500	0.13km east of Renforth Dr. to 0.1km east of Kipling Ave.	Plates 5 to 9	Catchbasins / roadside ditches	Mimico Creek	Mimico Creek
3	100+500	102+550	0.10km east of Kipling Ave to 0.15km east of Royal York Rd	Plates 9 to 11	Roadside Ditches	Silver Creek	Silver Creek
4	102+550	105+170	0.15km east of Royal York Rd to 0.47km east of Jane St	Plates 11 to 15	Storm sewer system	Humber River	Humber River
5	105+170 to 114+550		0.47km east of Jane St to Banff Rd.	Plates 15 to 27	Storm sewer system	Trunk Sewer	Black Creek
6					Storm sewer system	Trunk Sewer	Black Creek
7					Storm sewer system	Trunk Sewer	Black Creek
8					Storm sewer system	Trunk Sewer	Black Creek
9					Storm sewer system	Trunk Sewer	Black Creek
10					Storm sewer system	Trunk Sewer	Black Creek
11					Storm sewer system	Trunk Sewer	Black Creek
12					Storm sewer system	Trunk Sewer	Black Creek
13					Storm sewer system	Trunk Sewer	Black Creek
14	114+550	118+200	Banff Rd. to Don Mills Rd.	Plates 27 to 32	Storm sewer system	West Don River	West Don River
15	118+200	120+300	Don Mills Rd. to 0.3km west of Sloane Ave.	Plates 32 to 35	Storm sewer system	East Don River	East Don River
16	120+300	121+680	0.3km west of Sloane Ave to Pharmacy Ave.	Plate 35 to 37	Storm sewer system	Wilson Brook	Wilson Brook
17	121+680	122+510	Pharmacy Ave. to Warden Ave.	Plates 37 to 38	Storm sewer system	Trunk Sewer	Massey Creek
18	122+510	123+330	Warden Ave. to Birchmount Rd.	Plates 38 to 39	Storm sewer system	Trunk Sewer	Massey Creek
19	123+330	124+160	Birchmount Rd. to Kennedy Rd.	Plates 39 to 40	Storm sewer system	Massey Creek	Massey Creek

1.2 Existing Bridge/Culvert

Within the project limits, there are eight watercourse crossings which convey external drainage across the Eglinton Avenue right-of-way. An inventory of all the crossings and the respective bridges/culverts was completed and their characteristics are summarized in **Table 2.** The locations of existing transverse bridges /culverts are shown on **Plates 1 to 40**.

Table 2 – Existing Bridge/Culvert Data

River / Creek	Station	Approx. Location	Reference Drawing	Bridge / Culvert Type	River Bed / Invert Elevation	Fish Community
Mimico Creek	98+770	0.55 km west of Martin Groove Rd.	Plate 6	Single Span, RC deck on pre-stressed , pre-cast girders	137.10	Warmwater
Silver Creek	102+080	0.35 km west of Royal York Rd.	Plate 11	N/A	N/A	Warmwater
Humber River	103+740	0.10 km east of Scarlett Rd.	Plate 13	5 span circular voided post-tensioned concrete	100.87	Warmwater, Large Riverine habitat
Black Creek	106+190	0.15 km east of Black Creek Dr.	Plate 16	Single Span, RC deck on pre-stressed girders	104.50	Warmwater
West Don River	116+980	0.25 km west of Leslie St.	Plate 31	5 span (3 steel girder+2 RC slab on concrete girder approach spans)	95.50	Warmwater, Management target species including redside dace
East Don River	119+630	0.26 km east of Wynford Dr.	Plate 34	4 span, steel girders with concrete deck, skewed	95.50	Warmwater, Management target species including redside dace
Wilson Brook	120+675	0.33km east of Bermondsey Rd.	Plate 36	CSP, d/s buried	N/A	Warmwater, Management target species including redside dace
Massey Creek	123+655	0.33 km east of Birchmount Rd.	Plate 40	5.2 m (span) x 3.22 m (rise)	150.22	Warmwater, Management target species including redside dace

Note: CSP – Corrugated Steel Pipe

The peak flows and corresponding water surface elevations for 100 yr and Regional storms at major bridge / culvert crossings of Eglinton Avenue are presented in **Table 3.**

Table 3 – Peak Flows at Culvert Crossing Locations

Structure	River / Creek	Peak Flow (m3/s)		Water Surface Elevation (m)	
		Regional	100 yr	Regional	100 yr
Bridge	Mimico Creek	354.00	136.00	143.40	141.09
N/A	Silver Creek	N/A	N/A	N/A	N/A
Bridge	Humber River	1651.60	520.30	106.74	104.52
Bridge	Black Creek	510.80	240.00	111.30	109.14
Bridge	West Don River	620.15	178.06	101.63	99.64
Bridge	East Don River	861.86	283.32	105.98	101.37
Culvert	Wilson Brook	N/A	N/A	N/A	N/A
Culvert	Massey Creek	81.0	60.0	157.60	156.80

Source: TRCA's HEC-RAS/HEC-2 models
Notes:
1 100 year storm: A one-hundred-year flood is calculated to be the level of flood water expected to be equalled or exceeded every 100 years on average. The 100-year flood is more accurately referred to as the 1% flood, since it is a flood that has a 1% chance of being equalled or exceeded in any single year.
2 Regional Storm: In the above watersheds, the regional flood is a five-hundred-year flood event that has a 0.2% chance of being equalled or exceeded in any single year.

According to TTC design standards, 100-year design storm frequency shall apply for the design of major drainage system.

2. PROPOSED DRAINAGE / STORMWATER CONDITIONS

2.1 Roadway Drainage

The LRT will be located at grade between Kennedy Station and a point east of Brentcliffe Road, and between a point west of Keele Street to Pearson International Airport. Between Leslie and Jane streets, the LRT is proposed to be underground due to narrow width of Eglinton Avenue in this section (the width is insufficient to accommodate two lane of traffic in each direction and the LRT). A new lane (LRT) will be added in each direction west of Scarlett Road, but no widening is proposed in the east end or underground sections of the project. The plan for the proposed LRT/roadway is illustrated on **Plates 1 to 40**.

The LRT is approximately 33 kilometres in length. Within the project limits, LRT will traverse Mimico Creek, Humber River, Black Creek, West Don River, East Don River, and Massey Creek floodplains. The location of these floodplains is shown on **Plates 1 to 40**. A portion of the surface LRT between west of Keele Street and Scarlett Road will be within the Humber River and Black Creek floodplains. A more comprehensive description of floodplain associated impacts is provided in section 2.3.

There are four (4) tunnel portals for the LRT, one at each opening to the tunnel section as well as two at Don Mills station. The west portal is currently planned for east of Black Creek Drive and east tunnel portal is currently planned for east of Brentcliff Road. The

portals at Don Mills station are planned immediately to the east and west of the station. The location of these portals is presented in **Appendix B**.

With the close proximity of the floodplain, portal elevations at all four locations were reviewed. The proposed three (3) portals at the East section of the LRT (East Don River and West Don River floodplains) are above regional flood elevation. However, a portion of the tunnel approach at the portal located at Black Creek crossing will be within Black Creek floodplain. A more comprehensive hydraulic detail on the Black Creek portal is presented in section 2.3.

The general direction of roadway overland flow will not be altered and maintained as currently occurs. It is expected that the quantity of runoff from the improved section of the roadway will result only in a very minor increase in runoff, and as such, specific techniques to reduce the quantity and rate of runoff are not required. It is anticipated that there will be no significant changes in peak flows due to the proposed LRT. This is due to the fact that peak flows generated from the upstream catchments are much greater than the peak flows generated from smaller widened paved areas, which occur earlier. Due to this lagging effect a small increase in the peak flow generated by the widened roadway does not result in an appreciable increase in the peak flow of the overall hydrograph.

2.2 Minor Drainage System

Based on the Eglinton Avenue roadway profile, there are 19 roadway drainage areas within the project limits as shown on **Plates 1 to 40**. As illustrated in **Table 1,** runoff within most of the Eglinton Avenue right-of-way is conveyed by storm sewers. However, roadway runoff at the west section (drainage areas 2 and 3) of the project is conveyed by roadside ditches. Storm runoff from these areas is eventually conveyed to 8 watercourse crossings with the exception of drainage area 1. Storm runoff from the drainage area 1 (west project limit) is collected by storm sewers and conveyed to Renforth Creek /Etobicoke Creek located outside the project limits, and as such there is no creek crossing within this segment (Renforth Drive to Silver Dart) of the project.

Under proposed conditions, the existing storm sewers will continue to discharge to current cross-culverts and trunk sewer systems within the Eglinton Avenue ROW, as presently occurs. It is assumed that the proposed roadway drainage within Mimico Creek and Silver Creek watersheds will continue to be conveyed by roadside ditches. The general direction of roadway flow will not be altered and drainage pattern will be maintained.

At west section (west of Martin Grove Road), catchbasins / storm sewers may require relocation as a result of proposed Eglinton Avenue widening. The storm sewers located between Royal York and Weston Road may require hydraulic capacity assessment to ensure that the capacities of these receiving storm sewers are not compromised due to proposed increase in pavement area. At other locations where increase in pavement area is nominal, it is anticipated that the existing storm sewers capacities will not be impacted.

2.3 Hydraulic Assessment and Flood Plain Management

A hydraulic analysis was undertaken to assess the potential watercourse related impacts (i.e. upstream water levels and channel velocities) of proposed roadway widening at major crossings. The watercourse crossings proposed for widening include Mimico Creek, Black Creek, West Don River and East Don River. A one dimensional backwater assessment

was carried out using the HEC-RAS computer model. The HEC-RAS model developed by TRCA was updated to reflect the proposed bridge/culvert upgrades. Simulations were conducted for the 2 to 100 year as well as Regional storm events. According to the guidelines of MTO's Directive B-100, the design return period for structures with span less than 6.0 m is 50-year. A structure with a span of over 6m on an Urban Arterial road should be designed to convey the 100-year design storm at the required freeboard and soffit clearance.

No widening is proposed at Humber River and Massey Creek crossings and no hydraulic analyses were conducted at these two structures.

Mimico Creek Crossing

The Bridge at Mimico Creek is proposed to be extended approximately 5.5 m on either side of the roadway to accommodate the LRT. It is proposed to widen the bridge without disturbing the geometric shape and cross sections of the creek. Under existing conditions the Regional storm does not overtop Eglinton Avenue and floodline is below the top of the bridge.

A hydraulic analysis was undertaken using the HEC-2 computer model to simulate the effects of the proposed extensions. The TRCA's base model was modified to reflect the proposed widening at the bridge deck. TRCA's base model (HEC-2) and flows were adopted for this analysis. The results of HEC-2 model run for existing (base model) and proposed conditions are presented in **Table 4.** As shown in **Table 4**, the proposed widening of the bridge deck will not impact on regional flood line (water surface elevation) in the Mimico Creek. The HEC-2 model outputs are presented in **Appendix A.**

Table 4 – Mimico Creek HEC-2 Output Summary

HEC-2 X Section No.	Existing WSEL* (m)		Proposed WSEL (m)		Difference (m)	
	100 year	Regional	100 year	Regional	100 year	Regional
2.33	141.09	143.40	141.10	143.41	0.01	0.01

* Water surface elevation

Humber River Crossing

Under proposed conditions, no widening is proposed at Humber River Bridge. As such, no hydraulic analysis was conducted for this crossing.

A portion of the LRT at Jane Street intersection will be operating within the Humber River regional floodplain. To eliminate the risk of flooding on LRT operations, it is recommended to suspend the LRT operations during the regional storm event (i.e. 1 in 500 years). TRCA's base model (HEC-RAS) indicates that the 100 year flood event at this location will not impact on LRT operations.

Black Creek Crossing

Eglinton Avenue crossing over Black Creek has a single span bridge (28 m) and located 150 m east of Black Creek Drive intersection. It is proposed to extend the existing bridge by approximately 1.55 m on either side of the road to accommodate the LRT. Under

current Regional storm conditions, the water level upstream of watercourse crossing rises to 111.30 m, resulting in a 0.60 m depth of flooding over the road. The figure presenting the overtopping is provided in **Appendix A**.

A hydraulic analysis was undertaken using HEC-RAS computer model to simulate the effects of proposed extensions. TRCA's base model (HEC-RAS) and flows were adopted for this analysis. The preliminary results of HEC-RAS model run indicated that the proposed widening will not impact on upstream flooding conditions and the existing upstream flood elevations will be maintained. Since the proposed development is not impacting on regional flood elevations, no flood mitigation measures are required at this location. The results of HEC-RAS model run for existing (base model) and proposed conditions are presented in **Table 5**. As shown in **Table 5**, the proposed widening of the bridge deck will not impact on regional flood line (water surface elevation) in the Black Creek. The HEC-RAS model outputs are presented in **Appendix A**.

Table 5 – Black Creek HEC-RAS Output Summary

X Section No.	Existing WSEL (m)		Proposed WSEL (m)		Difference (m)	
	100 year	Regional	100 year	Regional	100 year	Regional
48.282	109.14	111.30	109.14	111.30	0.00	0.00

Based on the proposed design, the underground section of the LRT starts approximately 151 m east of the Black Creek Bridge. The location of the portal is provided in **Appendix B**. At this location, the bridge is located in a sag and the roadway profile gradually rises towards the east. To support the rising grade, approximately 115 m of retaining walls (Boat Walls) construction is proposed. According to the proposed design, the construction of retaining walls will start approximately 35 m east of the bridge centre line. It is assumed that the top elevation of retaining walls (boat walls) will not exceed the existing roadway profile. A review of regional flood line elevation indicates that approximately 50 m of tunnel approach at this location will be in the floodplain. However, the portal door is above the regional floodplain.

The 100 year flood elevation at Black Creek crossing will not impact on LRT operations. However under regional flood event, the LRT will be operating within the regional floodplain. The following options are suggested to eliminate the risk of regional flooding on LRT operations:

1. Suspend the LRT operations during regional storm event (i.e. 1 in 500 years). Currently this is what is happening to the traffic on the roadway.

2. Alternatives such as bypass culverts or raising the bridge profile above the regional flood elevation.

The size of floodplain precludes the option of relief culverts. Based on the size of floodplain at this location and LRT alignment considerations; option 1 (maintain status quo) was considered economical with no impact to natural environment. The findings presented here are preliminary and further investigations should be conducted during preliminary design.

West Don River Crossing

The top of existing road elevation at the centre line of Eglinton Avenue at West Don River Bridge is 106.0 m. Under current Regional storm condition, the flood elevation at the upstream face of the bridge is at 101.51 m, indicates that the flooding line is 4.49 m below the top of the bridge.

A HEC-RAS model incorporating the proposed improvements was created to assess the impact on the upstream water surface elevations. It is proposed to extend the existing bridge by approximately 1.05 m on either side of the road to accommodate the LRT. The bridge data were adjusted to incorporate the proposed extensions and to accurately reflect the cross-sectional data and/or bridge geometry associated with the extension of existing 5 (five) span bridge. The proposed widening of the bridge will not impact on the geometric shape and cross sections of the river. For consistency, the normal bridge routine was used for backwater analysis at the crossing location. The proposed conditions HEC-RAS model and the corresponding calculated water surface elevations are summarized in **Appendix A**.

Table 6 – West Don River HEC-RAS Output Summary

X Section No.	Existing WSEL (m)		Proposed WSEL (m)		Difference (m)	
	100 year	Regional	100 year	Regional	100 year	Regional
16.42	99.64	101.63	99.64	101.63	0.00	0.00

The results of the hydraulic analysis indicate that the proposed extensions will not cause any variation in the water surface elevations at the upstream face of the Bridge. **Table 6** summarizes the existing and proposed condition flood-levels during the Regional flood events.

East Don River Crossing

The Bridge at East Don River is proposed to be extended by 1.15 m on either side of the roadway to accommodate the LRT. It is proposed to widen the bridge without disturbing the geometric shape and cross sections of the river. The top of existing road elevation at the centre line of Eglinton Avenue at Bridge is 118.40 m. Under current Regional storm condition, the flood elevation at the upstream face of the bridge is at 105.49 m, indicates that the flooding line is 12.9 m below the top of the bridge.

A HEC-RAS model incorporating the proposed improvements was created to assess the impact on the upstream water surface elevations. The bridge data were adjusted to incorporate the proposed extensions and to accurately reflect the cross-sectional data and/or bridge geometry associated with the extension of existing 4 (four) span bridge. The proposed conditions HEC-RAS model and the corresponding calculated water surface elevations are summarized in **Appendix A**.

Table 7 – East Don River HEC-RAS Output Summary

X Section No.	Existing WSEL (m)		Proposed WSEL (m)		Difference (m)	
	100 year	Regional	100 year	Regional	100 year	Regional
41.045	101.37	105.98	101.39	105.99	0.02	0.01

The results of the hydraulic analysis indicate that the proposed extensions will cause minor variation in the water surface elevations at the upstream face of the Bridge. **Table 7** summarizes the existing and proposed condition flood-levels during the Regional flood events.

2.4 Water Quality Control

Water quality control for the Eglinton Avenue widening should meet the following stormwater management criteria:

- Provide water quality treatment to offset, as a minimum, the increase in roadway pavement area as a result of roadway widening;
- Any proposed control measures should be sized to provide Level 1 treatment and meet the design requirements of the Ministry of the Environment's Stormwater Management Planning and Design (MOE Manual, 2003);
- Provide erosion control, if feasible (Detention runoff for 24 hours from 25 mm storm).

A pavement area analysis was performed to determine the increase in impervious surface as a result of the roadway improvements. It was determined that the proposed roadway improvements will result in a 15-percent increase in pavement area within the study corridor. **Table 8** summarizes the results of the pavement area analysis.

Table 8 indicates the project will not significantly add impermeable areas in the east section (drainage areas 15 to 19) of the project. Also, at underground sections (drainage areas 5 to 14) there will be no significant increase in the pavement with the exception to portal locations where some roadway widening is anticipated. As such no water quality control measures are warranted on these segments of the road. However, according to MOE, any new construction/development must address existing situations and provide the necessary measures to achieve an 'enhanced' level of water quality treatment of stormwater converging into the watercourses that are located within the project area.

Due to the limitation of space, it is recommended to provide oil/grit separator (OGS) units to improve the existing situation at all watercourses where water quality is impaired. Where feasible, the report recommends incorporation of water quality control measures by means of permeable paving on future bike lanes/sidewalks and creating more green spaces within the right-of-way.

At west section, a number of stormwater quality control practices were reviewed and assessed for their applicability on this project. Due to the nature of this facility (i.e. linear transportation corridor), limited space within the roadway right-of-way, it was determined that two possible SWM measures were applicable for use, namely oil/grit separator systems and grassed swales. The possibility of using wet ponds located in adjacent lands outside the right-of-way (existing /future) should be explored to ensure that the stormwater objectives are effectively addressed. A more detailed evaluation of these measures is required during preliminary design.

It is assumed that existing water quality control measures (i.e. roadside ditches within the project corridor) will be maintained. Wherever feasible, opportunities to enhance existing stormwater measures will be explored. Currently water quality controls at Mimico Creek and Silver Creek are achieved by roadside ditches. Where space constraints allow, these roadside ditches should be enhanced by providing a flat bottom width of 0.75m. Details including location, length and size of swales will be determined during detail design.

The drainage system at east Don River Bridge consists of deck drains located at certain intervals on the bridge deck. Stormwater is collected into a single pipe and then discharged through outfall below the deck into the river. It is recommended to modify the current drainage system by directing outlet pipe from deck drain to soak pits. The soak pits can be placed at the bottom of piers. These soak pits will prevent erosion and filter runoff before discharging to river system. Possibility of installing OGS before discharging to soak pits should be explored during detail design.

It should be noted that no deck drains exist on other bridges including west Don River Bridge. Storm water drains to catch basins at the abutments and outlet to adjacent roadside ditches before reaching the river. Erosion protection is required at the catch basin outlets to protect the embankment and prevent potential sediments reaching to the river.

Stormwater Control, Mitigation, Erosion and Sediment Control measures shall be enumerated as per MOE's SWM Design Manual 2003 and City of Toronto's Wet Weather Flow Management Guidelines 2007.

GIFFELS ASSOCIATES LIMITED / IBI GROUP DRAINAGE AND STORMWATER MANAGEMENT ASSESSMENT REPORT
Toronto Transit Commission

EGLINTON CROSSTOWN LRT
FROM PEARSON INTERNATIONAL AIRPORT TO KENNEDY ROAD

Table 8 – Pavement Area Analysis

Drainage Areas (refer to plates)	Roadway Segment	Existing Pavement (ha)	Proposed Pavement (ha)	Additional Pavement (ha)	LRT Section
1	0.10km north of International Blvd. 0.13km east of Renforth Dr.	4.9	6.8	1.9	At-grade
2	0.13km east of Renforth Dr. to 0.1km east of Kipling Ave.	4.6	6.3	1.7	
3	0.10km east of Kipling Ave to 0.15km east of Royal York Rd	3.6	5.9	2.3	
4	0.15km east of Royal York Rd to 0.47km east of Jane St.	4.0	5.7	1.7	
5	0.47km east of Jane St to Banff Rd.	3.6	4.1	0.5	Underground (from 80 m east of Black Creek Dr. to 360 m east of Brentcliffe Rd)
6		0.26	0.26	0	
7		0.85	0.85	0	
8		2.3	2.3	0	
9		1.2	1.2	0	
10		2.3	2.3	0	
11		1.5	1.5	0	
12		2.5	2.5	0	
13		1.7	1.7	0	
14	Banff Rd. to Don Mills Rd.	5.3	5.7	0.4	
15	Don Mills Rd. to 0.3km west of Sloane Ave.	6.5	6.7	0.2	At-grade (approx. 700 m of LRT will be underground at Don Mills Road)
16	0.3km west of Sloane Ave. to Pharmacy Ave.	3.2	3.3	0.1	
17	Pharmacy Ave. to Warden Ave.	3.3	3.5	0.2	
18	Warden Ave. to Birchmount Rd.	2.4	2.4	0	
19	Birchmount Rd to Kennedy Rd.	2.3	2.3	0	
Total		**57.6**	**66.6**	**9.0**	

3. MITIGATION MEASURES

Mitigation measures for Mimico Creek, Black Creek, West Don River, East Don River and Wilson Brook will be required due to Bridge/ culvert modification work at these watercourses. All watercourses within the project limits are subject to Ontario Regulation

166/06. The following mitigation measures are recommended to offset negative impacts of the project on the terrestrial and aquatic features in the vicinity of the crossing.

- In-stream works are not proposed at any of the crossings therefore changes to the fluvial integrity of the channel are not anticipated. A comprehensive restoration plan including bank rehabilitation, planting/seeding strategy and erosion protection will be established to mimic pre construction conditions, to the extent possible.

- The temporary works yard proposed at Black Creek (50 m east of Black Creek and 30 m south of Eglinton Avenue) is located in the floodplain of Black Creek. The minimum return period for temporary (erosion and sediment control) works is 2 years. The proposed work zone is approximately 0.75 m above the 2 year flood elevation.

- No permanent filling should be permitted within the Black Creek floodplain and any material /earth stored during construction must be removed and the ground must be restored to original conditions following construction.

- The access shaft, which is to be used during tunnel construction, is located within the Black Creek floodplain and adjacent to the Black Creek crossing. In the event of regional flood, it is recommended that the construction operations must be suspended until regional flood recedes to normal level. In the event construction operations cannot be suspended, possibility of raising access shaft platform should be explored during detail design in order to prevent regional flood reaching into the tunnel during the construction.

- The recommended erosion and sediment control measures should be applied at all temporary work zone locations to mitigate the potential environmental impacts resulting from erosion and sedimentation.

- Measures will be put in place during all phases of construction to minimize disturbance and ecological impacts to these water features from inputs of soil and other materials. A detailed erosion and sediment control plan will be developed and will include measures such as silt fences, straw bale flow checks and rock flow checks to ensure no degradation of the watercourse.

- Measures (quality controls) will be included in the design process to ensure that storm water impacts will be minimal and that water features are protected as part of the proposed construction.

- Appropriate construction timing of the bridge/culvert extension activities is an important mitigation measure. All watercourses within the project limits are warm water and no in-water work is permitted between April 1 and June 30 for warmwater watercourses.

- In areas where construction sites or roadways are located in proximity to wetland features or watercourses, the use of minor grading to direct surface runoff away from the aquatic habitats is recommended. This generally consists of the slope leading to a very shallow swale created by a low ridge of topsoil. The vegetative

swale is configured to direct surface runoff along the swale back away from the edge.

4. EROSION AND SEDIMENT CONTROL

If uncontrolled, the construction activity associated with the Eglinton Crosstown LRT could result in increased rates of erosion and sedimentation within and adjacent to the site area and tributaries to three major watersheds which include Mimico Creek, Humber River and the Don River (east and west branches). Erosion, for the purposes of this discussion, is described as the process whereby soil particles are detached from an exposed surface and transported by water, wind or some other agent. Sedimentation is defined as the deposition of (eroded) particles at a "downstream" point, typically a watercourse. The potential environmental impacts from increased erosion and sedimentation include: degradation of water quality; destruction of fisheries habitat; and, increased flooding potential.

Erosion and sedimentation processes are typically accelerated due to construction activities. Literature indicates that construction activities can increase erosion and sedimentation rates by 2 to 3 orders of magnitude over that expected from a natural forested area. Erosion and sedimentation control are therefore an integral and important component in the design and construction of any project.

4.1 Erosion and Sediment Control Measures

To minimize the potential environmental impacts, the following erosion and sedimentation control practices will serve to guide the design and implementation phase of the Erosion and Sedimentation Control Plan:

- limit size of disturbed area,
- limit duration of soil exposure,
- retain existing vegetation where feasible,
- limit slope length and gradient of disturbed areas,
- preserve overland sheet flow and micro-drainage (avoid concentrated channel flows),
- break and redirect flows to lower gradients,
- design and implement staged stripping,
- prevent disturbance of previously stripped and stabilized parcels, and
- stabilize stripped parcels with temporary vegetative controls.

Appropriate permanent/temporary erosion control measures to be considered in the design and implementation of the Erosion and Sedimentation Control Plan are:

Hydroseeding - One step application of seed and hydraulic slurry with adhesive binder (provides permanent stabilization for moderate to steep slopes).

Seed and Straw Mulch - Alternative two step application that will be applied to provide permanent/temporary vegetative stabilization of disturbed areas.

Mulch (straw, wood etc.) - Used to provide temporary erosion protection of exposed slopes during over-wintering and for disturbed areas inactive for greater than 45 days.

Sod - Utilized to provide quick permanent stabilization of disturbed areas. Applications include lateral ditches with gradients <5% and slopes with steep to moderate grades.

Erosion Control Blanket - Applied as temporary/permanent erosion protection for slopes greater than 2:1 or as a ditch liner. For permanent applications, seed will be applied prior to installation.

Aggregate Stone - Appropriate material, such as rip rap will be used to provide immediate permanent erosion protection of lateral ditches >5% gradient; and along chute/spillways. Geotextile fabric will be applied prior to placement of any aggregate material.

4.2 Sediment Control

The following elements should be included in the sediment control plan:

- provision of a series of temporary interceptor/conveyor ditches to direct runoff to the siltation/stormwater management pond;
- provision of rock check dams within drainage swales/ditches; and
- placement of a series of silt control fencing for the interception of sheet flow drainage.

All sediment control measures should not be removed until final stabilization of the site. In addition, any accumulated sediment shall be removed, as part of a maintenance program, from all control measures when accumulation reaches 50% of the height or volume of the control structure.

- **Environmental Inspection Process** - As a component of erosion and sedimentation control, environmental inspections of the construction site will be conducted. Environmental inspections will be conducted to assess the performance of erosion and sedimentation control measures and identify any required maintenance. The frequent inspections will also permit the identification of localized erosion and sedimentation control issues that require site specific attention.
- **Implementation and Recommendation** - A 200 m standby supply of prefabricated silt fence barrier, in addition to silt fence requirements, shall be maintained at the construction site prior to commencement of grading operations and throughout the duration of the contract.
- Where interceptor ditches and/or subsurface drains are specified, they shall be constructed prior to commencement of any related cut or fill activities.

- Cut and fill earth slopes and ditches, shall be treated with the specified cover material (seed and mulch, seed and erosion control blanket, seed and sod, rip rap, etc.) within 45 days from the commencement of the cut, fill or ditching operation. Commencement of a cut, fill or ditching operation shall be considered to have occurred when the original stabilizing cover has been removed, including grubbing, or has been covered with fill material.
- Run-off from construction materials and any stockpiles shall be contained and discharged so as to prevent entry of sediment to watercourses.
- Where dewatering is required, and where culverts are cleaned by hydraulic means, the effluent shall be discharged in a manner that prevents the entry of sediments to watercourses, or scouring and erosion at the outlet.

Erosion and sediment control plan for the project must adhere to December 2006 Erosion and Sediment Control (ESC) Guideline.