

Appendix A

HEC-RAS Hydraulic Model Update and Floodplain Delineation for a Portion of Black Creek within the City of Vaughan (December, 2010)

905 477 8400 tel 905 477 1456 fax

December 22, 2010

Mr. Sameer Dhalla
Manager, Water Resources
Ecology Division
Toronto and Region Conservation Authority
5 Shoreham Drive
Downsview, ON M3N 1S4

Dear Mr. Dhalla:

Project No: 60163344

Regarding: HEC-RAS Hydraulic Model Update and Floodplain Delineation for a Portion of

Black Creek within the City of Vaughan

1. Introduction

AECOM is pleased to provide Toronto and Region Conservation (TRCA) with the results of the HEC-RAS hydraulic modelling update and resultant Regulatory floodplain delineation for the Black Creek from Highway 407ETR to north of Doughton Road within the City of Vaughan (the City). The additional work has been completed at the mutual request of TRCA and the City in order to more accurately delineate existing floodplain conditions within the above noted reach due to discrepancies that have been identified between detailed design information and "as-built" survey data. Current topographic mapping within the identified reach was further enhanced by J.D. Barnes to include additional elevation information and was provided to AECOM to be used as the basis for the HEC-RAS hydraulic model update and refinements to the delineation of the Regulatory floodplain.

In addition to the above tasks, AECOM staff completed a further field verification of all hydraulic structure openings currently included within the Black Creek Stormwater Optimization Study Area HEC-RAS model. Revisions to several culvert opening areas were identified and have also been included as part of the current modelling effort.

The following letter report provides a summary of the tasks that have been completed in accordance with the approved work plan and includes all supporting documentation within the enclosed attachments.

2. Review of Updated Topographic Information (Highway 407ETR to Doughton Road)

A cursory comparison between the current topographic mapping and enhanced base map prepared by J.D. Barnes for this assignment was completed in order to verify any notable differences in



elevation across the Study Area. Overall, the general topography (i.e., contour shape) appears visually similar between the two data sets given that there has been little physical change between Highway 407 and just north of Doughton Road. However, a closer examination of the updated mapping reveals that elevations within the floodplain and tableland areas are consistently higher than the previous mapping. For example, spot elevations along Peelar Road are approximately 0.4 m higher than the previous topographic information. The updated information compares more closely to the as-built survey and additional data collected by AECOM and therefore, it is concluded that the latest mapping provided by J.D. Barnes more accurately represents the topographic conditions within study reach.

3. HEC-RAS Cross-Section Geometry Update (Highway 407ETR to north of Doughton Road)

In order to update TRCA's HEC-RAS model for Black Creek, new cross-section data within the subject watercourse reach was prepared using the enhanced J.D. Barnes topographic mapping as noted above. AutoCAD Civil 3D was utilized to extract new cross-section data (i.e., distance and elevation) from Highway 407 to Doughton Road (i.e., Cross-section 46.10 to 46.182) as shown on *Figure 1*. A direct comparison of cross-section geometry and channel invert elevations was carried out between the current and updated mapping and has been summarized in Table 1 and corresponding cross-section plots are included in *Attachment A*.

A review of the cross-section plots contained in *Attachment A* shows good agreement with overall geometric shape at each cross-section. Several updated cross-sections appear to be shifted when compared to the previous data. However, the shift is associated with a difference in starting horizontal distance and does not affect hydraulic calculations. As noted previously, updated cross-section data are generally higher in elevation compared to the current cross-section information. More notably, as shown on *Table 1*, channel invert elevations appear to vary considerably, with differences ranging from -0.78 m to +1.83 m over the study reach. The significant difference in invert elevation observed at a number of cross-sections can be attributed to more accurate channel elevation information provided as part of the J.D. Barnes update. It is assumed that the previous HEC-RAS model utilized interpolation and estimates to derive channel invert elevations in absence of detailed contour and spot elevation information. Accordingly, it is assumed that the updated information prepared by J.D. Barnes more accurately represents conditions within the study reach.

It was also found during site visit that the abandoned culvert north of Peelar Road (culvert 46.135 in HEC-RAS model) has completely collapsed and no longer conveys flood flows through the structure. Accordingly, the culvert and associated bounding cross-sections (i.e., 46.135 and 46.131) were removed from the updated HEC-RAS model. Cross-section 46.132 was relocated as shown on *Figure 1* to reflect the current channel construction at this location and has now been coded as a normal cross-section. As a result, the updated geometry and invert elevation at Cross-section 46.132 is not directly comparable to the current HEC-RAS model.



Crossing Location	HEC-RAS Cross- section Location (Refer to Figure 1)	Current Channel Invert Elevation (m)	Updated Channel Invert Elevation (m)	Difference (±m)
	46.182	195.1	195.50	0.40
Private Entrance	46.181	195.0	195.42	0.42
	46.18	195.0	195.42	0.42
	46.172	195.0	195.42	0.42
Doughton Road	46.171	195.0	195.40	0.40
	46.17	195.0	195.07	0.07
	46.162	194.1	195.07	0.97
Paradise Banquet	46.161	194.0	195.05	1.05
Facility Entrance	46.15	193.5	195.02	1.52
	46.142	193.0	194.83	1.83
Iceplex Entrance	46.141	193.0	194.82	1.82
	46.14	193.0	194.82	1.82
	46.132 ¹	193.0	194.82	N/A
Abandoned	46.131 ¹	192.8	Removed	N/A
Crossing	46.13	192.8	192.82	0.02
	46.122	192.6	192.63	0.03
Peelar Road	46.121	192.6	191.82 (192.37) ²	-0.78
	46.12	192.0	191.82	-0.18
	46.11	191.5	191.73	0.23
Highway 407ETR	46.10	191.2	191.60	0.40

Table 1. Comparison of Cross-Section Invert Elevations

Notes: 1. Channel invert elevation comparison between the current and updated cross-section is not applicable due to cross-section relocation.

4. Black Creek HEC-RAS Model Update

The revised geometric data as noted above was integrated into the latest HEC-RAS model to reflect the updated topographic information provided by J.D. Barnes. Channel and overbank reach lengths were adjusted to account for the removal of the private culvert crossing downstream of the Iceplex entrance. Culvert invert elevations and road profiles between Peelar Road and Doughton Road were adjusted based on the new elevation data and further confirmed with field observations, as-built survey data and photographic records. The Peelar Road culvert was further adjusted to reflect the perched culvert condition noted at the downstream outlet. Manning's roughness coefficients and flow change locations were checked and maintained to match the previous model through the study reach. The updated HEC-RAS model was run for the full range of flows, from the 2-year to Regional Storm as well as the August 19th, 2005 storm event in order to establish revised existing conditions flood levels. A summary comparison between the TRCA HEC-RAS model and subsequent updates undertaken by AECOM for the 100-year and Regional Storm is contained in *Attachment B* with full HEC-RAS output included in *Attachment C*.

A review of the summary table provided in *Attachment B* shows localized increases in the 100-year flood elevation up to 0.58 m at Highway 7, between the TRCA HEC-RAS model and updated AECOM model which reflects revisions made to culvert opening geometry. Under the Regional Storm, the increases in flood levels associated with adjustments to culvert opening areas are shown to be relatively minor (i.e., <0.3 m) and are limited to local reaches at Highway 7 as well as the watercourse reach from Peelar Road to the Iceplex entrance and Millway Avenue to Highway 400. The minor increases in Regional Storm flood level will have no appreciable change to the Regulatory floodplain delineation.

^{2.} Culvert invert elevation () varies from channel invert (i.e., perched).



A further review of **Attachment B** provides a comparison of 100-year and Regional Stormwater surface elevations assuming the additional revisions made to the HEC-RAS model to reflect the updated J.D. Barnes mapping between Highway 407 and just north of Doughton Road. Model results contained in the attachments are also summarized for the Regional Storm event in Table 2 and show an increase up to 0.7 m for the Regional Storm event as a direct result of the topographic elevation increases noted above. As illustrated on the HEC-RAS profile plot (Figure 2), the resultant increase in flood level extends from Highway 407 up to Highway 7 prior to dissipating downstream of the Edgely Pond.

5. TRCA Floodplain Mapping Update

The current TRCA floodplain mapping was updated within the subject area to include the revised topographic information provided by J.D. Barnes and is included on *Figure 3*. The revised Regional Storm flood levels and floodplain delineation has been plotted in addition to the previous floodplain area for comparison purposes. As noted from *Figure 3*, the updated floodplain is similar in areal extent as the previous mapping and no additional structures will be subject to flooding under the Regional Storm event. The most notable difference is the removal of a "Spill" area located across Jane Street, immediately north of Peelar Road.

Table 2. Comparison of Current and Updated HEC-RAS Regional Stormwater Surface Elevations within Study Reach

HEC-RAS Cross-section Location (Refer to Figure 1)	Current Water Surface Elevation ¹ (m)	Updated Water Surface Elevation ² (m)	Difference (±m)4
46.212	202.33	202.33	0.00
46.211	201.15	201.23	0.08
46.21	201.11	201.20	0.09
46.202	201.08	201.17	0.09
46.201	200.46	201.16	0.70
46.192	200.55	201.16	0.61
46.191	200.52	201.14	0.62
46.19	200.51	201.13	0.62
46.182	200.47	201.12	0.65
46.181	200.44	201.11	0.67
46.18	200.43	201.11	0.68
46.172	200.45	201.11	0.66
46.171	200.44	201.10	0.66
46.17	200.44	201.09	0.65
46.162	200.38	201.07	0.69
46.161	200.35	200.99	0.64
46.15	200.30	200.99	0.69
46.142	200.28	200.92	0.64
46.141	198.67	198.97	0.30
46.14	198.71	198.97	0.26
46.132 ³	198.60	198.37	N/A
46.131 ³	198.08	N/A	N/A
46.13	198.17	198.37	0.20
46.122	198.16	198.31	0.15
46.121	197.70	198.17	0.47
46.12	197.71	198.17	0.46
46.11	197.19	197.64	0.45
46.10	194.35	194.78	0.43

Notes: 1. HEC-RAS model updated by AECOM to reflect revised culvert geometry.

2. HEC-RAS model updated by AECOM to reflect updated topography from J.D. Barnes.

- 3. WSEL comparison between the current and updated cross-section is not applicable due to cross-section relocation (refer to Section 1.2)
- Updated WSEL's adjusted where required to ensure equal or higher flood level compared to next downstream cross-section



6. **Summary and Conclusions**

The current TRCA HEC-RAS model for Black Creek was updated to include adjustments to culvert opening geometry at several locations within the City of Vaughan, based on additional field verification. Further revisions were made to reflect updated topographic data provided by J.D. Barnes for the area between Highway 407 to north of Doughton Road. The changes in modelling resulted in localized increases in both the 100-year and Regional Storm flood levels under existing conditions. However, a comparison of the current and updated Regional Storm floodplain confirmed that increases in flood levels do not appreciably affect the extent of the area subject to flooding and no additional structures will be impacted. Further, the updated mapping and floodplain delineation has resulted in the elimination of a "Spill" area currently located across Jane Street, immediately north of Peelar Road.

We trust the enclosed report and supporting documentation is satisfactory and we look forward to your approval of the revisions. However, should you have any questions or require additional information please contact the undersigned at your convenience.

Sincerely,

AECOM Canada Ltd.

Glenn A. Farmer

Senior Environmental Technologist, Environment

glenn.farmer@aecom.com

GAF:mm Attach.

cc: Michael Frieri, City of Vaughan



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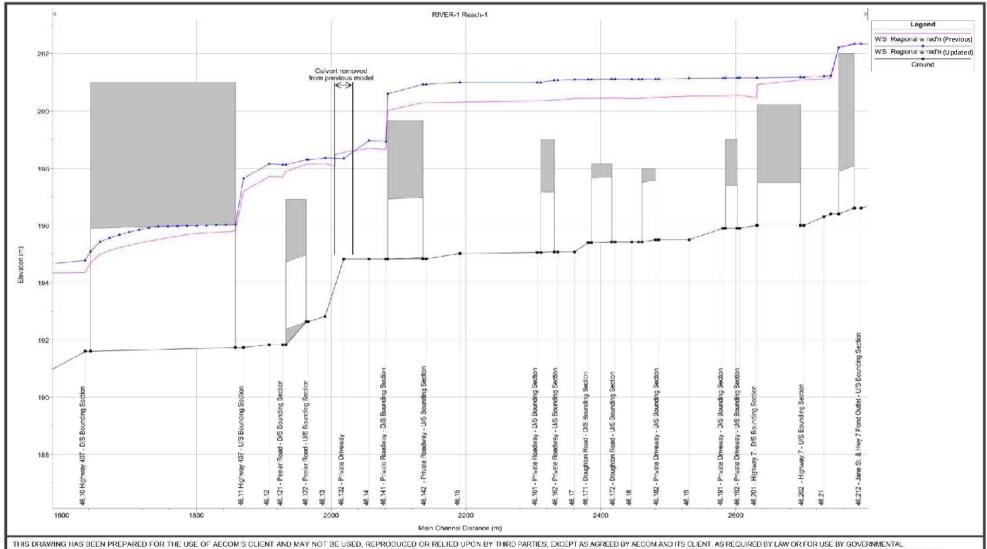
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Figures





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LEGEND

Current and Updated HEC-RAS Profile Plot

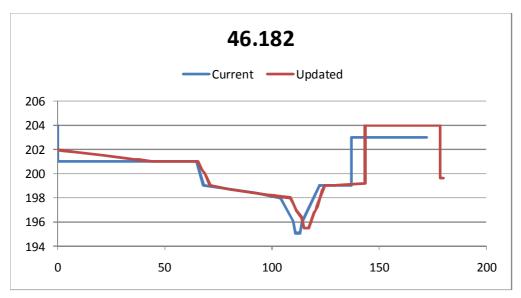
PROJECT NUMBER	DATE	FIGURE NUMBER
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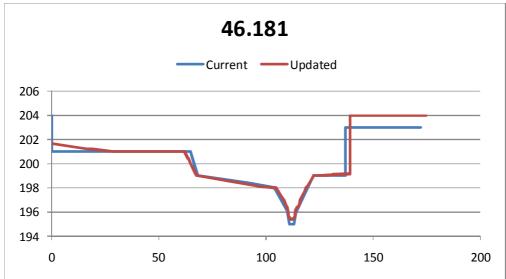




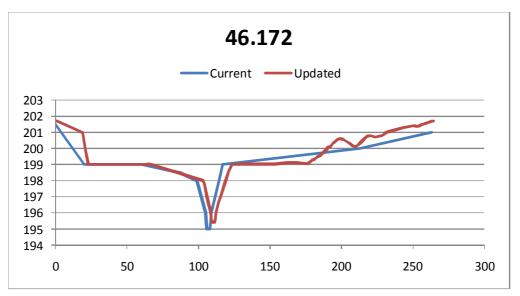
Attachment A

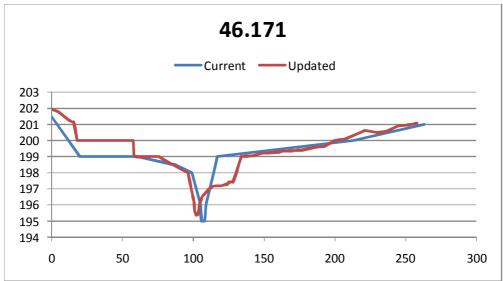
HEC-RAS Cross-section Comparison

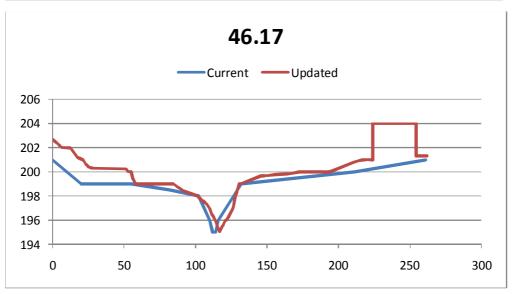


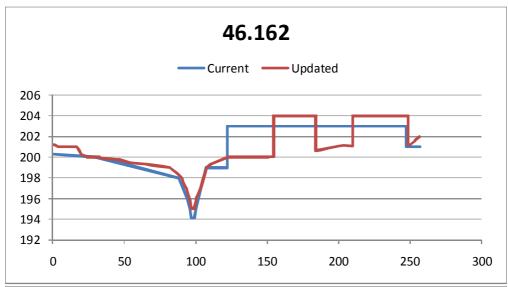


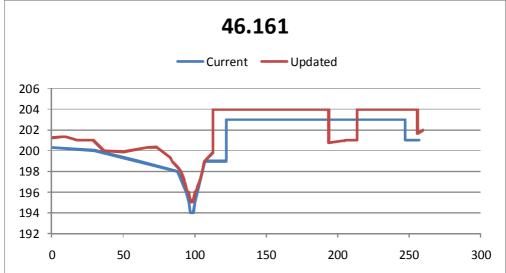


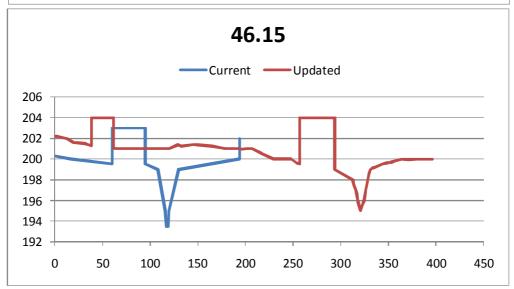


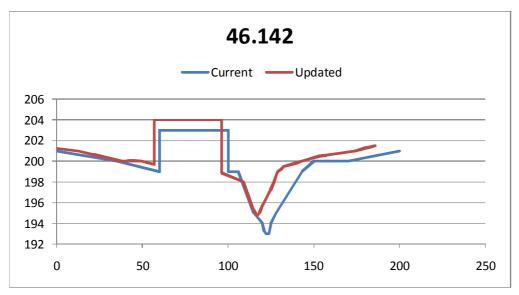


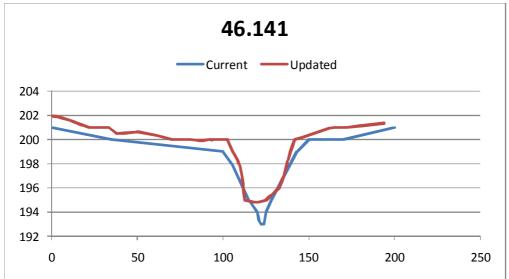


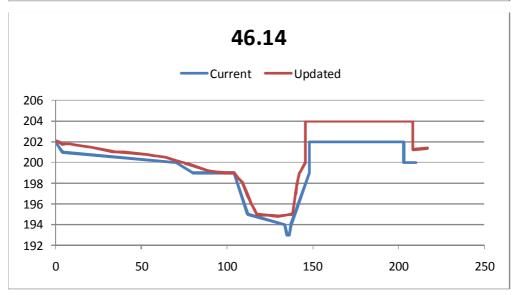


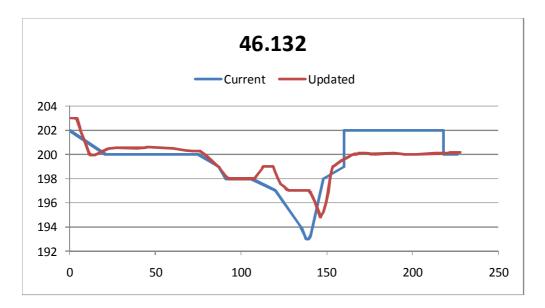




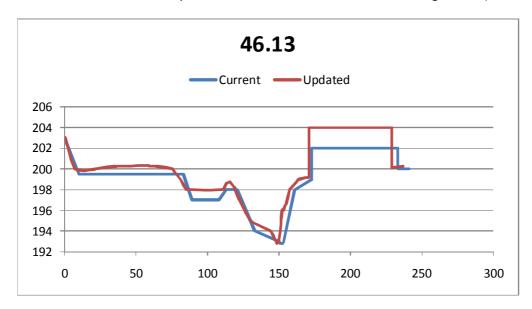


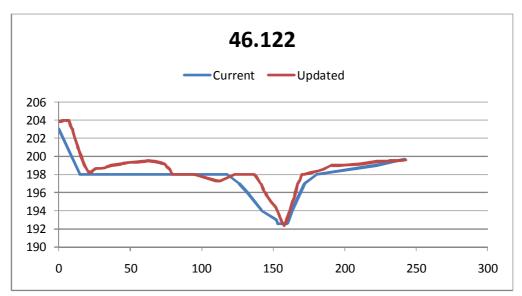


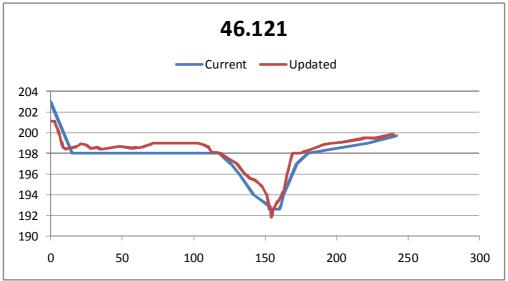




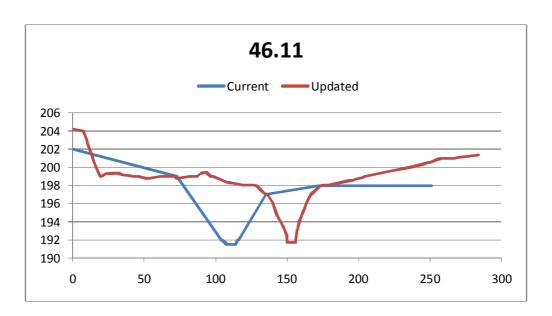
Note: The location of the updated 46.132 is different from the existing model (Section 1.2)

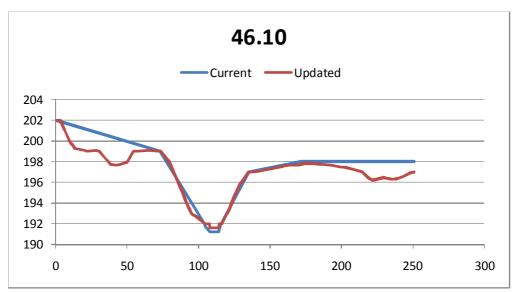














Attachment B

HEC-RAS Water Surface Elevation Comparison

Black Creek Stormwater Optimization Study HEC-RAS WSEL Comparison

Dec-**1**0

Black Creek - Hydraulic Model Comparison (Existing Hydrology)

X-Section Location Refer to Floodplain	1 - TRCA Ma	idel Geometry	•	ted Model Geometry rt Data - Aug 2010)		nce (2-1) -m)	-	ed Model Geometry iced Topo - Oct 2010)	Differen (+/-	
Maps)	100yr WSE	Regional WSE	100yr WSE	Regional WSE	100yr	Regional	100yr WSE	Regional WSE	100yr	Regio
46.450	207.19	207.95	207.19	207.95	0.00	0.00	207.19	207.95	0.00	0.00
46.440 46.430	205.28 205.27	207.45 207.45	205.28 205.27	207.45 207.45	0.00	0.00	205.28 205.27	207.45 207.45	0.00	0.00
46.420	205.26	207.44	205.26	207.44	0.00	0.00	205.26	207.44	0.00	0.0
46.413	205.26	207.43	205,26	207.43	0.00	0.00	205,26	207.43	0.00	0.0
46.412	203.87	207.36	203.90	207.37 Creditview F	0.03 Road	0.01	203.90	207.37	0.00	0.0
46.411	203.86	206.90	203.89	206.90	0.03	0.00	203.89	206.90	0.00	0.0
46.410 46.402	203.85	206.90 206.89	203.88 203.84	206.91 206.90	0.03 0.04	0.01	203.88	206.91 206.90	0.00	0.0
				Highway 4						
46.401 46.392	203.76 203.71	206.51 206.50	203.80 203.76	206.55 206.54 Langstaff R	0.04 0.05	0.04	203.80 203.76	206.55	0.00	0.0
46.391 46.390	203.66 203.65	206.39 206.39	203.71 203.70	206.45 206.45	0.05	0.06	203.71 203.70	206.45 206.45	0.00 0.00	0.0 0.0
46.390	203.65	206.39	203.68	206.45	0.05 0.06	0.06	203.68	206.45	0.00	0.0
46.381	203.57	205.89	203.63	206.08	0.06	0.19	203.63	206.08	0.00	0.0
46.360 46.350	203.42	205.82 205.79	203.50 203.45	206.02 206.00	0.08	0.20 0.21	203.50 203.45	206.02 206.0 0	0.00	0.0
46.340	203.32	205.79	203.42	205.98	0.10	0.19	203.42	205.98	0.00	0.0
46.330	203.20	205.73	203.33	205.95	0.13	0.22	203.33	205.95	0.00	0.0
46.322	203.16	205.69	203.29	205.92 Applewood	0.13 Cres.	0.23	203.29	205.92	0.00	0.0
46.321	203.14	205.19	203.22	205.31	0.08	0.12	203.22	205.31	0.00	0.0
46.320 46.312	203.02	205.07 205.10	203.12 203.13	205.21 205.23	0.10 0.10	0.14 0.13	203.12	205.21 205.23	0.00	0.0
40.312	203.03	205.10	203.13	Edgeley Blvd.	0.10	0.13	203.13	203.23	0.00	0.0
46.311	203.00	204.82	203.05	204.88	0.05	0.06	203.05	204.88	0.00	0.0
46.310 46.300	202.97	204.79 204.73	203.03 202.98	204.84	0.06	0.05	203.03 202.98	204,84 204,7 9	0.00	0.0
46.292	202.88	204.71	202.95	204.78	0 .07	0.07	202.95	204.78	0.00	0.0
46 301	707.04	204 57	303.03	Millway A		0.00	707.07	204.57	0.00	-
46.291 46.290	202.84	204.57 204.52	202.83 202.79	204.57 204.52	-0.01 0.00	0.00	202.83	204.57 204.52	0.00	0.0
46.282	202.76	204.50	202.76	204.50	0.00	0.00	202.76	204.50	0.00	0.0
46.281 46.280	202.70	204.38 204.29	202.70 202.64	204.38 204.29	0.00	0.00	202.70	204.38 204.29	0.00	0.0
46.274	202.67	204.23	202.67	204.23	0.00	0.00	202.67	204.29	0.00	0.0
46.273	202.5 7	204.25	202.57	204.25	0.00	0.00	202.57	204.25	0.00	0.0
46.272	202.54	204.21	202.54	204.21	0.00	0.00	202.54	204.21	0.00	0.0
46.271 46.270	202.11	203.02	202.11	203.02	0.00	0.00	202.11	203.02	0.00	0.0
46.260	202.09	202.65	202.09	202.65	0.00	0.00	202.09	202.65	0.00	0.0
46.250	202.05	202.56	202.05	202.56	0.00	0.00	202.05	202.56	0.00	0.0
46.240 46.230	202.01	202.31 202.41	202.01 202.02	202.31 202.41	0.00	0.00	202.01 202.02	202.3 1 202.4 1	0.00	0.0
46.220	202.02	202.42	202.02	202.42	0.00	0.00	202.02	202.42	0.00	0.0
46.214	202.02	202.41	202.02	202.41	0.00	0.00	202.02	202.41	0.00	0.0
46.213 46.212	200.11	202.32 202.33	200.66 200.65	202.33	0.55 0.56	0.01	200.73 200.72	202.33	0.07	0.0
46.211	199.89	201.12	200.44	201.15	0.55	0.03	200.51	201.23	0.07	0.0
46.210 46.202	199.88 199.86	201.08 201.04	200.44 200.44	201.11	0.56 0.58	0.03	200.51 200.51	201.20 201.17	0.07	0.0
40.202	199.80	201.04	200.44	Highway		0.04	200.31	201.17	0.07	0.0
46.201 46.192	199.42 199.42	200.46 200.54	199.41 199.41	200.46 200.55	-0.01 -0.01	0.00 0.01	199.82 199.82	201.16 201.16	0.4 1 0.4 1	0.7 0.6
46.191	199.28	200.52	199.28	Private Entre 200.52	0.00	0.00	199.82	201.14	0.54	0.6
46.190	199.27	200.51	199.27	200.51	0.00	0.00	199.82	201.13	0.55	0.6
46.182	199.27	200.48	19 9 .27	200.48	0.00	0.00	199.82	201.12	0.55	0.6
46.181	199.26	200.44	199.26	Private Entre 200.44	0.00	0.00	199.81	201.11	0.55	0.6
46.180	199.26	200.43	199.26	200.43	0.00	0.00	199.81	201.11	0.55	0.€
46.172	199.25	200.45	199.25	200.45 Doughton R	0.00	0.00	199.81	201.11	0.56	0.6
46.171	199.25	200.44	199.25	200.44	0.00	0.00	199.81	201.10	0.56	0.6
46.170	199.26	200.44	199.26	200.44	0.00	0.00	199.81	201.09	0.55	0.6
46.162	199.25	200.38	199.25	200.38 Paradise Banquet	0.00 Entrance	0.00	199.80	201.07	0.55	0.6
46.161	199.23	200.36	199,23	200.36	0.00	0.00	199.76	200.99	0.53	0.6
46.150 46.142	199.22 199.22	200.31 200.29	199.22	200.31	0.00	0.00	199.76	200.99	0.54 0.54	0.6
46.142	133.55	200.29	199.22	200.29 Iceplex Entre		0.00	199.76	200.92	Ų.54	0.6
46.141	197.20	198.64	197.20	198.66	0.00	0.02	197.43	198.97	0.23	0.3
46.140 46.132	197. 21 197.19	198.68 198.58	197.21 197.19	198.70 198.60	0.00	0.02	197.44 196.84	198.97 198.37	0.23 -0.35	-0.2
				Abandoned Cr	ossing	1				1
46.131 46.130	195.63 195.73	197.83 197.97	195.63 195.73	198.09 198.18	0.00	0.26	(removed) 195.67	(removed) 198.37	N/A -0.06	N/ 0.1
46.130	195.73	197.97	195.75	198.17	0.00	0.21	195.50	198.31	-0.06	0.1
10.404				Peelar Roo						
46.121 46.120	193.99 193.21	197.70 197.71	193.99 193.21	197. 7 0 197. 7 1	0.00	0.00	193.92 193.51	198.17 198.17	-0.07 0.30	0.4 0.4
46.110	193.25	197.19	193.25	197 .1 9	0.00	0.00	193.48	197.64	0.23	0.4
AC 100	102.17	104.35	100.47	Highway 40:		0.00	402.50	404.70	0.42	
46.100 46.090	192.1 7 190.85	194.35 194.29	192.17 190.85	194.35 194.29	0.00	0.00	192.59 190.85	194.78 194.29	0.42	0.4
46.082	190.68	194.29	190.68	194.29	0.00	0.00	190.68	194.29	0.00	0.0
AC 001	100.00	101.50	100.00	Jane Stree		0.00	100.00	101.00	0.00	
46.081 46.070	190.06 189.00	191.80 191.26	190.06 189.00	191.80 191.26	0.00	0.00	190.06 189.00	191.80 191.25	0.00	0.0
46.060	187.65	191.23	187.65	191.23	0.00	0.00	187.65	191.23	0.00	0.0
46.050	187.52	191.23	187.52	191.23	0.00	0.00	187.52	191.22	0.00	0.0
46.040 46.032	187.48 187.40	191.20 191.22	187.48 187.40	191.20 191.22	0.00	0.00	187.48 187.40	191.19 191.21	0.00	0.0
		1		CN Track	s	1				
46.031 46.030	184.21	185.89 185.39	184.21 184.00	185.89	0.00	0.00	184.21	185.89 185.39	0.00	0.0
46.030 46.020	184.00 183.57	185.39 184.99	184.00 183.57	185.39 184.99	0.00	0.00	184.00 183.57	185.39 184.99	0.00	0.0
46.010	183.22	184.76	183.22	184.76	0.00	0.00	183.22	184.76	0.00	0.0
46.000	183.04	184.54	183.04	184.54	0.00	0.00	183.04	184.54	0.00	0.0



Attachment C

Updated HEC-RAS Model Output

		iver: RIVER-1 Reach										
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Reach-1	46.45	2-year	(m3/s) 3.73	(m) 206.50	(m) 207.00	(m) 207.00	(m) 207.14	(m/m) 0.019044	(m/s) 1.68	(m2) 2.23	(m) 7.96	1.01
Reach-1	46.45	5-year	4.83	206.50	207.06	207.06	207.22	0.017835	1.74	2.77	8.86	1.00
Reach-1	46.45	10-year	5.61	206.50	207.10	207.10	207.26	0.017520	1.80	3.12	9.39	1.00
Reach-1	46.45	25-year	6.57	206.50	207.14	207.14	207.32	0.017192	1.86	3.53	9.99	1.00
Reach-1	46.45	50-year	7.34	206.50	207.17	207.17	207.36	0.017384	1.92	3.82	10.39	1.01
Reach-1	46.45	100-year	7.79	206.50	207.19	207.19	207.38	0.017127	1.94	4.02	10.65	1.01
Reach-1	46.45	Aug. 19th	16.70	206.50	207.47	207.47	207.72	0.014753	2.22	7.52	14.55	0.99
Reach-1	46.45	Regional w red'n	42.70	206.50	207.95	207.95	208.17	0.006939	2.33	31.53	90.68	0.75
Reach-1	46.44	2-year	3.73	203.70	204.99		204.99	0.000157	0.40	12.94	17.82	0.12
Reach-1	46.44	5-year	4.83	203.70	205.03		205.04	0.000224	0.49		18.46	0.14
Reach-1	46.44	10-year	5.61	203.70	205.06		205.07	0.000277	0.55	14.30	18.86	0.16
Reach-1	46.44	25-year	6.57	203.70	205.10		205.12	0.000329	0.62	15.16	19.50	0.17
Reach-1	46.44	50-year	7.34	203.70	205.19		205.20	0.000319	0.63	16.84	20.70	0.17
Reach-1	46.44	100-year	7.79	203.70	205.28		205.29	0.000274	0.61	18.81	22.02	0.16
Reach-1	46.44	Aug. 19th	16.70	203.70	206.14		206.16	0.000185	0.68	43.90	44.98	0.14
Reach-1	46.44	Regional w red'n	42.70	203.70	207.45		207.46	0.000074	0.58	171.57	129.43	0.10
Decel 4	40.40	0	0.70	000 50	004.00		004.00	0.000040	0.04	05.40	50.04	0.07
Reach-1	46.43	2-year	3.73 4.83	203.50	204.98		204.98 205.02	0.000049	0.24	35.42 38.09	59.81	0.07
Reach-1	46.43	5-year		203.50	205.02			0.000070			61.15	
Reach-1	46.43	10-year	5.61 6.57	203.50	205.05		205.05	0.000085	0.33	39.67 42.32	61.32	0.09 0.10
Reach-1 Reach-1	46.43 46.43	25-year 50-year	6.57 7.34	203.50 203.50	205.09 205.18		205.09 205.18	0.000099 0.000092	0.36 0.36	42.32	61.61 62.17	0.10
Reach-1	46.43	100-year	7.34	203.50	205.16		205.16	0.000092	0.36	53.53	62.17	0.09
Reach-1	46.43	Aug. 19th	16.70	203.50	205.27		205.27	0.000076	0.34	110.75	69.17	0.09
Reach-1	46.43	Regional w red'n	42.70	203.50	207.45		200.14	0.000045	0.35	213.92	99.66	0.07
r.caul-1	10.40	regional wileum	42.70	203.30	207.45		201.40	0.000047	0.47	213.82	33.00	0.06
Reach-1	46.42	2-year	3.73	203.30	204.97		204.98	0.000039	0.23	23.16	27.52	0.06
Reach-1	46.42	5-year	4.83	203.30	205.01		205.02	0.000059	0.28	24.31	28.36	0.07
Reach-1	46.42	10-year	5.61	203.30	205.04		205.04	0.000074	0.32	24.99	28.96	0.08
Reach-1	46.42	25-year	6.57	203.30	205.04		205.09	0.000074	0.37	26.19	29.98	0.09
Reach-1	46.42	50-year	7.34	203.30	205.16		205.17	0.000094	0.38	28.82	32.10	0.10
Reach-1	46.42	100-year	7.79	203.30	205.26		205.27	0.000085	0.38	32.02	34.50	0.09
Reach-1	46.42	Aug. 19th	16.70	203.30	206.13		206.14	0.000072	0.46	71.49	55.99	0.09
Reach-1	46.42	Regional w red'n	42.70	203.30	207.44		207.45	0.000067	0.58	174.05	130.97	0.09
		January 1						3.333333				3.33
Reach-1	46.413	2-year	1.61	203.05	204.97	203.15	204.97	0.000002	0.06	28.84	50.40	0.01
Reach-1	46.413	5-year	2.01	203.05	205.01	203.17	205.01	0.000002	0.07	29.46	50.68	0.02
Reach-1	46.413	10-year	2.24	203.05	205.04	203.18	205.04	0.000003	0.08	29.81	50.83	0.02
Reach-1	46.413	25-year	2.66	203.05	205.08	203.20	205.08	0.000004	0.09	30.42	51.10	0.02
Reach-1	46.413	50-year	3.59	203.05	205.16	203.23	205.16	0.000006	0.11	31.68	51.65	0.02
Reach-1	46.413	100-year	4.75	203.05	205.26	203.27	205.26	0.000009	0.14	33.11	52.28	0.03
Reach-1	46.413	Aug. 19th	10.80	203.05	206.13	203.43	206.13	0.000015	0.23	46.13	57.99	0.04
Reach-1	46.413	Regional w red'n	42.70	203.05	207.43	203.98	207.44	0.000021	0.35	219.81	99.68	0.05
Reach-1	46.4125		Inl Struct									
Reach-1	46.412	2-year	1.61	203.05	203.33	203.15	203.33	0.001047	0.39	4.12	16.83	0.24
Reach-1	46.412	5-year	2.01	203.05	203.44	203.17	203.44	0.000524	0.35	5.80	17.58	0.18
Reach-1	46.412	10-year	2.24	203.05	203.53	203.18	203.53	0.000327	0.31	7.13	19.32	0.15
Reach-1	46.412	25-year	2.66	203.05	203.66	203.20	203.66	0.000205	0.29	9.09	26.12	0.12
Reach-1	46.412	50-year	3.59	203.05	203.77	203.23	203.78	0.000206	0.33	10.86	32.24	0.12
Reach-1	46.412	100-year	4.75	203.05	203.90	203.27	203.91	0.000208	0.37	12.81	39.03	
Reach-1	46.412	Aug. 19th	10.80	203.05	206.10	203.43	206.10	0.000015	0.24	45.73	57.82	0.04
Reach-1	46.412	Regional w red'n	42.70	203.05	207.37	203.98	207.38	0.000032	0.42	161.02	94.47	0.07
Deart 6	46 4445		0.1									
Reach-1	46.4115		Culvert									
Ponch 1	46.411	2 voor	4.04	202.00	203.31	202.07	202.24	0.000481	0.31	E 00	46.00	0.47
Reach-1		2-year	1.61	202.96		203.07	203.31			5.20	16.93	0.17
Reach-1	46.411	5-year	2.01	202.96	203.42	203.08	203.43	0.000284	0.29		17.58	0.14
Reach-1	46.411	10-year	2.24 2.66	202.96 202.96	203.52 203.65	203.09 203.11	203.52	0.000194 0.000134	0.27 0.26	8.34 10.33	18.84 25.73	0.12 0.10
Reach-1	46.411 46.411	25-year	3.59	202.96	203.65	203.11	203.65 203.77	0.000134	0.26		31.75	
Reach-1	46.411	50-year 100-year	4.75	202.96	203.76	203.14	203.77	0.000145	0.30		31.75	0.11
Reach-1	46.411	Aug. 19th	10.80	202.96	203.89	203.16	203.90	0.000155	0.34	46.58	57.60	0.11
Reach-1	46.411	Regional w red'n	42.70	202.96	206.90	203.90	206.91	0.000013	0.23	179.93	63.12	0.04
		9.2	.2.70	202.00	200.00			2.300000	0.11		00.12	5.07
Reach-1	46.41	2-year	3.07	202.50	203.24		203.25	0.000877	0.56	6.35	19.31	0.24
Reach-1	46.41	5-year	4.07	202.50	203.37		203.39	0.000685	0.57	9.32	25.52	0.22
Reach-1	46.41	10-year	4.85	202.50	203.47		203.49	0.000563	0.57	12.15	30.26	0.21
Reach-1	46.41	25-year	5.93	202.50	203.62		203.63	0.000396	0.53	19.21	76.28	0.18
Reach-1	46.41	50-year	6.83	202.50	203.75		203.75	0.000234	0.45		82.89	0.14
Reach-1	46.41	100-year	7.62	202.50	203.88		203.89	0.000132	0.37	41.33	89.89	0.11
Reach-1	46.41	Aug. 19th	17.75	202.50	206.07		206.07	0.000003	0.11	285.09	125.95	0.02
	46.41	Regional w red'n	47.80	202.50	206.91		206.91	0.000008	0.20		131.61	0.03
Reach-1				,	,		,		5.20			2.00
Reach-1												
Reach-1	46.402	2-year	3.07	202.40	203.16	202.64	203.17	0.000395	0.47	6.47	13.29	0.17

Reach	River Sta	River: RIVER-1 Read	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
rtcaon	Triva ola	Tionic	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	1 loude # Oli
Reach-1	46.402	10-year	4.85	202.40	203.41	202.72	203.42	0.000392	0.57	8.54	15.24	0.18
Reach-1	46.402	25-year	5.93	202.40	203.56	202.77	203.57	0.000368	0.60	9.82	16.45	0.18
Reach-1	46.402	50-year	6.83	202.40	203.69	202.81	203.71	0.000336	0.62	10.99		0.17
Reach-1	46.402	100-year	7.62	202.40	203.84	202.84	203.86	0.000293	0.62	12.23	18.71	0.17
Reach-1	46.402	Aug. 19th	17.75	202.40	206.05	203.16	206.06	0.000071	0.57	31.00	229.64	0.10
Reach-1	46.402	Regional w red'n	47.80	202.40	206.90	203.88	206.90	0.000023	0.36	329.94	241.16	0.05
Reach-1	46.4015		Culvert									
Reach-1	46.401	2-year	3.07	202.40	203.13	202.64	203.14	0.000450	0.49	6.22	13.06	0.18
Reach-1	46.401	5-year	4.07	202.40	203.27	202.68	203.28	0.000456	0.55	7.35	14.12	0.19
Reach-1	46.401	10-year	4.85	202.40	203.37	202.72	203.39	0.000445	0.59	8.23	14.94	0.19
Reach-1	46.401	25-year	5.93	202.40	203.52	202.77	203.54	0.000413	0.62	9.49	16.13	0.19
Reach-1	46.401	50-year	6.83	202.40	203.65	202.81	203.67	0.000373	0.64	10.65	17.22	0.18
Reach-1	46.401	100-year	7.62	202.40	203.80	202.84	203.82	0.000321	0.64	11.90	18.40	0.17
Reach-1	46.401	Aug. 19th	17.75	202.40	205.95	203.16	205.97	0.000078	0.59	30.19	110.76	0.10
Reach-1	46.401	Regional w red'n	47.80	202.40	206.55	203.88	206.56	0.000062	0.57	233.93	250.91	0.09
Reach-1	46.392	2-year	3.07	202.50	203.06	202.74	203.08	0.001088	0.64	4.80	12.32	0.27
Reach-1	46.392	5-year	4.07	202.50	203.20	202.78	203.22	0.000924	0.68	5.98	13.07	0.26
Reach-1	46.392	10-year	4.85	202.50	203.30	202.82	203.33	0.000811	0.70	6.90		0.25
Reach-1	46.392	25-year	5.93	202.50	203.46	202.87	203.49	0.000670	0.72	8.24	14.52	0.23
Reach-1	46.392	50-year	6.83	202.50	203.60	202.90	203.63	0.000558	0.72	9.48	15.31	0.22
Reach-1	46.392	100-year	7.62	202.50	203.76	202.93	203.78	0.000447	0.70	10.82	16.17	0.20
Reach-1	46.392	Aug. 19th	17.75	202.50	205.94	203.26	205.96	0.000085	0.60	29.61	74.84	0.10
Reach-1	46.392	Regional w red'n	47.80	202.50	206.54	203.96	206.55	0.000080	0.64	140.55	166.93	0.10
	+											
Reach-1	46.3915		Mult Open									
5 1 4	10.001		0.07	202.42	200.04	222.22	222.22	0.004004	0.50	E 05	40.00	
Reach-1	46.391	2-year	3.07	202.40	203.01	202.63	203.03	0.004204	0.58	5.25	12.06	0.24
Reach-1	46.391	5-year	4.07	202.40	203.15	202.68	203.17	0.003826	0.64	6.41	12.80	0.23
Reach-1	46.391	10-year	4.85	202.40	203.25	202.72	203.27	0.003471	0.66	7.33	13.39	0.23
Reach-1	46.391	25-year	5.93	202.40	203.41	202.76	203.43	0.002953	0.68	8.67	14.25	0.22
Reach-1	46.391	50-year	6.83	202.40	203.55	202.80	203.58	0.002503	0.69	9.93	t	0.20
Reach-1	46.391	100-year	7.62	202.40	203.71	202.83	203.74	0.002024	0.67	11.30	15.93	0.19
Reach-1	46.391	Aug. 19th	17.75 47.80	202.40 202.40	205.85	203.16	205.87	0.000438	0.60	29.69 130.24	74.28	0.10 0.07
Reach-1	46.391	Regional w red'n	47.80	202.40	206.45	203.87	206.46	0.000208	0.45	130.24	166.34	0.07
Reach-1	46.39	2-year	3.07	202.40	202.96	202.62	202.97	0.000874	0.51	6.02	12.70	0.24
Reach-1	46.39	5-year	4.07	202.40	203.10	202.67	203.12	0.000628	0.51	8.03	14.46	0.21
Reach-1	46.39	10-year	4.85	202.40	203.22	202.70	203.23	0.000497	0.51	9.80		0.19
Reach-1	46.39	25-year	5.93	202.40	203.39	202.74	203.40	0.000366	0.50	12.66	18.41	0.17
Reach-1	46.39	50-year	6.83	202.40	203.54	202.77	203.55	0.000381	0.49	15.63	20.54	0.15
Reach-1	46.39	100-year	7.62	202.40	203.70	202.80	203.71	0.000201	0.46	19.21	22.85	0.13
Reach-1	46.39	Aug. 19th	17.75	202.40	205.86	203.07	205.86	0.000009	0.19	172.39	135.14	0.03
Reach-1	46.39	Regional w red'n	47.80	202.40	206.45	203.62	206.45	0.000029	0.38	239.57	219.42	0.06
Reach-1	46.382	2-year	3.07	202.40	202.90	202.63	202.93	0.001562	0.71	4.31	18.18	0.32
Reach-1	46.382	5-year	4.07	202.40	203.06	202.68	203.09	0.001089	0.72	5.69	20.74	0.28
Reach-1	46.382	10-year	4.85	202.40	203.18	202.72	203.21	0.000882	0.72	6.73	22.19	0.26
Reach-1	46.382	25-year	5.93	202.40	203.35	202.76	203.38	0.000681	0.72	8.20	24.25	0.24
Reach-1	46.382	50-year	6.83	202.40	203.51	202.80	203.54	0.000547	0.72	9.54	26.11	0.22
Reach-1	46.382	100-year	7.62	202.40	203.68	202.83	203.70	0.000425	0.69	10.99	28.14	0.20
Reach-1	46.382	Aug. 19th	17.75	202.40	205.84	203.16	205.86	0.000085	0.60		+	0.10
Reach-1	46.382	Regional w red'n	47.80	202.40	206.45	203.86	206.45	0.000023	0.34	361.60	248.51	0.06
Reach-1	46.3815		Culvert									
	40.55				=.							
Reach-1	46.381	2-year	3.07	202.30	202.84	202.54	202.86	0.001238	0.66		t	0.29
Reach-1	46.381	5-year	4.07	202.30	203.01	202.59	203.03	0.000879	0.67	6.07	20.07	0.26
Reach-1	46.381	10-year	4.85	202.30	203.13	202.62	203.15	0.000728	0.68	7.13		0.24
Reach-1	46.381	25-year	5.93	202.30	203.30	202.67	203.33		0.69			0.22
Reach-1	46.381	50-year	6.83	202.30	203.46	202.70	203.48	0.000471	0.68	9.98		0.20
Reach-1	46.381	100-year	7.62	202.30	203.63	202.73	203.66	0.000369	0.66	11.47	27.61	0.18
Reach-1	46.381	Aug. 19th	17.75	202.30	205.75	203.05	205.75	0.000005	0.13		193.47	0.02
Reach-1	46.381	Regional w red'n	47.80	202.30	206.08	203.76	206.08	0.000019	0.29	334.20	237.30	0.05
Ponch 1	46.26	2 1005	6.04	204.00	202.52		202.52	0.000000	0.77	0.04	40.07	0.00
Reach-1	46.36	2-year	6.21 8.54	201.60 201.60	202.56 202.77		202.59 202.80	0.000889 0.000788	0.77	9.01 11.96	13.27 14.88	0.26 0.26
Reach-1	46.36 46.36	5-year	10.17	201.60	202.77		202.80	0.000788	0.84		14.88	
		10-year									t	0.25
Reach-1	46.36	25-year	12.32	201.60	203.13		203.16		0.88			0.23 0.22
Reach-1	46.36	50-year	14.30	201.60	203.31		203.34	0.000515 0.000441	0.89	21.09		
Reach-1	46.36	100-year	16.31	201.60	203.50		203.54		0.89	24.96	20.51	0.21
Reach-1	46.36	Aug. 19th	41.07	201.60	205.72		205.74		0.76			
Reach-1	46.36	Regional w red'n	66.49	201.60	206.02		206.05	0.000194	1.05	128.83	96.09	0.16
Reach-1	46.35	2-vear	6.21	201.40	202.44		202.46	0.000776	0.71	9.52	14.43	0.25
	46.35 46.35	2-year	6.21 8.54	201.40	202.44		202.46		0.71			0.25 0.23
Reach-1	40.33	5-year	0.04	201.40	202.07		202.09	0.000038	0.76	13.10	10.76	0.23

Reach	River Sta	River: RIVER-1 Reac	n: Reach-1 (Co Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Reacti	River Sta	FIUITE	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	Floude # Chi
Doosh 1	46.35	10				(111)			0.77			0.22
Reach-1	_	10-year	10.17	201.40	202.83		202.86	0.000545		16.01	18.44	
Reach-1	46.35	25-year	12.32	201.40	203.05		203.08	0.000440	0.77	20.40	20.72	
Reach-1	46.35	50-year	14.30	201.40	203.25		203.27	0.000378	0.78	24.56	22.67	0.19
Reach-1	46.35	100-year	16.31	201.40	203.45		203.48	0.000319	0.77	29.45	24.77	0.18
Reach-1	46.35	Aug. 19th	41.07	201.40	205.71		205.72	0.000084	0.67	118.98	63.97	0.10
Reach-1	46.35	Regional w red'n	66.49	201.40	206.00		206.03	0.000157	0.96	137.64	64.98	0.15
Reach-1	46.34	2-year	6.21	201.20	202.36		202.38	0.000631	0.63	10.24	14.07	0.22
Reach-1	46.34	5-year	8.54	201.20	202.60		202.62	0.000488	0.66	13.90	15.52	
Reach-1	46.34	10-year	10.17	201.20	202.78		202.80	0.000410	0.67	16.71	16.54	0.19
Reach-1	46.34	25-year	12.32	201.20	203.01		203.04	0.000331	0.67	20.76	17.91	0.18
Reach-1	46.34	50-year	14.30	201.20	203.21		203.23	0.000288	0.68	24.40	19.06	0.17
Reach-1	46.34	100-year	16.31	201.20	203.42		203.44	0.000246	0.68	28.56	20.29	0.16
Reach-1	46.34	Aug. 19th	41.07	201.20	205.70		205.71	0.000076	0.64	108.52	107.24	0.10
Reach-1	46.34	Regional w red'n	66.49	201.20	205.98		206.01	0.000144	0.92	126.32	107.94	0.14
Reach-1	46.33	2-year	8.66	201.00	202.14		202.19	0.001244	0.90	9.66	11.92	0.3
		<u> </u>	 	201.00	202.14		202.19	0.000911	0.94		13.78	
Reach-1	46.33	5-year	12.09							13.43		
Reach-1	46.33	10-year	14.45	201.00	202.63		202.68	0.000764	0.95	16.25	15.02	0.26
Reach-1	46.33	25-year	17.55	201.00	202.89		202.94	0.000618	0.96	20.33	16.65	0.24
Reach-1	46.33	50-year	20.24	201.00	203.10		203.15	0.000536	0.97	23.96	17.98	
Reach-1	46.33	100-year	22.97	201.00	203.33		203.37	0.000458	0.97	28.14	19.39	0.22
Reach-1	46.33	Aug. 19th	57.02	201.00	205.67		205.69	0.000114	0.80	146.39	115.00	0.12
Reach-1	46.33	Regional w red'n	74.78	201.00	205.95		205.98	0.000128	0.89	179.02	115.00	0.10
Reach-1	46.322	2-year	8.66	201.00	202.05	201.38	202.08	0.000554	0.65	13.25	14.45	0.2
Reach-1	46.322	5-year	12.09	201.00	202.37	201.47	202.40	0.000436	0.70	17.39	16.26	
Reach-1	46.322	10-year	14.45	201.00	202.58	201.47	202.40	0.000438	0.70	20.07	17.43	
Reach-1	46.322	25-year	17.55	201.00	202.85	201.53	202.87	0.000387	0.72	23.54	18.95	
	-	1 -										
Reach-1	46.322	50-year	20.24	201.00	203.06	201.66	203.09	0.000306	0.77	26.34	20.17	
Reach-1	46.322	100-year	22.97	201.00	203.29	201.72	203.32	0.000276	0.78	29.31	21.47	0.17
Reach-1	46.322	Aug. 19th	57.02	201.00	205.65	202.29	205.68	0.000113	0.81	103.18	42.38	0.12
Reach-1	46.322	Regional w red'n	74.78	201.00	205.92	202.53	205.96	0.000153	0.98	117.81	57.00	0.14
Reach-1	46.3215		Culvert									
Reach-1	46.321	2-year	8.66	200.60	202.02	200.98	202.03	0.000221	0.49	17.81	14.27	0.13
	_	I -										
Reach-1	46.321	5-year	12.09	200.60	202.33	201.07	202.35	0.000218	0.55	21.84	16.03	0.14
Reach-1	46.321	10-year	14.45	200.60	202.53	201.13	202.55	0.000213	0.59	24.46	17.18	
Reach-1	46.321	25-year	17.55	200.60	202.80	201.21	202.82	0.000204	0.63	27.86	18.66	
Reach-1	46.321	50-year	20.24	200.60	203.01	201.26	203.03	0.000198	0.66	30.59	19.86	0.14
Reach-1	46.321	100-year	22.97	200.60	203.22	201.32	203.24	0.000191	0.69	33.37	21.07	0.14
Reach-1	46.321	Aug. 19th	57.02	200.60	205.10	201.90	205.14	0.000149	0.88	88.85	31.78	0.13
Reach-1	46.321	Regional w red'n	74.78	200.60	205.31	202.15	205.36	0.000215	1.09	95.59	32.96	0.16
Reach-1	46.32	2-year	8.66	200.60	201.90		201.99	0.001952	1.36	8.46	11.09	0.4
Reach-1	46.32	5-year	12.09	200.60	202.21		202.30	0.001553	1.43	12.23	13.19	0.38
Reach-1	46.32		14.45	200.60					1.45	15.07	14.57	0.36
		10-year			202.42		202.51	0.001347				
Reach-1	46.32	25-year	17.55	200.60	202.69		202.78	0.001111	1.46	19.25	16.39	
Reach-1	46.32	50-year	20.24	200.60	202.90		202.99	0.000978	1.47	22.94	17.85	0.32
Reach-1	46.32	100-year	22.97	200.60	203.12		203.21	0.000855	1.47	27.05	19.34	0.30
Reach-1	46.32	Aug. 19th	57.02	200.60	205.03		205.11	0.000461	1.60	76.18	32.97	0.25
Reach-1	46.32	Regional w red'n	74.78	200.60	205.21		205.33	0.000649	1.95	82.60	38.69	0.29
Reach-1	46.312	2-year	8.66	200.60	201.89	200.98	201.91	0.000256	0.53	16.46	17.48	0.15
Reach-1	46.312	5-year	12.09	200.60	202.21	201.07	202.23	0.000236	0.59	20.60	19.29	•
Reach-1	46.312	10-year	14.45	200.60	202.42	201.12	202.44	0.000224	0.62	23.30	20.46	
Reach-1	46.312	25-year	17.55	200.60	202.42	201.12	202.71	0.000224	0.65	26.84	22.01	
Reach-1	46.312		20.24	200.60	202.69	201.19	202.71	0.000206	0.68	29.65	23.23	•
		50-year										
Reach-1	46.312	100-year	22.97	200.60	203.13	201.31	203.15	0.000186	0.71	32.53	24.49	
Reach-1 Reach-1	46.312 46.312	Aug. 19th Regional w red'n	57.02 74.78	200.60 200.60	205.04 205.23	201.88 202.12	205.07 205.27	0.000117 0.000169	0.82 1.01	107.09 115.81	47.00 47.00	•
TCGGIT I	40.012	regional wream	74.70	200.00	200.20	202.12	200.21	0.000103	1.01	110.01	47.00	0.10
Reach-1	46.3115		Culvert									
Reach-1	46.311	2-year	8.66	200.50	201.86	200.88	201.87	0.000222	0.50	17.26	17.29	0.14
Reach-1	46.311	5-year	12.09	200.50	202.17	200.97	202.18	0.000215	0.57	21.28	19.05	
Reach-1	46.311	10-year	14.45	200.50	202.37	201.03	202.39	0.000218	0.60	23.91	20.19	
Reach-1	46.311	25-year	17.55	200.50	202.64	201.03	202.66	0.000200	0.64	27.38	21.71	0.14
Reach-1	46.311	50-year	20.24	200.50	202.85	201.15	202.87	0.000193	0.67	30.13	22.90	•
		<u> </u>										
Reach-1	46.311	100-year	22.97	200.50	203.05	201.21	203.08	0.000184	0.70	32.79	24.06	
Reach-1	46.311	Aug. 19th	57.02	200.50	204.75	201.78	204.78	0.000149	0.89	94.49	47.00	•
Reach-1	46.311	Regional w red'n	74.78	200.50	204.88	202.03	204.93	0.000225	1.12	100.57	47.00	0.17
Reach-1	46.31	2-year	8.66	200.40	201.82		201.83	0.000277	0.55	17.43	17.45	
Reach-1	46.31	5-year	12.09	200.40	202.13		202.15	0.000249	0.61	23.22	19.54	
Reach-1	46.31	10-year	14.45	200.40	202.34		202.35	0.000231	0.64	27.37	20.90	0.15
Reach-1	46.31	25-year	17.55	200.40	202.61		202.63	0.000206	0.66	33.28	22.71	0.15

		River: RIVER-1 Read			W.O. El	0-11110	F.O. Fl	F.O. 01	\/-I ObI	El A	T 14/5-161-	F
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El	W.S. Elev	Crit W.S. (m)	E.G. Elev	E.G. Slope	Vel Chnl (m/s)	Flow Area (m2)	Top Width	Froude # Chl
Reach-1	46.31	50-year	20.24	(m) 200.40	(m) 202.82	(111)	(m) 202.84	(m/m) 0.000192	0.68	38.28	(m) 24.13	0.14
Reach-1	46.31	100-year	22.97	200.40	203.03		203.05	0.000132	0.70	43.40	25.51	0.14
Reach-1	46.31	Aug. 19th	57.02	200.40	204.73		204.76	0.000156	0.92	101.89	67.00	0.14
Reach-1	46.31	Regional w red'n	74.78	200.40	204.84		204.90	0.000236	1.15	109.80	67.00	0.18
Reach-1	46.30	2-year	10.77	200.30	201.76		201.78	0.000420	0.68	17.24	16.92	0.19
Reach-1	46.30	5-year	15.14	200.30	202.07		202.10	0.000385	0.76	22.90	18.97	0.19
Reach-1	46.30	10-year	18.13	200.30	202.28		202.31	0.000359	0.80	26.97	20.32	0.19
Reach-1	46.30	25-year	22.04	200.30	202.55		202.59	0.000320	0.83	32.80	22.10	0.18
Reach-1	46.30	50-year	25.35	200.30	202.77		202.80	0.000297	0.85	37.72	23.50	0.18
Reach-1	46.30	100-year	28.70	200.30	202.98		203.01	0.000278	0.87	42.75	24.86	0.18
Reach-1	46.30	Aug. 19th	70.73	200.30	204.67		204.73	0.000246	1.16	94.27	36.06	
Reach-1	46.30	Regional w red'n	81.91	200.30	204.79		204.86	0.000297	1.29	98.86	46.84	0.20
Reach-1	46.292	2-year	10.77	200.30	201.72	200.72	201.74	0.000281	0.61	17.78	18.33	0.16
Reach-1	46.292	5-year	15.14	200.30	202.04	200.83	202.06	0.000284	0.70	21.73	20.23	0.17
Reach-1	46.292	10-year	18.13	200.30	202.25	200.89	202.27	0.000280	0.75	24.33	21.48	0.17
Reach-1	46.292	25-year	22.04	200.30	202.52	200.98	202.55	0.000266	0.79	27.78	23.13	
Reach-1	46.292	50-year	25.35	200.30	202.74	201.05	202.77	0.000258	0.83	30.48	24.43	0.17
Reach-1	46.292	100-year	28.70	200.30	202.95	201.12	202.98	0.000252	0.87	33.07	25.67	0.17
Reach-1	46.292	Aug. 19th	70.73	200.30	204.66	201.78	204.70	0.000171	0.96	111.29	58.10	0.15
Reach-1	46.292	Regional w red'n	81.91	200.30	204.78	201.94	204.82	0.000204	1.07	118.03	60.00	0.16
Reach-1	46.2915		Culvert									
	40.00											
Reach-1	46.291	2-year	10.77	200.20	201.68	200.63	201.70	0.000246	0.58	18.51	18.09	0.15
Reach-1	46.291	5-year	15.14	200.20	201.98	200.73	202.01	0.000262	0.68	22.28	19.90	0.16
Reach-1	46.291	10-year	18.13	200.20	202.18	200.80	202.21	0.000263	0.73	24.78	21.09	0.17
Reach-1	46.291	25-year	22.04	200.20	202.45	200.88	202.48	0.000255	0.78	28.13	22.70	0.17
Reach-1	46.291	50-year	25.35	200.20	202.66	200.95	202.69	0.000252	0.83	30.70	23.94	0.17
Reach-1	46.291	100-year	28.70	200.20	202.83 204.45	201.01	202.87	0.000257	0.87	32.89	24.99	0.17
Reach-1 Reach-1	46.291 46.291	Aug. 19th Regional w red'n	70.73 81.91	200.20 200.20	204.45	201.68 201.84	204.49	0.000202 0.000239	1.02	101.32 107.50	49.69 53.52	0.16 0.17
Neauli-1	40.291	Regional wreum	01.91	200.20	204.57	201.04	204.03	0.000239	1.13	107.50	33.32	0.17
Reach-1	46.29	2-year	10.77	200.20	201.61		201.64	0.000691	0.75	15.22	17.65	0.24
Reach-1	46.29	5-year	15.14	200.20	201.92		201.95	0.000545	0.80	20.97	19.50	0.22
Reach-1	46.29	10-year	18.13	200.20	202.12		202.16	0.000473	0.82	25.11	20.74	0.21
Reach-1	46.29	25-year	22.04	200.20	202.40		202.43	0.000389	0.83	31.09	22.40	0.20
Reach-1	46.29	50-year	25.35	200.20	202.61		202.65	0.000348	0.85	35.96	23.67	0.19
Reach-1	46.29	100-year	28.70	200.20	202.79		202.82	0.000331	0.87	40.24	24.73	0.19
Reach-1	46.29	Aug. 19th	70.73	200.20	204.40		204.46	0.000263	1.12	93.35	61.02	0.18
Reach-1	46.29	Regional w red'n	81.91	200.20	204.52		204.58	0.000310	1.24	100.69	68.39	0.20
Reach-1	46.282	2-year	10.77	199.90	201.58	200.33	201.59	0.000155	0.50	21.69	19.01	0.12
Reach-1	46.282	5-year	15.14	199.90	201.89	200.42	201.90	0.000174	0.59	25.69	20.22	0.13
Reach-1	46.282	10-year	18.13	199.90	202.09	200.50	202.11	0.000179	0.64	28.37	21.10	0.14
Reach-1	46.282	25-year	22.04	199.90	202.37	200.58	202.39	0.000177	0.69	31.99	22.40	0.14
Reach-1	46.282	50-year	25.35	199.90	202.58	200.64	202.61	0.000178	0.73	34.74	23.38	0.14
Reach-1	46.282	100-year	28.70	199.90	202.76	200.71	202.79	0.000185	0.78	37.02	24.20	0.15
Reach-1	46.282	Aug. 19th	70.73	199.90	204.39	201.35	204.42	0.000148	0.93	122.19	106.22	0.14
Reach-1	46.282	Regional w red'n	81.91	199.90	204.50	201.50	204.54	0.000170	1.02	134.50	112.37	0.15
Reach-1	46.2815		Culvert									
Reach-1	46.281	2-year	10.77	199.80	201.57	200.23	201.58	0.000130	0.47	22.87	18.98	0.11
Reach-1	46.281	5-year	15.14	199.80	201.87	200.33	201.89	0.000152	0.56	26.80	20.17	0.13
Reach-1	46.281	10-year	18.13	199.80	202.07	200.39	202.09	0.000159	0.62	29.42	21.02	
Reach-1	46.281	25-year	22.04	199.80	202.34	200.48	202.37	0.000162	0.67	32.92	22.27	0.13
Reach-1	46.281	50-year	25.35	199.80	202.54	200.54	202.57	0.000167	0.71	35.49	23.19	
Reach-1	46.281 46.281	100-year	28.70 70.73	199.80 199.80	202.70 204.22	200.60 201.26	202.73 204.26	0.000177 0.000171	0.76 0.98	37.57 116.03	23.94 143.02	0.14 0.15
Reach-1 Reach-1	46.281	Aug. 19th Regional w red'n	70.73 81.91	199.80	204.22		204.26	0.000171	1.04	139.42	154.50	0.15
	10.201		01.91	100.00	204.00	201.41	207.42	3.300102	1.04	100.42	104.00	0.10
Reach-1	46.28	2-year	10.77	199.80	201.53		201.56	0.000526	0.92	17.02	15.34	0.23
Reach-1	46.28	5-year	15.14	199.80	201.82		201.87	0.000566	1.06	21.79	17.20	
Reach-1	46.28	10-year	18.13	199.80	202.02		202.07	0.000562	1.13	25.34	18.46	
Reach-1	46.28	25-year	22.04	199.80	202.29		202.35	0.000530	1.18	30.53	20.16	
Reach-1	46.28	50-year	25.35	199.80	202.49		202.55		1.23	34.63	21.41	0.24
Reach-1	46.28	100-year	28.70	199.80	202.64		202.71	0.000528	1.29	38.09	22.41	0.25
Reach-1	46.28	Aug. 19th	70.73	199.80	204.13		204.23	0.000541	1.74	87.61	109.62	0.27
Reach-1	46.28	Regional w red'n	81.91	199.80	204.29		204.39	0.000551	1.80	106.07	121.29	0.27
Reach-1	46.274	2-year	8.06	199.34	201.54	199.90	201.55	0.000050	0.32	26.69	26.08	0.07
		·			201.54		201.55	0.000050			26.08	
Reach-1	46.274 46.274	5-year 10-year	11.40 13.74	199.34 199.34	201.84	200.01 200.07	201.85	0.000062	0.39	30.86 33.68	28.91	0.08
Reach-1	46.274	25-year	17.02	199.34	202.04	200.07	202.05	0.000067	0.43	37.45	30.43	0.09
Reach-1	46.274	50-year	19.57	199.34	202.51	200.10	202.52	0.000073	0.46	40.23	31.56	
Reach-1	46.274	100-year	22.11	199.34	202.67	200.22	202.68	0.000070	0.55	42.47	32.46	
		,	-4.11	. 55.54	202.01	_50.21	_02.00	3.000001	0.00	72.71	, JZ10	, 0.1

		River: RIVER-1 Reac										
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Reach-1	46.274	Aug. 19th	52.86	199.34	204.18	200.79	204.20	0.000063	0.62	149.20	176.45	0.09
Reach-1	46.274	Regional w red'n	81.91	199.34	204.33	201.18	204.36	0.000124	0.89	175.49	181.59	0.13
Decel 4	40.0705		Duistan									
Reach-1	46.2735		Bridge									
Reach-1	46.273	2-year	8.06	199.34	201.53	199.90	201.54	0.000051	0.32	26.54	26.02	0.07
Reach-1	46.273	5-year	11.40	199.34	201.82	200.01	201.83	0.000064	0.39	30.54	27.64	0.08
Reach-1	46.273	10-year	13.74	199.34	202.01	200.07	202.02	0.000071	0.43	33.19	28.71	0.09
Reach-1	46.273 46.273	25-year 50-year	17.02 19.57	199.34 199.34	202.26 202.44	200.16 200.22	202.27 202.45	0.000078 0.000083	0.49 0.52	36.67 39.18	30.12 31.13	0.09
Reach-1	46.273	100-year	22.11	199.34	202.44	200.22	202.43	0.000090	0.52	41.11	31.13	0.10
Reach-1	46.273	Aug. 19th	52.86	199.34	204.07	200.79	204.09	0.000072	0.66	129.48	172.49	0.10
Reach-1	46.273	Regional w red'n	81.91	199.34	204.25	201.19	204.28	0.000138	0.93	161.07	178.79	0.14
Deceb 1	46.070	2	8.06	100.24	204 52	199.81	204.54	0.000092	0.46	47.40	4E 22	0.10
Reach-1	46.272 46.272	2-year 5-year	11.40	199.34 199.34	201.53 201.81	199.81	201.54 201.82	0.000092	0.46	17.48 19.73	15.33 17.10	0.10
Reach-1	46.272	10-year	13.74	199.34	201.99	200.01	202.01	0.000120	0.65	21.21	18.28	0.13
Reach-1	46.272	25-year	17.02	199.34	202.24	200.11	202.26	0.000160	0.73	23.16	21.47	0.14
Reach-1	46.272	50-year	19.57	199.34	202.41	200.19	202.44	0.000174	0.80	24.56	23.81	0.15
Reach-1	46.272	100-year	22.11	199.34	202.54	200.26	202.58	0.000193	0.86	25.63	25.58	0.15
Reach-1	46.272	Aug. 19th	52.86	199.34	204.05	200.99	204.08	0.000136	0.90	101.13	171.68	0.13
Reach-1	46.272	Regional w red'n	81.91	199.34	204.21	201.54	204.27	0.000263	1.28	128.75	177.22	0.19
Reach-1	46.2715		Culvert									
Reach-1	46.271	2-year	8.06	198.98	201.36	199.45	201.37	0.000070	0.42	18.99	26.39	0.09
Reach-1	46.271	5-year	11.40	198.98	201.58	199.57	201.59	0.000104	0.55	20.74	28.46	0.11
Reach-1	46.271 46.271	10-year 25-year	13.74 17.02	198.98 198.98	201.72 201.92	199.65 199.75	201.74 201.94	0.000125 0.000154	0.63 0.73	21.92 23.46	29.87 31.69	0.12 0.14
Reach-1	46.271	50-year	19.57	198.98	202.05	199.83	202.08	0.000175	0.80	24.53	32.62	0.15
Reach-1	46.271	100-year	22.11	198.98	202.11	199.91	202.15	0.000209	0.88	25.03	32.78	0.16
Reach-1	46.271	Aug. 19th	52.86	198.98	202.67	200.63	202.71	0.000163	0.83	83.94	34.18	0.14
Reach-1	46.271	Regional w red'n	81.91	198.98	203.02	201.18	203.08	0.000275	1.15	96.06	35.13	0.19
Reach-1	46.27	2-year	8.06	198.90	201.35		201.36	0.000135	0.60	29.36	20.10	0.12
Reach-1	46.27	5-year	11.40	198.90	201.55		201.58	0.000135	0.60	33.85	21.40	0.12
Reach-1	46.27	10-year	13.74	198.90	201.71		201.73	0.000219	0.83	37.06	22.28	0.16
Reach-1	46.27	25-year	17.02	198.90	201.90		201.93	0.000254	0.94	41.44	23.43	0.17
Reach-1	46.27	50-year	19.57	198.90	202.04		202.07	0.000279	1.01	44.63	24.23	0.18
Reach-1	46.27	100-year	22.11	198.90	202.10		202.13	0.000328	1.11	46.11	24.59	0.20
Reach-1	46.27 46.27	Aug. 19th Regional w red'n	52.86 81.91	198.90 198.90	202.53 202.75		202.66 202.99	0.001087 0.002039	2.21 3.14	57.38 63.35	27.21 28.49	0.37 0.51
iveacii- i	40.27	regional wreum	01.31	130.30	202.73		202.55	0.002033	3.14	03.33	20.43	0.51
Reach-1	46.26	2-year	8.06	198.80	201.34		201.35	0.000052	0.38	38.05	23.62	0.08
Reach-1	46.26	5-year	11.40	198.80	201.56		201.57	0.000075	0.48	43.24	24.89	0.09
Reach-1	46.26	10-year	13.74	198.80	201.70		201.72	0.000089	0.54	46.94	25.75	0.10
Reach-1	46.26 46.26	25-year 50-year	17.02 19.57	198.80 198.80	201.89 202.03		201.91 202.04	0.000106 0.000119	0.61 0.67	51.94 55.57	26.88 27.95	0.11 0.12
Reach-1	46.26	100-year	22.11	198.80	202.09		202.10	0.000113	0.74	57.23	28.90	0.12
Reach-1	46.26	Aug. 19th	52.86	198.80	202.48		202.56	0.000526	1.54	70.01	35.36	0.26
Reach-1	46.26	Regional w red'n	81.91	198.80	202.65		202.81	0.001027	2.22	77.51	45.97	0.36
		_										
Reach-1	46.25 46.25	2-year 5-year	15.03 21.49	198.60 198.60	201.33 201.54		201.34 201.55	0.000074 0.000112	0.46	52.35 59.29	32.44 34.38	0.09
Reach-1	46.25	10-year	25.94	198.60	201.68		201.33		0.68	64.26	35.70	0.11
Reach-1	46.25	25-year	31.81	198.60	201.87		201.89	0.000160	0.77	71.04	37.43	0.14
Reach-1	46.25	50-year	36.29	198.60	202.00		202.02	0.000177	0.83	75.96	38.64	0.15
Reach-1	46.25	100-year	40.81	198.60	202.05		202.08	0.000209	0.91	78.03	39.64	0.16
Reach-1	46.25	Aug. 19th	96.52	198.60	202.34		202.48	0.000821	1.91	90.32	45.23	0.32
Reach-1	46.25	Regional w red'n	108.10	198.60	202.56		202.70	0.000797	1.96	100.80	49.52	0.32
Reach-1	46.24	2-year	15.03	198.40	201.32		201.33	0.000090	0.52	44.45	27.43	0.10
Reach-1	46.24	5-year	21.49	198.40	201.52		201.54	0.000139	0.68	50.10	29.16	0.13
Reach-1	46.24	10-year	25.94	198.40			201.68	0.000169	0.77	54.17	30.35	0.14
Reach-1	46.24	25-year	31.81	198.40	201.84		201.87	0.000203	0.88	59.75	31.90	0.16
Reach-1	46.24	50-year	36.29	198.40	201.96		202.00	0.000227	0.95	63.82	32.99	0.17
Reach-1	46.24 46.24	100-year Aug. 19th	40.81 96.52	198.40 198.40	202.01 202.10		202.05 202.33	0.000272 0.001371	1.05 2.40	65.31 68.47	33.41 34.68	0.18
Reach-1	46.24	Regional w red'n	108.10	198.40	202.10		202.56	0.001371	2.40	76.14	37.58	0.41
Reach-1	46.23	2-year	15.03	198.20	201.32		201.32	0.000011	0.18	131.99	70.15	0.04
Reach-1	46.23	5-year	21.49	198.20	201.52		201.53	0.000017	0.24	146.32	71.50	0.04
Reach-1	46.23	10-year	25.94	198.20	201.66		201.67	0.000020	0.27	156.30	72.42	0.05
Reach-1	46.23 46.23	25-year 50-year	31.81 36.29	198.20 198.20	201.85 201.97		201.85 201.98	0.000024 0.000027	0.31	169.61 179.04	73.64 74.49	0.05
Reach-1	46.23	100-year	40.81	198.20	201.97		201.98	0.000027	0.33	182.63	74.49	0.06
Reach-1	46.23	Aug. 19th	96.52	198.20	202.19		202.21	0.000152	0.82	195.14	75.92	0.14
Reach-1	46.23	Regional w red'n	108.10	198.20	202.41		202.44	0.000152	0.86	212.10	77.39	0.14

Reach	River Sta	River: RIVER-1 Read	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
iteacii	INVELOID	1 Tollie	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	1 loude # Cill
Reach-1	46.22	2-year	15.03	197.50	201.32		201.32	0.000001	0.05	341.18	134.23	0.0
Reach-1	46.22	5-year	21.49	197.50	201.53		201.53	0.000001	0.07	368.70	137.31	0.0
Reach-1	46.22	10-year	25.94	197.50	201.66		201.67	0.000001	0.08	387.93	139.42	
Reach-1 Reach-1	46.22 46.22	25-year 50-year	31.81 36.29	197.50 197.50	201.85 201.98		201.85 201.98	0.000002 0.000002	0.09	413.64 431.91	142.19 144.12	0.01
Reach-1	46.22	100-year	40.81	197.50	201.98		201.98	0.000002	0.10	438.91	144.12	0.02
Reach-1	46.22	Aug. 19th	96.52	197.50	202.02		202.02	0.000002	0.26	464.42	146.78	0.04
Reach-1	46.22	Regional w red'n	108.10	197.50	202.42		202.42	0.000012	0.27	497.30	149.34	0.04
11000111	10.22	rtogioriai ii rodii	100.10	107.00	202.12		202.12	0.000012	0.2.	107.00	1 10.01	0.0
Reach-1	46.214	2-year	3.78	196.70	201.32	196.81	201.32	0.000000	0.02	241.90	87.54	0.00
Reach-1	46.214	5-year	6.82	196.70	201.53	196.87	201.53	0.000000	0.03	255.48	93.37	0.00
Reach-1	46.214	10-year	9.18	196.70	201.66	196.91	201.67	0.000000	0.04	264.80	97.36	0.01
Reach-1	46.214	25-year	12.68	196.70	201.85	196.95	201.85	0.000000	0.05	277.03	102.61	0.01
Reach-1	46.214	50-year	15.80	196.70	201.98	196.99	201.98	0.000001	0.06	285.58	106.28	0.01
Reach-1	46.214	100-year	19.06	196.70	202.02	197.03	202.02	0.000001	0.08	324.72	172.41	0.01
Reach-1	46.214	Aug. 19th	49.30	196.70	202.20	197.30	202.20	0.000005	0.19	356.38	190.39	0.03
Reach-1	46.214	Regional w red'n	108.10	196.70	202.41	197.70	202.42	0.000019	0.39	399.88	212.63	0.05
Reach-1	46.2135		Inl Struct									
							-				-	
Reach-1	46.213	2-year	3.78	196.70	198.15	196.81	198.15	0.000004	0.07	57.67	47.16	0.02
Reach-1	46.213	5-year	6.82	196.70	199.17	196.87	199.17	0.000002	0.06	109.72	55.05	0.01
Reach-1	46.213	10-year	9.18	196.70	199.75	196.91	199.75	0.000001	0.07	143.05	59.59	0.01
Reach-1	46.213	25-year	12.68	196.70	200.34	196.95	200.34	0.000001	0.08	177.82	67.26	0.01
Reach-1	46.213	50-year	15.80	196.70	200.56	196.99	200.56	0.000002	0.09	191.57	70.94	0.02
Reach-1	46.213	100-year	19.06	196.70	200.73	197.03	200.73	0.000002	0.10	202.55	73.79	0.02
Reach-1	46.213 46.213	Aug. 19th Regional w red'n	49.30 108.10	196.70 196.70	202.06 202.33	197.30 197.70	202.06 202.34	0.000005 0.000020	0.19	330.51 382.65	175.84 204.12	0.03
Neau1-1	40.213	Regional wreum	106.10	190.70	202.33	197.70	202.34	0.000020	0.40	302.03	204.12	0.00
Reach-1	46.212	2-year	3.78	196.60	198.15	196.83	198.15	0.000034	0.22	17.01	50.10	0.06
Reach-1	46.212	5-year	6.82	196.60	199.16	196.94	199.17	0.000020	0.24	28.21	88.96	0.05
Reach-1	46.212	10-year	9.18	196.60	199.75	197.01	199.75	0.000019	0.27	34.65	121.25	0.05
Reach-1	46.212	25-year	12.68	196.60	200.34	197.11	200.34	0.000020	0.31	41.12	128.40	0.05
Reach-1	46.212	50-year	15.80	196.60	200.56	197.20	200.56	0.000026	0.36	43.51	131.89	0.06
Reach-1	46.212	100-year	19.06	196.60	200.72	197.27	200.73	0.000033	0.42	45.35	134.56	0.07
Reach-1	46.212	Aug. 19th	49.30	196.60	202.06	197.88	202.06	0.000003	0.13	520.83	232.46	0.02
Reach-1	46.212	Regional w red'n	108.10	196.60	202.33	198.74	202.34	0.000010	0.26	586.63	244.33	0.04
Doods 1	46 0445		Cubant									
Reach-1	46.2115		Culvert									
Reach-1	46.211	2-year	3.78	196.40	198.14	196.62	198.14	0.000019	0.18	20.88	20.26	0.04
Reach-1	46.211	5-year	6.82	196.40	199.14	196.73	199.14	0.000014	0.21	32.87	28.42	0.04
Reach-1	46.211	10-year	9.18	196.40	199.70	196.79	199.70	0.000013	0.23	39.63	30.11	0.04
Reach-1	46.211	25-year	12.68	196.40	200.25	196.89	200.25	0.000015	0.27	46.15	92.74	0.04
Reach-1	46.211	50-year	15.80	196.40	200.41	196.97	200.42	0.000021	0.33	48.14	102.69	0.05
Reach-1	46.211	100-year	19.06	196.40	200.51	197.04	200.52	0.000028	0.39	49.35	108.76	0.06
Reach-1	46.211	Aug. 19th	49.30	196.40	200.83	197.60	200.85	0.000051	0.54	164.83	128.04	0.08
Reach-1	46.211	Regional w red'n	108.10	196.40	201.23	198.42	201.26	0.000144	0.96	224.48	173.18	0.14
Reach-1	46.21	2-year	7.79	196.30	198.03		198.11	0.002589	1.59	7.58	10.71	0.41
Reach-1	46.21	5-year	11.08	196.30	198.03		199.14	0.002569	0.79	24.20	19.83	0.41
Reach-1	46.21	10-year	13.19	196.30	199.12		199.70	0.000318	0.79	37.14	25.37	0.10
Reach-1	46.21	25-year	15.19	196.30	200.24		200.25	0.000137	0.62	62.10	74.82	0.10
Reach-1	46.21	50-year	17.82	196.30	200.41		200.42	0.000100	0.58	75.43	82.24	0.09
Reach-1	46.21	100-year	20.59	196.30	200.51		200.52	0.000105	0.61	84.11	86.72	0.10
Reach-1	46.21	Aug. 19th	50.39	196.30	200.82		200.84	0.000318	1.11	113.11	100.27	0.17
Reach-1	46.21	Regional w red'n	122.56	196.30	201.20		201.25	0.000885	1.95	153.55	111.21	0.29
Reach-1	46.202	2-year	7.79	196.00	198.07	196.50	198.08	0.000135	0.54	14.46	11.29	0.12
Reach-1	46.202	5-year	11.08	196.00	199.12	196.64	199.13	0.000069 0.000056	0.51	21.83	14.62	0.09
Reach-1	46.202 46.202	10-year	13.19 15.82	196.00 196.00	199.69 200.24	196.71 196.81	199.70 200.25	0.000056	0.51 0.46	25.80 54.36	16.80 102.35	0.08
Reach-1	46.202	25-year 50-year	17.82	196.00	200.24	196.81	200.25	0.000043	0.46	69.40	119.08	0.07
Reach-1	46.202	100-year	20.59	196.00	200.40	196.95	200.41	0.000039	0.46	98.90	129.48	
Reach-1	46.202	Aug. 19th	50.39	196.00	200.81	197.74	200.84	0.000039	0.84	142.67	159.47	0.07
Reach-1	46.202	Regional w red'n	122.56	196.00	201.17	199.15	201.24	0.000379	1.50	206.12	186.57	0.12
			50									
Reach-1	46.2015		Culvert									
Reach-1	46.201	2-year	7.79	196.00	197.87	196.50	197.88	0.000190	0.60	13.06	10.67	0.14
Reach-1	46.201	5-year	11.08	196.00	198.70	196.64	198.72	0.000112	0.59	18.88	13.24	0.11
D	46.201	10-year	13.19	196.00	199.08	196.71	199.10 199.37	0.000085	0.50 0.54	30.88 35.01	14.49	0.09
Reach-1	40.004							0.000088	0.54	35.01		0.09
Reach-1	46.201	25-year	15.82	196.00	199.36	196.81					15.54	
Reach-1 Reach-1	46.201	50-year	17.82	196.00	199.52	196.87	199.54	0.000093	0.57	37.57	16.16	0.10
Reach-1												

Reach	River Sta	River: RIVER-1 Read	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Reacii	INVELOID	1 Tonie	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	1 loude # Cill
Reach-1	46.192	2-year	7.79	195.90	197.81	196.63	197.87	0.000534	1.02	7.66	13.51	0.23
Reach-1	46.192 46.192	5-year	11.08 13.19	195.90	198.65 199.06	196.82 196.94	198.70	0.000323	1.01 0.77	11.00 22.40	20.19 50.86	0.19
Reach-1	46.192	10-year 25-year	15.19	195.90 195.90	199.06	196.94	199.09 199.37	0.000180 0.000072	0.77	55.68	60.15	0.12
Reach-1	46.192	50-year	17.82	195.90	199.52	197.16	199.53	0.000072	0.49	65.89	65.20	
Reach-1	46.192	100-year	20.59	195.90	199.82	197.29	199.83	0.000052	0.46	86.98	74.55	
Reach-1	46.192	Aug. 19th	50.39	195.90	200.49	198.42	200.50	0.000104	0.73	145.38	92.46	0.11
Reach-1	46.192	Regional w red'n	122.56	195.90	201.16	199.36	201.19	0.000229	1.19	207.91	95.00	0.17
Reach-1	46.1915		Culvert									
Decel 4	40.404	0	7.70	405.00	407.70	400.00	407.70	0.000057	4.00	7.40	40.50	0.00
Reach-1	46.191 46.191	2-year 5-year	7.79 11.08	195.90 195.90	197.70 198.36	196.63 196.82	197.76 198.42	0.000657 0.000468	1.08	7.19 9.84	12.59 17.87	0.26
Reach-1	46.191	10-year	13.19	195.90	198.69	196.94	198.70		0.60	29.26	20.50	0.12
Reach-1	46.191	25-year	15.82	195.90	199.29	197.07	199.30	0.000081	0.52	51.75	58.09	0.09
Reach-1	46.191	50-year	17.82	195.90	199.51	197.16	199.52	0.000069	0.50	64.95	64.75	0.09
Reach-1	46.191	100-year	20.59	195.90	199.82	197.29	199.83	0.000053	0.46	86.53	74.37	0.08
Reach-1	46.191	Aug. 19th	50.39	195.90	200.49	198.43	200.50	0.000105	0.73	144.87	92.43	0.11
Reach-1	46.191	Regional w red'n	122.56	195.90	201.14	199.36	201.17	0.000235	1.20	206.20	95.00	0.17
Reach-1	46.19	2-year	7.79	195.50	197.67		197.71	0.000754	1.00	11.49	13.17	0.24
Reach-1	46.19	5-year	11.08	195.50	198.36		198.38	0.000320	0.81	22.77	20.03	0.16
Reach-1	46.19	10-year	13.19	195.50	198.68		198.69	0.000247	0.77	29.61	23.53	0.15
Reach-1	46.19	25-year	15.82	195.50	199.29		199.30	0.000106	0.57	68.12	81.45	0.10
Reach-1	46.19	50-year	17.82	195.50	199.51		199.51	0.000073	0.49	85.87	82.53	0.08
Reach-1	46.19	100-year	20.59	195.50	199.82		199.82	0.000047	0.42	111.78	84.09	0.07
Reach-1	46.19 46.19	Aug. 19th Regional w red'n	50.39 122.56	195.50 195.50	200.48 201.13		200.49 201.15	0.000084 0.000200	0.62 1.04	169.35 235.49	88.88 143.00	0.09
Reach-1	46.182	2-year	7.79	195.50	197.63		197.68		0.99	7.88	12.09	0.22
Reach-1	46.182	5-year	11.08	195.50	198.36		198.37	0.000130	0.52	26.93	30.29	0.11
Reach-1 Reach-1	46.182 46.182	10-year 25-year	13.19 15.82	195.50 195.50	198.67 199.29	196.70 196.83	198.68 199.29	0.000099 0.000044	0.50	38.34 73.30	42.16 72.92	0.10
Reach-1	46.182	50-year	17.82	195.50	199.29	196.93	199.51	0.000044	0.36	89.11	73.46	
Reach-1	46.182	100-year	20.59	195.50	199.82	197.06	199.82	0.000027	0.34	112.31	75.63	0.06
Reach-1	46.182	Aug. 19th	50.39	195.50	200.48	197.88	200.49		0.56	163.19	77.73	0.09
Reach-1	46.182	Regional w red'n	122.56	195.50	201.12	198.95	201.14	0.000168	1.02	216.05	105.46	0.15
Reach-1	46.1815		Culvert									
Reach-1	46.181	2-year	7.79	195.42	197.42	196.40	197.48	0.000910	1.12	6.98	10.39	0.27
Reach-1	46.181	5-year	11.08	195.42	198.22	196.60	198.24		0.63	22.32	25.87	0.14
Reach-1	46.181	10-year	13.19	195.42	198.66	196.70	198.67	0.000125	0.55	37.14	41.94	0.11
Reach-1	46.181	25-year	15.82	195.42	199.29	196.84	199.29	0.000052	0.41	72.60	72.19	0.07
Reach-1	46.181	50-year	17.82	195.42	199.50	196.94	199.51	0.000042	0.38	88.21	72.79	0.07
Reach-1	46.181	100-year	20.59	195.42	199.81	197.07	199.82	0.000031	0.35	111.07	73.65	0.06
Reach-1 Reach-1	46.181 46.181	Aug. 19th	50.39 122.56	195.42 195.42	200.47 201.10	197.81 198.99	200.48 201.13	0.000068 0.000187	0.58 1.05	160.29 211.38	75.46 114.92	0.09
		Regional w red'n				196.99						
Reach-1	46.18	2-year	7.79	195.42	197.42		197.46	0.000550	0.92	12.00	11.63	0.22
Reach-1	46.18	5-year	11.08	195.42	198.21		198.24	0.000248	0.80	23.72	23.04	0.16
Reach-1 Reach-1	46.18	10-year 25-year	13.19 15.82	195.42 195.42	198.65 199.28		198.67 199.29	0.000155	0.70	37.51 72.57	39.81 71.48	0.13
Reach-1	46.18	50-year	17.82	195.42	199.28		199.50	0.000052	0.33	88.09	71.48	0.08
Reach-1	46.18	100-year	20.59	195.42	199.81		199.82		0.43		72.83	
Reach-1	46.18	Aug. 19th	50.39	195.42	200.47		200.48		0.72		119.41	0.11
Reach-1	46.18	Regional w red'n	122.56	195.42	201.10		201.12		1.15		123.36	0.16
Reach-1	46.172	2-year	7.79	195.42	197.38	196.34	197.44	0.000781	1.12	7.29	11.78	0.26
Reach-1	46.172	5-year	11.08	195.42	198.21	196.53	198.23	0.000701	0.76		23.93	
Reach-1	46.172	10-year	13.19	195.42	198.65		198.67	0.000138	0.67	39.22	41.74	
Reach-1	46.172	25-year	15.82	195.42	199.28	196.78	199.29	0.000063	0.51	97.46	157.32	
Reach-1	46.172	50-year	17.82	195.42	199.50	196.88	199.50	0.000038	0.41	132.25	162.05	
Reach-1	46.172	100-year	20.59	195.42	199.81	197.00	199.81	0.000021	0.32		166.84	
Reach-1	46.172	Aug. 19th	50.39	195.42	200.48		200.48		0.43	297.38	176.28	
Reach-1	46.172	Regional w red'n	122.56	195.42	201.11	199.38	201.11	0.000073	0.72	429.09	220.09	0.10
Reach-1	46.1715		Culvert									
Reach-1	46.171	2-year	7.79	195.40	197.19		197.28		1.31	6.23	18.90	
Reach-1	46.171	5-year	11.08	195.40	198.02		198.03		0.58	36.53	34.62	
Reach-1	46.171	10-year	13.19	195.40	198.65		198.66		0.41	63.43	50.11	0.07
Reach-1	46.171	25-year	15.82	195.40	199.29		199.29		0.31	107.36	100.88	
Reach-1	46.171	50-year	17.82	195.40	199.50	196.92	199.50		0.29		123.50	
Reach-1	46.171	100-year	20.59	195.40	199.81	197.05	199.81	0.000013	0.25	173.22	138.65	0.04
Reach-1	46.171	Aug. 19th	50.39	195.40	200.47	197.76	200.47	0.000023	0.37	290.55	200.23	
Reach-1	46.171	Regional w red'n	122.56	195.40	201.10	198.39	201.10	0.000046	0.57	431.52	243.13	1 0.0

Darak		iver: RIVER-1 Read			W O Flori	04440	F.O. Fl	F 0 01	V-1 Ob1	El A	T 145-141-	Frank # Obl
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
			(1113/8)	(III)	(m)	(111)	(111)	(111/111)	(111/5)	(1112)	(111)	
Reach-1	46.17	2-year	7.79	195.07	197.22		197.23	0.000169	0.51	19.47	18.27	0.13
Reach-1	46.17	5-year	11.08	195.07	198.02		198.03	0.000103	0.43	37.36	27.30	
Reach-1	46.17	10-year	13.19	195.07	198.65		198.66	0.000037	0.36	59.17	40.80	
Reach-1	46.17	25-year	15.82	195.07	199.28		199.29	0.000022	0.32	95.78		
Reach-1	46.17	50-year	17.82	195.07	199.50		199.50	0.000019	0.31	113.60	85.82	
Reach-1	46.17	100-year	20.59	195.07	199.81		199.81	0.000015	0.29	142.48	104.78	
Reach-1	46.17	Aug. 19th	50.39	195.07	200.47		200.47	0.000033	0.46			
Reach-1	46.17	Regional w red'n	122.56	195.07	201.09		201.10	0.000067	0.72	355.65	204.38	•
Reach-1	46.162	2-year	7.79	195.07	197.17	195.99	197.22	0.000615	1.02	7.65	11.01	0.23
Reach-1	46.162	5-year	11.08	195.07	197.96	196.18	198.02	0.000391	1.02	10.83	15.05	0.20
Reach-1	46.162	10-year	13.19	195.07	198.60	196.29	198.65	0.000274	0.99	13.37	21.14	0.17
Reach-1	46.162	25-year	15.82	195.07	199.27	196.42	199.28	0.000072	0.56	52.55	42.33	
Reach-1	46.162	50-year	17.82	195.07	199.49	196.52	199.50	0.000072	0.58	63.35	60.03	
Reach-1	46.162	100-year	20.59	195.07	199.80	196.65	199.81	0.000059	0.55	84.26		0.08
Reach-1	46.162	Aug. 19th	50.39	195.07	200.45	197.79	200.47	0.000115	0.84	161.40	t	0.12
Reach-1	46.162	Regional w red'n	122.56	195.07	201.07	198.81	201.10	0.000239	1.31	249.24	167.91	0.17
5 1 4	40.4045		0.1.									
Reach-1	46.1615		Culvert									
Ponch 1	16 161	2 1005	7.79	40E 0E	400.05	400.00	197.02	0.004000	1.17	6.07	40.44	0.00
Reach-1 Reach-1	46.161 46.161	2-year	11.08	195.05 195.05	196.95 197.49	196.02 196.21	197.02	0.001000 0.000798	1.17	6.67 8.82	10.41 12.68	0.29
		5-year	13.19	195.05	197.49	196.21	197.57	0.000798	1.26	10.47	12.68	
Reach-1	46.161 46.161	10-year 25-year	15.82	195.05	197.90	196.32	197.98	0.000638	1.26	13.07	18.85	
Reach-1	46.161		17.82	195.05	198.55	196.45	199.08	0.000439	0.63	43.81	23.32	
Reach-1	46.161	50-year 100-year	20.59	195.05	199.07	196.55	199.08	0.000102	0.56	63.25	33.47	0.09
Reach-1	46.161	Aug. 19th	50.39	195.05	200.42	197.81	200.45	0.000004	1.09	100.62	79.54	
Reach-1	46.161	Regional w red'n	122.56	195.05	200.42	198.80	201.08	0.000138	1.84	149.15	95.06	
rtodon i	10.101	rtogional wroan	122.00	100.00	200.00	100.00	201.00	0.000100	1.01		00.00	0.20
Reach-1	46.15	2-year	7.79	195.02	196.89	196.01	196.92	0.000529	0.80	10.88	10.05	0.22
Reach-1	46.15	5-year	11.08	195.02	197.46	196.15	197.49	0.000319	0.78	17.44	13.07	0.18
Reach-1	46.15	10-year	13.19	195.02	197.89	196.22	197.91	0.000220	0.74	23.51	15.20	
Reach-1	46.15	25-year	15.82	195.02	198.55	196.32	198.57	0.000128	0.66	37.29		•
Reach-1	46.15	50-year	17.82	195.02	199.06	196.39	199.07	0.000084	0.59	53.96	38.06	
Reach-1	46.15	100-year	20.59	195.02	199.76	196.48	199.77	0.000043	0.48	88.60		
Reach-1	46.15	Aug. 19th	50.39	195.02	200.42	197.27	200.43	0.000080	0.72	162.92	139.48	
Reach-1	46.15	Regional w red'n	122.56	195.02	200.99	198.74	201.02	0.000159	1.09	247.33	170.72	0.15
											-	
Reach-1	46.142	2-year	7.79	194.83	196.83	195.74	196.89	0.000656	1.06	7.32	12.01	0.25
Reach-1	46.142	5-year	11.08	194.83	197.40	195.93	197.46	0.000537	1.15	9.60	15.13	0.24
Reach-1	46.142	10-year	13.19	194.83	197.82	196.04	197.89	0.000438	1.16	11.32	17.08	0.22
Reach-1	46.142	25-year	15.82	194.83	198.49	196.18	198.56	0.000309	1.13	14.02	25.96	0.19
Reach-1	46.142	50-year	17.82	194.83	199.00	196.28	199.06	0.000250	1.11	16.05	32.66	0.18
Reach-1	46.142	100-year	20.59	194.83	199.76	196.40	199.77	0.000036	0.45	84.82	43.44	0.07
Reach-1	46.142	Aug. 19th	50.39	194.83	200.40	197.53	200.42	0.000110	0.86	126.29	84.20	
Reach-1	46.142	Regional w red'n	122.56	194.83	200.92	199.50	201.00	0.000346	1.62	178.72	117.13	0.22
Reach-1	46.1415		Culvert									
Decel 4	40.444	0	7.70	404.00	400.50	405.50	400.57	0.000000	4.40	0.74	00.04	0.00
Reach-1	46.141	2-year	7.79	194.82	196.50	195.56	196.57	0.000832	1.16	6.71	22.64	0.29
Reach-1	46.141	5-year	11.08	194.82	196.77	195.74	196.87	0.001022	1.42	7.80		
Reach-1	46.141	10-year	13.19	194.82	196.92	195.86	197.04		1.57	8.40		
	46.141	25-year	15.82	194.82	197.16	196.00	197.17	0.000093	0.48	44.61	24.87	
Reach-1	46.141 46.141	50-year	17.82 20.59	194.82 194.82	197.28 197.43	196.09 196.22	197.29 197.45		0.50 0.54	47.71 51.65	25.28 25.79	•
Reach-1	46.141	100-year	50.39	194.82	197.43	196.22	197.45	0.000104	1.02	69.74	+	
Reach-1	46.141	Aug. 19th Regional w red'n	122.56	194.82	198.10	197.00	198.15		1.02	95.70		
ouon-1	70.171	cgional wileum	122.30	134.02	130.35	131.00	133.10	5.000034	1.81	95.70	33.15	0.30
Reach-1	46.14	2-year	7.79	194.82	196.53		196.53	0.000033	0.23	38.19	26.77	0.06
Reach-1	46.14	5-year	11.08	194.82	196.82		196.82	0.000033	0.23	45.98		
Reach-1	46.14	10-year	13.19	194.82	196.98		196.98	0.000041	0.30		28.23	•
Reach-1	46.14	25-year	15.82	194.82	197.16		197.16	0.000045	0.33	55.61	28.82	
Reach-1	46.14	50-year	17.82	194.82	197.28		197.29		0.35		29.22	
Reach-1	46.14	100-year	20.59	194.82	197.44		197.44	0.000050	0.38	63.76		
Reach-1	46.14	Aug. 19th	50.39	194.82	198.11		198.13	0.000134	0.72	84.60		
Reach-1	46.14	Regional w red'n	122.56	194.82	198.97		199.05	0.000347	1.35		37.72	
Reach-1	46.132	2-year	7.79	194.82	196.13	196.13	196.49	0.010704	3.27	4.80	7.01	0.95
Reach-1	46.132	5-year	11.08	194.82	196.34	196.34	196.77	0.010791	3.66		7.92	•
Reach-1	46.132	10-year	13.19	194.82	196.45	196.45	196.93	0.011272	3.92	7.27	8.37	
Reach-1	46.132	25-year	15.82	194.82	196.60	196.60	197.11	0.010788	4.09			
Reach-1	46.132	50-year	17.82	194.82	196.70	196.70	197.23	0.010733	4.24	9.57	9.64	•
Reach-1	46.132	100-year	20.59	194.82	196.84	196.84	197.38	0.010357	4.38	10.94	10.22	
Reach-1	46.132	Aug. 19th	50.39	194.82	197.67	197.67	198.08	0.007141	4.62			
Reach-1	46.132	Regional w red'n	122.56	194.82	198.35	198.35	198.97	0.009775	6.25	50.68	31.87	1.08
		2-year	7.79	192.82	194.06	193.99	194.40	0.009014	2.93	4.87	7.78	0.87

		River: RIVER-1 Read			W.C. Floy	Crit W.S.	F.C. Flav	F.C. Clana	Val Chal	Flour Area	Ton Width	Frauda # Chi
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El	W.S. Elev		E.G. Elev	E.G. Slope	Vel Chnl (m/s)	Flow Area (m2)	Top Width	Froude # Chl
Reach-1	46.13	5-year	11.08	(m) 192.82	(m) 194.48	(m) 194.27	(m) 194.73	(m/m) 0.005038	2.69	9.38	(m) 13.92	0.69
Reach-1	46.13	10-year	13.19	192.82	194.74	194.43	194.73	0.003036	2.46	13.50		0.58
Reach-1	46.13	25-year	15.82	192.82	195.09	194.57	195.21	0.001994	2.11	20.54		0.46
Reach-1	46.13	50-year	17.82	192.82	195.34	194.66	195.43	0.001368	1.88	26.26	23.22	0.38
Reach-1	46.13	100-year	20.59	192.82	195.67	194.77	195.73	0.000919	1.68	34.23	24.79	0.32
Reach-1	46.13	Aug. 19th	50.39	192.82	197.61	195.47	197.65	0.000382	1.54	94.09	36.36	0.23
Reach-1	46.13	Regional w red'n	122.56	192.82	198.37	196.37	198.49	0.001050	2.83	123.54	41.89	0.39
Reach-1	46.122	2-year	7.79	192.63	194.13	193.54	194.24	0.001908	1.49	5.21	9.27	0.41
Reach-1	46.122	5-year	11.08	192.63	194.48		194.63	0.001754	1.68	6.61	11.49	0.41
Reach-1	46.122	10-year	13.19	192.63	194.70	193.85	194.86	0.001655	1.77	7.46	13.03	0.41
Reach-1	46.122	25-year	15.82	192.63	194.98		195.16	0.001502	1.85	8.57	15.04	0.40
Reach-1	46.122	50-year	17.82	192.63	195.20	194.08	195.38	0.001392	1.89	9.42	16.41	0.39
Reach-1	46.122	100-year	20.59	192.63	195.50	194.21	195.69	0.001249	1.94	10.61	18.32	0.38
Reach-1	46.122	Aug. 19th	50.39	192.63	197.60	195.37	197.64	0.000210	1.17	77.70	30.46	0.17
Reach-1	46.122	Regional w red'n	122.56	192.63	198.31	196.70	198.47	0.000795	2.48	130.76	102.69	0.34
Ponch 1	46 1215		Culvert									
Reach-1	46.1215		Culvert									
Reach-1	46.121	2-year	7.79	191.82	193.25	193.25	193.62	0.017531	2.67	2.92	6.08	0.99
Reach-1	46.121	5-year	11.08	191.82	193.44	193.44	193.91	0.017351	3.01	3.68	7.39	1.00
Reach-1	46.121	10-year	13.19	191.82	193.56	193.56	194.08	0.015790	3.19	4.13	8.08	1.00
Reach-1	46.121	25-year	15.82	191.82	193.69	193.69	194.28	0.015189	3.39	4.66	8.76	1.00
Reach-1	46.121	50-year	17.82	191.82	193.79	193.79	194.42	0.014584	3.52	5.07	9.28	0.99
Reach-1	46.121	100-year	20.59	191.82	193.92	193.92	194.61	0.014198	3.69	5.57	9.96	1.00
Reach-1	46.121	Aug. 19th	50.39	191.82	195.06	195.06	196.32	0.011676	4.98	10.11	18.08	1.00
Reach-1	46.121	Regional w red'n	122.56	191.82	198.14	196.51	198.23	0.000575	1.90	131.82	64.37	0.26
Reach-1	46.12	2-year	7.79	191.82	192.96	192.96	193.24	0.015963	2.37	3.29	5.77	1.00
Reach-1	46.12	5-year	11.08	191.82	193.13	193.13	193.46	0.014000	2.58	4.39	7.65	0.97
Reach-1	46.12	10-year	13.19	191.82	193.23	193.23	193.58	0.012551	2.66	5.22	8.99	0.94
Reach-1	46.12	25-year	15.82	191.82	193.34	193.34	193.71	0.011113	2.74	6.37	10.55	0.91
Reach-1	46.12	50-year	17.82	191.82	193.42	193.42	193.80	0.010463	2.81	7.23	11.60	0.89
Reach-1	46.12	100-year	20.59	191.82	193.51	193.51	193.92	0.010117	2.92	8.31	12.83	0.89
Reach-1	46.12 46.12	Aug. 19th	50.39 122.56	191.82 191.82	195.15 198.17	194.23 194.95	195.23 198.19	0.000890 0.000121	1.59 0.96	53.97 250.60	38.95 89.08	0.31 0.13
Reach-1	40.12	Regional w red'n	122.56	191.02	190.17	194.95	190.19	0.000121	0.96	250.60	69.06	0.13
Reach-1	46.11	2-year	7.79	191.73	192.68	192.27	192.76	0.002310	1.28	6.23	7.32	0.42
Reach-1	46.11	5-year	11.08	191.73	192.91	192.40	193.02	0.002310	1.45	7.87	8.13	0.42
Reach-1	46.11	10-year	13.19	191.73	193.05	192.49	193.17	0.002255	1.55	8.83	8.67	0.43
Reach-1	46.11	25-year	15.82	191.73	193.21	192.59	193.34	0.002100	1.65	9.96	9.47	0.43
Reach-1	46.11	50-year	17.82	191.73	193.32	192.66	193.47	0.002063	1.72	10.77	9.97	0.43
Reach-1	46.11	100-year	20.59	191.73	193.48	192.75	193.64	0.002017	1.81	11.85	10.75	0.44
Reach-1	46.11	Aug. 19th	50.39	191.73	194.87	193.56	195.16	0.001687	2.44	21.57	17.94	0.44
Reach-1	46.11	Regional w red'n	122.56	191.73	197.64	195.00	198.13	0.001192	3.13	41.01	40.32	0.41
Reach-1	46.1015		Culvert									
Reach-1	46.10	2-year	7.79	191.60	192.13	192.13	192.38	0.015925	2.22	3.51	13.85	1.00
Reach-1	46.10	5-year	11.08	191.60	192.26	192.26	192.58	0.015094	2.51	4.41	15.36	1.01
Reach-1	46.10	10-year	13.19	191.60	192.34	192.34	192.70	0.014194	2.64	4.99	16.33	1.00
Reach-1	46.10	25-year	15.82	191.60	192.43	192.43	192.84	0.013691	2.81	5.62	17.40	1.00
Reach-1	46.10	50-year	17.82	191.60	192.50		192.93		2.93	6.09	+	
Reach-1 Reach-1	46.10	100-year	20.59 50.39	191.60 191.60	192.59	192.59 193.38	193.07 194.24	0.012753 0.010422	3.06 4.12	6.73		1.00 1.00
Reach-1	46.10 46.10	Aug. 19th Regional w red'n	122.56	191.60 191.60	193.38 194.78		194.24		5.56	12.23 22.05		1.00
TOUGH-1	70.10	cgioriai w ieu ii	122.50	131.00	134.10	134.10	130.33	0.000034	0.00	22.05	30.02	1.00
Reach-1	46.09	2-year	9.00	189.00	189.99		190.13	0.005345	1.66	5.41	6.96	0.60
Reach-1	46.09	5-year	12.90	189.00	190.22		190.39		1.83	7.10		0.58
Reach-1	46.09	10-year	15.58	189.00	190.37		190.55		1.93	8.25	8.10	0.57
Reach-1	46.09	25-year	19.07	189.00	190.55		190.76	0.003802	2.02	9.82	8.65	0.56
Reach-1	46.09	50-year	21.78	189.00	190.70		190.91	0.003485	2.07	11.09		0.54
Reach-1	46.09	100-year	24.80	189.00	190.85		191.07	0.003187	2.11	12.54	9.55	0.53
Reach-1	46.09	Aug. 19th	62.78	189.00	192.73		192.78	0.000426	1.29	95.88	71.77	0.22
Reach-1	46.09	Regional w red'n	133.76	189.00	194.29		194.32	0.000217	1.17	229.65	101.32	0.17
Reach-1	46.082	2-year	9.00	188.70	189.76	189.27	189.83	0.001817	1.24	7.27	33.44	0.39
Reach-1	46.082	5-year	12.90	188.70	190.00		190.11	0.001827	1.43	9.01	55.07	0.40
Reach-1	46.082	10-year	15.58	188.70	190.16		190.28	0.001826	1.54	10.10		0.41
Reach-1	46.082	25-year	19.07	188.70	190.36		190.50	0.001775	1.66	11.50	t	0.41
Reach-1	46.082	50-year	21.78	188.70	190.51	189.71	190.67	0.001717	1.73	12.57		0.41
Reach-1	46.082	100-year	24.80	188.70	190.68	189.80	190.84	0.001663	1.81	13.72		0.41
Reach-1	46.082	Aug. 19th	62.78	188.70	192.38		192.68	0.001331	2.45	25.62	110.01	0.41
Reach-1	46.082	Regional w red'n	133.76	188.70	194.29	192.06	194.30	0.000051	0.64	433.14	195.45	0.09
Peach 1	46.0815		Culticant									
Reach-1	40.0015		Culvert									
Reach-1	46.081	2-year	9.00	188.70	189.53	189.27	189.66	0.004021	1.57	5.73	14.05	0.55
	.0.001	1- 100.	9.00	100.70	100.00	100.27	100.00	J.JJ402 I	1.01	5.13	17.00	0.33

		River: RIVER-1 Read			W.O. El	041110	F 0 Fl	F.O. 01	\/-I ObI	F1 A	T 10/5-141-	Fd- # Obl
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
Reach-1	46.081	5-year	12.90	188.70	189.70	189.42	189.88	0.004477	1.87	6.89	28.59	0.60
Reach-1	46.081	10-year	15.58	188.70	189.79	189.51	190.01	0.004477	2.06	7.55	36.85	0.63
Reach-1	46.081	25-year	19.07	188.70	189.91	189.62	190.17	0.005173	2.29	8.34	46.84	0.67
Reach-1	46.081	50-year	21.78	188.70	189.98	189.71	190.29	0.005473	2.45	8.88	53.64	0.70
Reach-1	46.081	100-year	24.80	188.70	190.06	189.80	190.41	0.005838	2.63	9.41	56.16	0.72
Reach-1	46.081	Aug. 19th	62.78	188.70	190.94	190.73	191.77	0.007022	4.04	15.55	72.82	0.86
Reach-1	46.081	Regional w red'n	133.76	188.70	191.80	191.80	191.93	0.001608	2.40	147.38	98.07	0.44
Reach-1	46.07	2-year	9.00	187.70	188.61		188.70	0.008324	2.05	11.20	29.01	0.69
Reach-1	46.07	5-year	12.90	187.70	188.73		188.83	0.008530	2.26	15.04	33.66	0.71
Reach-1	46.07	10-year	15.58	187.70	188.80		188.91	0.008686	2.38	17.47	36.30	0.72
Reach-1	46.07	25-year	19.07	187.70	188.88		189.00	0.008845	2.52	20.49	39.34	0.74
Reach-1	46.07	50-year	21.78	187.70	188.93		189.06	0.008901	2.60	22.79	41.50	0.75
Reach-1	46.07	100-year	24.80	187.70	189.00		189.12	0.008834	2.68	25.40	43.82	0.75
Reach-1	46.07	Aug. 19th	62.78	187.70	191.18		191.20	0.000370	1.06	151.04	73.52	0.18
Reach-1	46.07	Regional w red'n	133.76	187.70	191.25		191.31	0.001532	2.19	156.30	74.63	0.37
Doodh 1	46.06	2	0.00	100.40	107.21	407.24	107.40	0.000420	2.15	0.63	20.20	0.77
Reach-1	46.06 46.06	2-year 5-year	9.00 12.90	186.40 186.40	187.31 187.42	187.31 187.42	187.49 187.62	0.008439 0.008686	2.15	8.63 12.46	30.28 37.36	0.77 0.80
Reach-1	46.06	10-year	15.58	186.40	187.42	187.49	187.69	0.008805	2.50	14.99	41.37	0.82
Reach-1	46.06	25-year	19.07	186.40	187.56	187.56	187.77	0.008973	2.66	18.12	45.85	0.84
Reach-1	46.06	50-year	21.78	186.40	187.61	187.61	187.83	0.006973	2.77	20.38	48.83	0.85
Reach-1	46.06	100-year	24.80	186.40	187.65	187.65	187.89	0.009163	2.89	22.81	51.83	0.87
Reach-1	46.06	Aug. 19th	62.78	186.40	191.18	. 51.00	191.18	0.000050	0.54	327.40	152.84	0.08
Reach-1	46.06	Regional w red'n	133.76	186.40	191.23		191.24	0.000217	1.14	333.53	154.66	0.17
Reach-1	46.05	2-year	9.00	184.50	185.25	184.73	185.25	0.000290	0.38	24.45	38.08	0.15
Reach-1	46.05	5-year	12.90	184.50	185.56	184.80	185.56	0.000172	0.38	36.68	40.64	0.12
Reach-1	46.05	10-year	15.58	184.50	185.90	184.82	185.91	0.000092	0.34	51.24	43.49	0.09
Reach-1	46.05	25-year	19.07	184.50	186.66	184.87	186.66	0.000030	0.26	86.43	50.08	0.06
Reach-1	46.05	50-year	21.78	184.50	187.05	184.90	187.05	0.000022	0.25	106.67	53.54	0.05
Reach-1	46.05	100-year	24.80	184.50	187.52	184.94	187.52	0.000015	0.23	133.01	57.72	0.04
Reach-1	46.05	Aug. 19th	62.78	184.50	191.18	185.26	191.18	0.000005	0.24	438.53	197.80	0.03
Reach-1	46.05	Regional w red'n	133.76	184.50	191.22	185.72	191.23	0.000024	0.50	444.79	201.30	0.06
Reach-1	46.04	2-year	9.00	184.00	184.84	184.84	185.16	0.013771	2.53	3.95	7.59	0.95
Reach-1	46.04	5-year	12.90	184.00	185.34	185.04	185.51	0.004234	1.95	8.57	10.61	0.57
Reach-1	46.04	10-year	15.58	184.00	185.76	185.15	185.88	0.001967	1.63	13.52	12.63	0.41
Reach-1	46.04	25-year	19.07	184.00	186.59	185.27	186.65	0.000610	1.20	25.58	16.56	0.24
Reach-1	46.04	50-year	21.78	184.00 184.00	186.99 187.48	185.36	187.04 187.52	0.000440	1.12	32.61 42.10	18.46 20.76	0.21 0.18
Reach-1	46.04 46.04	100-year	24.80 62.78		191.17	185.46	191.18	0.000306	0.64	341.32		0.18
Reach-1 Reach-1	46.04	Aug. 19th	133.76	184.00 184.00	191.17	186.37 187.50	191.18	0.000043 0.000191	1.36	341.32	168.21 168.94	0.06
Reaul-1	46.04	Regional w red'n	133.76	104.00	191.19	167.50	191.23	0.000191	1.30	343.20	100.94	0.16
Reach-1	46.032	2-year	19.48	182.60	184.82	183.28	184.85	0.000269	0.80	24.44	161.51	0.17
Reach-1	46.032	5-year	29.21	182.60	185.38		185.43	0.000286	0.96	30.58	181.36	
Reach-1	46.032	10-year	36.46	182.60	185.76	183.64	185.82	0.000290	1.05	34.80	185.93	0.19
Reach-1	46.032	25-year	51.57	182.60	186.54	183.91	186.61	0.000278	1.19	43.36	195.38	0.19
Reach-1	46.032	50-year	58.85	182.60	186.93	184.03	187.01	0.000265	1.24	47.64	200.11	0.19
Reach-1	46.032	100-year	66.97	182.60	187.40	184.16	187.49	0.000243	1.27	52.85	208.43	0.18
Reach-1	46.032	Aug. 19th	191.20	182.60	191.17	185.74	191.17	0.000007	0.30	921.08	346.07	0.03
Reach-1	46.032	Regional w red'n	200.64	182.60	191.21	185.83	191.22	0.000007	0.31	929.15	347.17	0.04
Reach-1	46.0315		Culvert									
		-										
Reach-1	46.031	2-year	19.48	182.60	183.34		183.68	0.014328	2.60			
Reach-1	46.031	5-year	29.21	182.60	183.55		184.00	0.012846	2.96		37.02	
Reach-1	46.031	10-year	36.46	182.60	183.69	183.69	184.21	0.012336	3.19		47.37	1.00
Reach-1	46.031	25-year	51.57	182.60	183.96 184.08		184.62	0.011561	3.59		66.94	
Reach-1 Reach-1	46.031 46.031	50-year 100-year	58.85 66.97	182.60 182.60	184.08 184.21	184.08 184.21	184.80 184.99	0.011213 0.010789	3.76 3.91	15.67 17.13	72.82 77.54	1.00
Reach-1	46.031	Aug. 19th	191.20	182.60	185.79		187.36	0.010789	5.55		125.51	1.00
Reach-1	46.031	Regional w red'n	200.64	182.60	185.89	185.89	187.51	0.008346	5.63	35.64	128.27	1.00
	10.001	g.c.i.a. wicum	200.04	102.00	100.00	100.00	107.01	5.500427	0.00	55.54	120.27	1.00
Reach-1	46.03	2-year	19.48	181.50	183.21	182.84	183.24	0.000884	1.04	49.28	80.44	0.27
Reach-1	46.03	5-year	29.21	181.50	183.42	183.10	183.45	0.000896	1.14	66.59	81.90	
Reach-1	46.03	10-year	36.46	181.50	183.55		183.59	0.000923	1.22	77.29	82.79	0.28
Reach-1	46.03	25-year	51.57	181.50	183.79		183.82	0.000970	1.35		84.38	
Reach-1	46.03	50-year	58.85	181.50	183.89		183.93	0.000983	1.40		85.09	
Reach-1	46.03	100-year	66.97	181.50	184.00		184.04	0.000995	1.45	114.78	85.83	0.30
Reach-1	46.03	Aug. 19th	191.20	181.50	185.33	183.82	185.40	0.000968	1.94	235.21	98.43	0.32
Reach-1	46.03	Regional w red'n	200.64	181.50	185.39	183.85	185.45	0.000999	1.99	240.58	99.53	0.33
Reach-1	46.02	2-year	19.48	181.00	182.65		182.86	0.006588	2.58	18.35	36.79	0.66
Reach-1	46.02	5-year	29.21	181.00	182.92		183.10		2.61	30.06	48.59	
Reach-1	46.02	10-year	36.46	181.00	183.10		183.25	0.004548	2.54	39.14	52.68	0.58
Reach-1	46.02	25-year	51.57	181.00	183.35		183.49	0.004064	2.61	52.84	54.47	0.56
Reach-1	46.02	50-year	58.85	181.00	183.46		183.59	0.003944	2.65	58.74	55.22	0.55

HEC-RAS Plan: Plan 15 River: RIVER-1 Reach: Reach-1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach-1	46.02	100-year	66.97	181.00	183.57		183.71	0.003860	2.70	64.91	56.00	0.55
Reach-1	46.02	Aug. 19th	191.20	181.00	184.96		185.10	0.002878	3.14	149.20	65.70	0.51
Reach-1	46.02	Regional w red'n	200.64	181.00	184.99		185.15	0.003026	3.24	151.61	65.95	0.53
Reach-1	46.01	2-year	19.48	180.40	182.13		182.29	0.003577	1.98	16.18	24.54	0.51
Reach-1	46.01	5-year	29.21	180.40	182.53		182.66	0.002612	1.98	29.93	44.46	0.46
Reach-1	46.01	10-year	36.46	180.40	182.76		182.88	0.002205	1.96	41.74	56.20	0.43
Reach-1	46.01	25-year	51.57	180.40	182.92		183.09	0.003009	2.40	51.01	63.91	0.51
Reach-1	46.01	50-year	58.85	180.40	183.07		183.23	0.002670	2.36	61.44	68.48	0.48
Reach-1	46.01	100-year	66.97	180.40	183.22		183.36	0.002412	2.34	71.76	69.45	0.46
Reach-1	46.01	Aug. 19th	191.20	180.40	184.74		184.86	0.001586	2.57	184.64	79.32	0.40
Reach-1	46.01	Regional w red'n	200.64	180.40	184.76		184.89	0.001702	2.68	186.34	79.46	0.42
Reach-1	46.00	2-year	19.48	180.00	181.99	181.24	182.07	0.001188	1.35	24.67	32.74	0.33
Reach-1	46.00	5-year	29.21	180.00	182.42	181.56	182.49	0.000962	1.41	41.16	43.92	0.31
Reach-1	46.00	10-year	36.46	180.00	182.66	181.74	182.73	0.000904	1.46	52.44	50.16	0.30
Reach-1	46.00	25-year	51.57	180.00	182.73	182.03	182.86	0.001573	1.97	56.02	51.98	0.40
Reach-1	46.00	50-year	58.85	180.00	182.89	182.15	183.02	0.001508	2.01	64.67	56.14	0.40
Reach-1	46.00	100-year	66.97	180.00	183.04	182.26	183.18	0.001480	2.07	73.37	59.48	0.40
Reach-1	46.00	Aug. 19th	191.20	180.00	184.54	183.34	184.71	0.001394	2.68	175.94	76.94	0.42
Reach-1	46.00	Regional w red'n	200.64	180.00	184.54	183.37	184.73	0.001535	2.81	175.94	76.94	0.44



Appendix B

Black Creek Erosion/Geomorphic Assessment Photograph Log





Photo 1. Eroding bank upstream of misplaced deflection berm (ES1)



Photo 2. Collapsed fence resulting from bank undercutting (ES2)





Photo 3. Collapsed gabion baskets and rip-rap (ES3)



Photo 4. Abandoned filter cloth and cobble rip-rap along bank (ES4)





Photo 5. Cut-bank in gentle valleyside exposing till (ES5)



Photo 6. Scour pool below perched culvert and eroding road embankment (ES6)





Photo 7. Erosion at toe of railway embankment (ES7)



Photo 8. Erosion at toe of railway embankment (ES8)







Photo 9. High, seeping valleyside cut-bank (ES9)



Photo 10. Erosion along northern bank of Black Creek near Hydro One tower foundation (ES10)





Photo 11. View toward eroding valleyside toe across imminent meander cut-off (ES11)



Photo 12. Degradation and bank erosion at footing of hydroelectric tower (ES12)





Photo 13. Undercut pond-perimeter berm at Beechwood Cemetery (ES13)



Photo 14. Cut-bank in gentle valleyside (ES14)



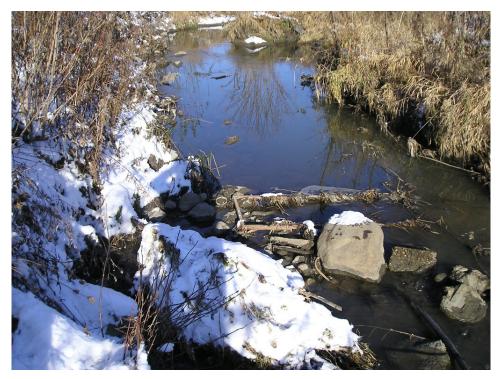


Photo 15. Minor undercutting and slumping of valleyside below Highway 407 on-ramp (ES15)



Photo 16. Log jams and alternate bank erosion (ES16)







Photo 17. Undermined gabion retaining wall collapsing into channel (ES17)



Photo 18. Breached access road berm, destroyed culverts and eroded valleyside (ES18)



Appendix C

Rapid Stream Assessment Technique (RSAT) and Rapid Geomorphic Assessment (RGA) Calculations

Summary of Rapid Stream Assessment Technique

Proj. #: 90057 Crew: RM, AD

Date: 19-Nov-08, 21-Nov-08 Weather: snow, -3°C / sunny, -7°C Stream: Black Creek & Tributaries

Reach 1:	Steeles Ave to Railway	
Reach 2:	Railway to Jane St	
Reach 3:	Jane St to Hwy 407	
Reach 4:	Hwy 407 to Hwy 7	
Trib. #1:	West of Jane Street	
Trib. #2:	Upstream of Railway	

Evaluation Category	Score by Reach							
Evaluation Category	No. 1	No. 2	No. 3	No. 4	Trib. #1	Trib. #2		
1. Channel Stability	5	3	4	1	7	3		
2. Channel Scouring/Sediment Deposition	6	4	5	3	4	4		
3. Physical Instream Habitat	5	4	5	3	5	3		
4. Water Quality	4	5	2	2	5	7		
5. Riparian Habitat Conditions	5	1	1	3	1	1		
6. Biological Indicators	3	4	2	2	4	3		
Total:	28	21	19	14	26	21		

Score	Verbal Stream Quality Ranking
42 - 50	Excellent Condition
30 - 41	Good Condition
16 - 30	Fair Condition
<16	Poor Condition

Proj. #: 90057	Stream: Black Creek
Crew: RM, AD	Reach: 1 (Steeles to railway)
Date: 19-Nov-08	Weather: snow, -3°C

FORM/PROCESS	GEOMORP	PHIC INDICATOR	PRES	ENT	FACTOR
	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar	1		
Aggradation (AI)	2	Coarse material in riffles embedded	1		
	3	Siltation in pools		1	
	4	Medial bars		1	
	5	Accretion on point bars		1	
	6	Poor longitudinal sorting of bed materials	1		
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	4	3	0.43
Evidence of	1	Exposed bridge footing(s)	1		
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)	1		
	4	Undermined gabion baskets/concrete aprons/etc.		1	
	5	Scour pools d/s of culverts/stormsewer outlets	n/a		
	6	Cut face on bar forms	1		
	7	Head cutting due to knick point migration	1		
	8	Terrace cut through older bar material		1	
	9	Suspended armor layer visible in bank	1		
	10	Channel worn into undisturbed overburden/bedrock	1		
		SUM OF INDICES	6	2	0.25
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.		1	
(WI)	2	Occurrence of large organic debris		1	
	3	Exposed tree roots		1	
	4	Basal scour on inside meander bends		1	
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked		1	
	7	Length of basal scour > 50% through subject reach	1		
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	1		
	10	Exposed building foundation	n/a		
		SUM OF INDICES	2	6	0.75
Evidence of	1	Formation of cute(s)		1	
Planimetric Form	2	Single thread channel to multiple channel	1		
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)		1	
	5	Formation of island(s)	1		
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed	1		
		SUM OF INDICES	5	2	0.29
STABILITY INDEX (SI)	= (AI + DI +	WI + PI) / m	•		0.43

Interpretation of RGA Form Stability Index Value

SI <u>≤</u> 0.2	In Regime	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes
0.21 <u>≤</u> SI <u>≤</u> 0.4		Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
SI > 0.4	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is wide spread

Proj. #: 90057	Stream: Black Creek
Crew: RM, AD	Reach: 2 (Railway to Jane)
Date: 19-Nov-08	Weather: snow, -3°C

FORM/PROCESS	GEOMORP	PHIC INDICATOR	PRES	ENT	FACTOR
	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar	1		
Aggradation (AI)	2	Coarse material in riffles embedded		1	
	3	Siltation in pools		1	
	4	Medial bars		1	
	5	Accretion on point bars		1	
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	2	5	0.7
Evidence of	1	Exposed bridge footing(s)	n/a		
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)	n/a		
	4	Undermined gabion baskets/concrete aprons/etc.	n/a		
	5	Scour pools d/s of culverts/stormsewer outlets	1		
	6	Cut face on bar forms	1		
	7	Head cutting due to knick point migration		1	
	8	Terrace cut through older bar material	1		
	9	Suspended armor layer visible in bank		1	
	10	Channel worn into undisturbed overburden/bedrock			
		SUM OF INDICES	3	2	0.40
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.		1	
(WI)	2	Occurrence of large organic debris	1		
	3	Exposed tree roots		1	
	4	Basal scour on inside meander bends		1	
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked	n/a		
	7	Length of basal scour > 50% through subject reach	1		
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank		1	
	10	Exposed building foundation	n/a		
		SUM OF INDICES	2	5	0.7
Evidence of	1	Formation of cute(s)		1	
Planimetric Form	2	Single thread channel to multiple channel	1		
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)		1	
	5	Formation of island(s)	1		
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed	1		
		SUM OF INDICES	5	2	0.29
STABILITY INDEX (SI)	= (AI + DI +	WI + PI) / m			0.53

Interpretation of RGA Form Stability Index Value

SI <u>≤</u> 0.2	In Regime	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes
0.21 <u><</u> SI <u><</u> 0.4	Transitional or Stressed	Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
SI > 0.4	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is wide spread

Proj. #: 90057	Stream: Black Creek
Crew: RM	Reach: 3 (Hwy 407 to Daughton Rd.)
Date: 21-Nov-08	Weather: Sunny, -7°C

FORM/PROCESS	GEOMORF	PHIC INDICATOR	PRE	SENT	FACTOR
i okumi koozoo	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar	1		
Aggradation (AI)	2	Coarse material in riffles embedded	1		
	3	Siltation in pools	1		
	4	Medial bars	1		
	5	Accretion on point bars	1		
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	6	1	0.14
Evidence of	1	Exposed bridge footing(s)		1	
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)	n/a		
	4	Undermined gabion baskets/concrete aprons/etc.	n/a		
	5	Scour pools d/s of culverts/stormsewer outlets	n/a		
	6	Cut face on bar forms	1		
	7	Head cutting due to knick point migration		1	
	8	Terrace cut through older bar material		1	
	9	Suspended armor layer visible in bank		1	
	10	Channel worn into undisturbed overburden/bedrock		1	
		SUM OF INDICES	1	5	0.83
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.	1		
(WI)	2	Occurrence of large organic debris	1		
	3	Exposed tree roots		1	
	4	Basal scour on inside meander bends		1	
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked	n/a		
	7	Length of basal scour > 50% through subject reach		1	
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	1		
	10	Exposed building foundation		1	
		SUM OF INDICES	3	5	0.63
Evidence of	1	Formation of cute(s)	1		
Planimetric Form	2	Single thread channel to multiple channel	1		
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)	1		
	5	Formation of island(s)	1		
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed		1	
		SUM OF INDICES	6	1	0.14
STABILITY INDEX (SI)	= (AI + DI +	WI + PI) / m			0.44
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Interpretation of RGA Form Stability Index Value

Adjustment

 SI ≤ 0.2
 In Regime
 The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes

 0.21 ≤ SI ≤ 0.4
 Transitional or Stressed
 Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent

 SI > 0.4
 In
 Channel morphology is not within the range of variance and

evidence of instability is wide spread

Proj. #: 90057	Stream: Black Creek
Crew: RM	Reach: 4 (Hwy 407 to Daughton Rd.)
Date: 21-Nov-08	Weather: Sunny, -7°C

FORM/PROCESS	GEOMORP	PHIC INDICATOR	PRES	SENT	FACTOR
	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar	1		
Aggradation (AI)	2	Coarse material in riffles embedded		1	
	3	Siltation in pools		1	
	4	Medial bars	1		
	5	Accretion on point bars	1		
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	4	3	0.43
Evidence of	1	Exposed bridge footing(s)	1		
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)		1	
	4	Undermined gabion baskets/concrete aprons/etc.		1	
	5	Scour pools d/s of culverts/stormsewer outlets		1	
	6	Cut face on bar forms	n/a		
	7	Head cutting due to knick point migration		1	
	8	Terrace cut through older bar material	n/a		
	9	Suspended armor layer visible in bank	1		
	10	Channel worn into undisturbed overburden/bedrock	1		
		SUM OF INDICES	3	4	0.57
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.	1	1	
(WI)	2	Occurrence of large organic debris		1	
	3	Exposed tree roots		1	
	4	Basal scour on inside meander bends		1	
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked		1	
	7	Length of basal scour > 50% through subject reach	1		
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	1		
	10	Exposed building foundation	1		
		SUM OF INDICES	3	6	0.67
Evidence of	1	Formation of cute(s)	1		
Planimetric Form	2	Single thread channel to multiple channel	1		
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form		1	
	4	Cutoff channel(s)	1		
	5	Formation of island(s)	1		
	6	Thalweg alignment out of phase meander form		1	
	7	Bar forms poorly formed/reworked/removed		1	
		SUM OF INDICES	4	3	0.43
STABILITY INDEX (SI)	= (Al + Dl +	WI + PI) / m	<u>. </u>		0.52
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Interpretation of RGA Form Stability Index Value

SI ≤ 0.2

In Regime

The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes

0.21 ≤ SI ≤ 0.4

Transitional or Stressed

Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent

SI > 0.4

In

Channel morphology is not within the range of variance and evidence of instability is wide spread

Proj. #: 90057	Stream: Black Creek
Crew: RM, AD	Reach: Tributary #1 - Upstream Railway (west side Black Creek)
Date: 19-Nov-08	Weather: Sunny, -7°C

FORM/PROCESS	GEOMORP	PHIC INDICATOR	PRES	SENT	FACTOR
	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar		1	
Aggradation (AI)	2	Coarse material in riffles embedded		1	
	3	Siltation in pools		1	
	4	Medial bars		1	
	5	Accretion on point bars		1	
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	1	6	0.86
Evidence of	1	Exposed bridge footing(s)	n/a		
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)	n/a		
	4	Undermined gabion baskets/concrete aprons/etc.	n/a		
	5	Scour pools d/s of culverts/stormsewer outlets		1	
	6	Cut face on bar forms	1		
	7	Head cutting due to knick point migration	1		
	8	Terrace cut through older bar material	1		
	9	Suspended armor layer visible in bank	1		
	10	Channel worn into undisturbed overburden/bedrock		1	
		SUM OF INDICES	4	2	0.33
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.		1	
(WI)	2	Occurrence of large organic debris	1		
	3	Exposed tree roots	1		
	4	Basal scour on inside meander bends	1		
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked	n/a		
	7	Length of basal scour > 50% through subject reach	1		
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	n/a		
	10	Exposed building foundation	n/a		
		SUM OF INDICES	4	2	0.33
Evidence of	1	Formation of cute(s)	1		
Planimetric Form	2	Single thread channel to multiple channel		1	
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)		1	
	5	Formation of island(s)		1	
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed	1		
		SUM OF INDICES	4	3	0.43
STABILITY INDEX (SI)	= (AI + DI +	WI + PI) / m			0.49

Interpretation of RGA Form Stability Index Value

SI <u>≤</u> 0.2	In Regime	The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes
0.21 <u>≤</u> SI <u><</u> 0.4	Transitional or Stressed	Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
SI > 0.4	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is wide spread

Proj. #: 90057	Stream: Black Creek
Crew: RM	Reach: Tributary #2 (West of Jane Street), "Beechwood Tributary"
Date: 21-Nov-08	Weather: Sunny, -7°C

FORM/PROCESS	GEOMORF	PHIC INDICATOR	PRES	PRESENT	
	NO	DESCRIPTION	NO	YES	VALUE
Evidence of	1	Lobate bar	1		
Aggradation (AI)	2	Coarse material in riffles embedded	1		
	3	Siltation in pools	1		
	4	Medial bars	1		
	5	Accretion on point bars	1		
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		SUM OF INDICES	6	1	0.14
Evidence of	1	Exposed bridge footing(s)		1	
Degradation (DI)	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated stormsewer outfall(s)	n/a		
	4	Undermined gabion baskets/concrete aprons/etc.	n/a		
	5	Scour pools d/s of culverts/stormsewer outlets	n/a		
	6	Cut face on bar forms	1		
	7	Head cutting due to knick point migration		1	
	8	Terrace cut through older bar material		1	
	9	Suspended armor layer visible in bank		1	
	10	Channel worn into undisturbed overburden/bedrock		1	
		SUM OF INDICES	1	5	0.83
Evidence of Widening	1	Fallen/leaning trees/fence posts/etc.	1		
(WI)	2	Occurrence of large organic debris	1		
	3	Exposed tree roots		1	
	4	Basal scour on inside meander bends		1	
	5	Basal scour on both sides of channel through riffle		1	
	6	Gabion baskets/concrete walls/etc. out flanked	n/a		
	7	Length of basal scour > 50% through subject reach		1	
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	1		
	10	Exposed building foundation		1	
		SUM OF INDICES	3	5	0.63
Evidence of	1	Formation of cute(s)	1		
Planimetric Form	2	Single thread channel to multiple channel	1		
Adjustment (PI)	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)	1		
	5	Formation of island(s)	1		
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed		1	
		SUM OF INDICES	6	1	0.14
STABILITY INDEX (SI)	= (AI + DI +	WI + PI) / m	•		0.44
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Interpretation of RGA Form Stability Index Value

SI ≤ 0.2

In Regime
The channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes

0.21 ≤ SI ≤ 0.4

Transitional or Stressed
Transitional or Stressed

Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent

SI > 0.4

In
Channel morphology is not within the range of variance and evidence of instability is wide spread



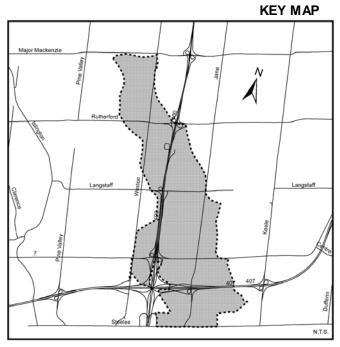
Appendix D

Notice of Commencement Advertisement and Letter

Notice of Study Commencement Black Creek Storm Water Optimization Master Plan Class Environmental Assessment Study

The City of Vaughan has retained AECOM to complete a Storm Water Optimization Master Plan Class Environmental Assessment (EA) Study to determine what storm water management measures can be implemented to improve storm water runoff quantity and quality, and to minimize erosion and flooding potential within the Black Creek watershed (see Key Map below for limits of Study Area). Development through much of the Black Creek watershed within the City occurred prior to the implementation of modern storm water management practices and techniques. This study will look at alternative solutions available to better optimize the existing conditions related to flooding, erosion and water quality within the Black Creek watershed.

The preferred alternative will be determined based on engineering requirements, environmental considerations, public input and information gathered during the study.



Limits of Study Area --

The study is being conducted in accordance with the Master Plan process as outlined in the Municipal Engineers Association's Municipal Class Environmental Assessment (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, evaluation of alternatives, assessment of the potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Public and external agency consultation is a key component of this Study. Details regarding the project will be presented at Public Information Forums to provide interested stakeholders with an opportunity to meet the Project Team and to discuss alternative solutions, environmental considerations/impacts, evaluation criteria, and design options. Each Forum will include opportunities for interactive discussions to engage participants and solicit their input. These forthcoming Public Information Forums will be advertised in future editions of the local newspaper as the Study progresses.

We are interested in receiving any comments that you may have about the Study. Should you have any questions or comments, or wish to receive additional information regarding this project, please contact either of the following Project Team members:

Mr. Saad Yousaf, P.Eng. City of Vaughan Project Manager Development/Transportation Engineering Department 2141 Major Mackenzie Drive

Vaughan, ON L6A 1T1 Phone: 905-832-8585 Ext: 8251

Fax: 905-832-6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng. Project Manager AECOM 300 Town Centre Blvd., Suite 300 Markham, Ontario L3R 5Z6 Phone: 905-477-8400 Ext. 430 Fax: 905-477-1456

Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the Freedom of Information and Protection of Privacy Act. With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Andrew Pearce, Director of Development & Transportation Engineering This notice was issued on February 19, 2009



AECOM

300 – 300 Town Centre Boulevard, Markham, ON, Canada L3R 5Z6 T 905.477.8400 F 905.477.1456 www.aecom.com

March 16, 2009 Project Number: 108203_90057

Name
Address 1
Address 2
City, Province Postal Code

Dear Sir/Madame:

Re: Notice of Study Commencement

Black Creek Stormwater Optimization Master Plan

Class Environmental Assessment Study

The City of Vaughan has retained AECOM to complete a Stormwater Optimization Master Plan Class Environmental Assessment (EA) Study to determine what storm water management measures can be implemented to improve storm water runoff quantity and quality, and to minimize erosion and flooding potential within the Black Creek watershed (see **Key Map** below for limits of Study Area). Development through much of the Black Creek watershed within the City occurred prior to the implementation of modern storm water management practices and techniques. This study will look at alternative solutions available to better optimize the existing conditions related to flooding, erosion and water quality within the Black Creek watershed.

The preferred alternative will be determined based on engineering requirements, environmental considerations, public input and information gathered during the study.

The study is being conducted in accordance with the Master Plan process as outlined in the Municipal Engineers Association's Municipal Class Environmental Assessment (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, evaluation of alternatives, assessment of the potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Public and external agency consultation is a key component of this Study. Details regarding the project will be presented at Public Information Forums to provide interested stakeholders with an opportunity to meet the Project Team and to discuss alternative solutions, environmental considerations/impacts, evaluation criteria, and design options. Each Forum will include an interactive roundtable discussion to engage participants and solicit their input. These forthcoming Public Information Forums will be advertised in future editions of the local newspaper as the Study progresses.

Comments and information regarding this project are being collected by the Study Team in accordance with the requirements of the *Ontario Environmental Assessment Act*. We have included a response form with this letter for your use. If possible, please fax or mail back your comments to our office.

We are interested in receiving any comments that you may have about the Study. Should you have any questions or comments, or wish to receive additional information regarding this project, please contact either of the following Project Team members:

Mr. Saad Yousaf, P.Eng. City of Vaughan Project Manager

Development/Transportation Engineering Department

2141 Major Mackenzie Drive Vaughan, ON L6A 1T1

Phone: 905.832.8585, Ext: 8251

Fax: 905.832.6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng.

Project Manager

AECOM

300 Town Centre Blvd., Suite 300

Markham, ON L3R 5Z6

Phone: 905.477.8400, Ext. 430

Fax: 905.477.1456

Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the *Freedom of Information and Protection of Privacy Act*. With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Sincerely,

AECOM Canada Ltd.

Joe Puopolo, P.Eng.

Consultant Project Manager joe.puopolo@aecom.com

JP:pc

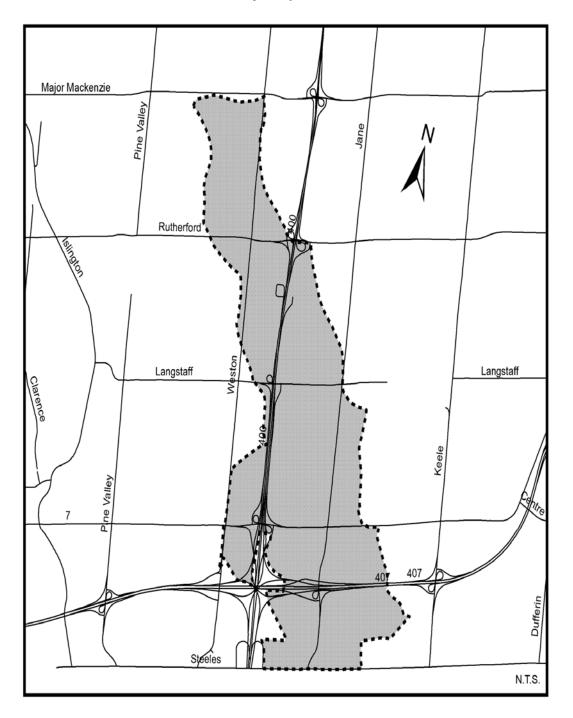
cc: B. Robinson, Commissioner of Engineering and Public Works, City of Vaughan

A. Pearce, Director of Development / Transportation Engineering, City of Vaughan

M. Frieri, Development Supervisor, Engineering Planning & Studies Division, City of Vaughan

S. Yousaf, Project Manager, City of Vaughan

Key Map Area



Limits of Study Area -----



Appendix E

Stakeholder Contact List and Comment & Response Tracking Matrix



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
Stakenoider	Contact	Comments	Response	Comments	Response
Federal, Provincial, and	Municipal Agencies				
Canadian Environmental Assessment Agency (CEAA) 55 St. Clair Avenue East Suite 907 Toronto, ON M4T 1M2	Jim Chan Senior Program Officer Ontario Regional Office Phone: 416-952-6063 Fax: 416-952-1573 E-mail: Jim.Chan@ceaa-acee.gc.ca				
Ministry of Transportation (MTO) 1201 Wilson Avenue, 3 rd Floor, Bldg. D Downsview, ON M3M 1J8	Lola Vaz-Rafearo Lola.Vaz@ontario.ca (Dean.kemper@mto.gov.ca) Phone: 416-235-5095				
Ministry of Environment 14 th Floor, 2 St. Clair Ave. West Toronto, ON M4V 1L5	Notices Should be sent to MEA.Notices.EAAB@ontario.ca and the Regional EA Contact should be copied. Solange Desautels Solange.desautels@ontario.ca Tel. 416-314-8360				
Ministry of Environment 5775 Yonge Street, 9 th Floor Toronto, ON M2M4J1	Dorothy Moszynski Phone: 416-326-5745 Email: dorothy.moszynski@ontario.ca Environmental Resource Planner/EA Coordinator	 Letter sent to Mr. Yousaf on June 17, 2009 in response to the Notice of Commencement and PIC #1. Based on the information submitted, we have identified the following issues of concern with respect to the proposed undertaking: Ecosystem Protection and Restoration Surface Water Groundwater Planning and Policy Master Planning Process First Nations Consultation We are providing the following general comments to assist you in effectively addressing these issues: Ecosystem Protection and Restoration: Any impacts to ecosystem form and function must be avoided where possible. The Master Plan should describe any proposed mitigation measures and how project planning will protect and enhance the local ecosystem. All natural heritage features should be identified and described in detail to assess potential impacts and to develop appropriate mitigation measures. Our records confirm that the following sensitive environmental features are located within or adjacent to the Study Area:	Thank-you for your comments. We will ensure to follow the MEA Class EA for Master Plans and incorporate your suggestions as best as possible.	•	



Stakeholder	Contact	Notice of Commencement and Notice	of PIF #1	Notice of PIF #2	
Stakerioluer	Contact	Comments	Response	Comments	Response
		 Future drainage conditions, stormwater management options, information on erosion on sediment control during construction and other details of the proposed works Information on maintenance and monitoring commitments Groundwater The status of and potential impacts to any well water supplies should be addressed. Appropriate information to define existing groundwater conditions should be included in the Master Plan If the potential construction or decommissionin of water is identified as an issues, the Master Plan should refer to Ontario Regulation 903, Wells under the Ontario Water Resources Act. Potential Impacts to groundwater-dependent natural features should be addressed. Any changes to groundwater flow or quality from groundwater taking may interfere with the ecological processes of streams, wetlands or other surficial features. Discharging contaminated or high volumes of groundwater to these features may have direct impacts on their function. Any potential effects should be identified and appropriate mitigation measures should be 	Response	Comments	Response
		recommended. The level of detail required will be dependent on the significance of the potential impacts. Planning and Policy The 2005 Provincial Policy Statement contains policies that protect Ontario's Natural Heritage Applicable policies should be referenced in the Master Plan and the proponent should demonstrate how this proposed plan is consistent with these policies. The Places to Grow Plan contains policies which guide decisions on a range of issues such as infrastructure planning and land-use planning to ensure that stronger and more prosperous communities are built in the Greater Golden Horseshoe. The study should			
		demonstrate how it adheres to the relevant policies of the Places to Grow Plan. Master Plan Process: The Master Plan should clearly indicate the selected approach for conducting the plan, in particularly by identifying whether the levels of assessment, consultation and documentation are sufficient to fulfill the requirements for Schedule B or C projects. Please note that any Schedule B or C projects identified in the plan would be subject to Part II Order Requests under the Environmental Assessment Act, although the plan itself would not be. The Master plan should provide clear and completer documentation on the planning process in order to allow traceability of decision-making. It must also demonstrate how the consultation provisions of the Class EA have been fulfilled, including documentation of all public consultation efforts undertaken during the planning process. It should identify all concerns that were raised and how they have been addressed throughout the planning process. The Class EA also directs proponents to include copies of comments submitted on			
		the project by interested stakeholders and the proponent's responses to these comments. First Nations Consultation: As part of the required stakeholder consultation, proponents are advised to contact the Ministry of Aboriginal Affairs and the Department of Indian and Northern Affairs to determine potentially affected Aboriginal peoples in the protected area. Once identified you are advised to provide notification directly to the Aboriginal peoples who may be affected by the plan and provide them with an opportunity to participate in any planned public consultation sessions and comment on the plan.			

Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF	#2
StakeHolder		Comments	Response	Comments	Response
Toronto and Region Conservation Authority (TRCA) 5 Shoreham Drive	Phone: 416-661-6600				
Downsview, ON M3N 1S4	Bill Kiru E-mail: bkiru@trca.on.ca Phone: 416-661-6600				
	Carolyn Woodland E-mail: cwoodland@trca.on.ca Phone: 416-661-6600				
	Gary Wilkins E-mail: gwilkins@trca.on.ca Phone: 416-661-6600				
	Suzanna Bevan Email: sbevan@trca.on.ca Phone: 416-661-6600 x5759	 Toronto and Region Conservation Authority (TRCA) staff received the Notice of Commencement for the above noted Environmental assessment (EA) on March 23, 2009. Staff understands that this undertaking involves a Master Plan study to determine storm water management measure that can be implemented to improve storm water runoff quantity and quality, and to minimize erosion and flooding potential within the Black Creek watershed. The study will also examine alternative solutions available to better optimize the existing conditions related flooding, erosion and water quality within the Black Creek watershed. 	 Thank-you for your comments. We will ensure to follow the MEA Class EA for Master Plans and incorporate your suggestions as best as possible. We will continue to consult and engage with TRCA on this project. 		
		TRCA Areas of Interest ■ Regulated Areas — Regulated Limit — Crest of slope — Meander Belt — Regulatory Flood Pain — Regulated Wetlands — Watercorses — Conservation Land (TRCA property) — Living City Programs — Sustainable Communities, Sustainable Technologies, Living City Trails — Terrestrial Natural Heritage Strategy — Terrestrial Species and Habitat ■ TRCA Program and Policy Areas — Aquatic Species and Habitat — Aquifers and Hydrogeological Features — Archaeological and Heritage Resources ■ Provincial and Federal Program Areas			
		 Areas of Natural and Scientific Interest Asian Long-horned Beetle Regulated Area Selection of Alternatives In consideration of TRCA's Valley and Stream Corridor Management Program, Ontario Regulation 166/06, and TRCA's other programs and policies, staff requires that the preferred alternative meets the following criteria: Prevents the risk associated with flooding, erosion or slope 			
		instability 2. Protects and rehabilitates exiting landforms, features and functions 3. Provides for aquatic, terrestrial and human access. 4. Minimizes water/energy consumption and pollution. 5. Addresses TRCA property and heritage resource concerns. TRCA Review			
		 Prior to selecting the preferred alternative solution and design, please arrange a meeting to discuss issues that relate to our program and policy concerns. In addition, please add TRCA's Watershed Specialist, Gary Wilkins to the project mailing list to receive any public information updates. 			





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		A copy of the TRCA Environmental Assessment Review Program Service Delivery Standards and a summary chart is enclosed for your reference. We recommend you refer to these submission standards during the study to facilitate TRCA review. Please provide the following submissions to expedite TRCA review. Notices of public meetings and display material and handouts Four hard copies of the Phases 1 and 2 Report Four hard copies of the Draft Master Plan, and One hard copy and one digital copy of the final Master Plan. Letter sent on May 27, 2009: Toronto and Region Conservation Authority (TRCA) staff received				
	Beth Williston	notice of the Public Information Forum (PIC) scheduled for May 20, 2009. While TRCA planning staff was unable to attend the meeting, please forward one copy of any handouts or display materials from this meeting for our files. Please include a digital copy of all materials as part of your submission.	information to TRCA.			
	Email: bwilliston@trca.on.ca					
Conservation Authority (TRCA) Black Creek Pioneer Village	Marty Brent	 The Black Creek runs under the Bridge at Jane & Steeles. While the study area ends at Steeles, the area of the creek under the Bridge and through Black Creek Pioneer Village is a high risk area in major storms. Hopefully this study will be co-coordinated with City of Toronto to ensure the area under the bridge is dealt with and improved to handle major storm conditions. 	TRCA was involved in this study and is aware of the expressed concern and the appropriate agency coordinated with the City of Toronto.			
Region of York	Loy Cheah	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1				
	E-mail: Loy.cheah@york.ca					
*New Contact added for 2 nd PIF	Phone: 905-895-1200 ext. 5024 Salim Alibhai, P.Eng., PMP Project Manager Roads Branch - Capital Delivery Transportation and Works Department Regional Municipality of York 90 Bales Drive East Sharon, ON., L0G 1V0 Tel: (905) 830 4444 ext. 5229 Fax: (905) 836 4590 Email: salim.alibhai@york.ca					
55 John Street, 18th Floor	Bill Snodgrass E-mail: wsnodgr@toronto.ca Phone: 416-392-9746					
CP Rail 1290 Central Parkway West, Suite 800 Mississauga, ON L5C 4R3	Paul Kerry Phone: 905-803-3249 E-mail: Paul_kerry@cpr.ca					
GO Transit 20 Bay St., Suite 600 Toronto, ON M5J 2W3	Dan Francey Phone: 416-869-3600 E-mail: danf@gotransit.com					
	Bert Peverini Phone: 416-869-3600 E-mail: bertp@gotransit.com Jeff Bateman Phone: 905-869-3600 ext. 5305 E-mail: Jeff.Bateman@gotransit.com	Returned Response Form on March 25, 2009. Would like to be notified for continued involvement in the process.	Added to Project Mailing List			
Vaughan Chamber of Commerce 160 Applewood Crescent Unit 32 Vaughan, ON L4K 4H2	Debbie Bonk (Replaced Ian Raynor) E-mail: deborah@vaughanchamber.ca (ian@properties2discover.com) Phone: 905-761-1366					



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
Stakenoluer	Contact	Comments	Response	Comments	Response
Canadian National Railway (CN					·
Rail)	Phone: 905-669-3119				
1 Administration Road PO Box 1000					
Concord, ON L4K 1B9					
Indian and Northern Affairs	Chuck Strahl				
25 St. Clair Ave. East, 8 th Floor	Phone: 416-973-6234				
Toronto, ON M4T 1M2 Ministry of Agriculture, Food,	Ray Valaitis				
and Rural Affairs	Phone: 613-475-4764				
95 Dundas Street East					
Brighton, ON K0K 1H0					
Ministry of Culture	Malcolm Horne				
400 University Avenue, 4th Floor Toronto, ON M7A 2R9	Phone: 416-314-7146 E-mail: malcolm.horne@mcl.gov.on.ca				
Ministry of Municipal Affairs	Marc Magierowicz				
and Housing, Municipal	E-mail: Marc.Magierowicz@ontario.ca				
Services Office – Central					
Ontario 777 Bay Street, 2 nd Floor					
Toronto, ON M5G 2E5					
Oak Ridges Moraine	Michael Scott				
Foundation	Phone: 905-883-5733				
13990 Dufferin Street North King City, ON L7B 1B3	E-mail: m.g.scott@ormf.com				
Ontario Heritage Trust	Barbara Heidenreich				
10 Adelaide Street East	E-mail:				
Toronto, ON M5C 1J3	Barbara.Heindenreich@heritagetrust.on.				
	ca Phone: 416-314-4918				
Ontario Nature	Wendy Francis				
366 Adelaide Street West	Phone: 416-444-8419				
Suite 201	E-mail: wendyf@ontarionature.org				
Toronto, ON M5V 1R9 STORM Coalition	Deb Crandall				
PO Box 533	Phone: 905-880-3465				
Bolton, ON L7E 5T4	E-mail: dcrandall@stormcoalition.com				
Toronto York Spadina Subway					
Extension Project Toronto Transit Commission	Phone: 416-393-7884 E-mail: Charles.wheeler@ttc.ca				
(TTC)	Judith Witzig	Letter sent to Mr. Yousaf on April 6, 2009	In response to April 6, 2009 letter, TTC	PIF#2 Comment Form Submitted March 11/2010	Comments noted.
5160 Yonge Street, 11th Floor	Environmental Coordinator	Relationship to improvements associated with the Toronto York	was added to project mailing list.	Excellent set of alternatives	• Electronic copy of display material was
Toronto, ON M2M 6L9	Phone: 416-397-8625	Spadina Subway Extention improvements within the Black Creek	- Sent link to website.	May we please receive an electronic copy of the presentation	sent.
	E-mail: Judith.witzig@ttc.ca	subwatershed.	 Response to May 20, 2009 letter, the following response has been prepared but 		
		Optimization study timing, recommendations. Relationship to other TTC projects within the optimization study area	not yet sent to TTC:	·	
		(e.g. Transit City).	 The results of hydrologic and hydraulic 		
		I look forward to receiving updates on the various components of	modelling carried out for the Study have		
		this study. Please advise me of any changes to the schedule which	been provided to the City. However, no water quality data was collected in the		
		you had previously provided in early February 2009. • As you are aware, the timing of proposed solutions to storm water	field, but rather was obtained from		
		management at three of our station areas is critical. We would like	background sources (i.e., TRCA, City,		
		the opportunity to continue to discuss proposed storm water	MNR).		
		management solutions and staging with you for three stations:	- Recommendations noted and		
		Steels West, Highway 407 and Vaughan Corporate Centre. Letter sent to Mr. Yousaf on May 20, 2009	incorporated into EA evaluation where appropriate.		
		Re: Information Requested to be Included in the Investigations and	The evaluation of flood improvement		
		Analysis	alternatives considered a range of alternatives to improve the level of		
		From Black Creek Optimization Study Stakeholder meeting on May	service, and the preferred alternative		
		14, 2009, have gathered material including: fluvial geomorphology,	includes a combination of remedial		



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
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		preliminary grading and associated revised HEC RAS analysis. In turn we appreciate receiving copies of any supporting flow information as well as culvert dimensions and capacities and any water quality baseline date complied in the data gathering stages in those areas surrounding and feeding the three TYSSE station locations. • With regard to the scope of your EA Evaluation, we make the following recommendations: - Identify and include cross sectional analysis and locations to be completed within the various areas of the study area - We agree with Mr. Snodgrass' suggestion that the event based analysis does not lead to a particularly useful approach to area drainage plan development and erosion analysis. While we recognize the limits of the data, we urge Vaughan to incorporate both analysis methods. - Request that the study realistically recognize the existing flooding conditions particularly at the CN crossing of Jane Street, the Jane Street culvert and Jane street north of Highway 7 and elsewhere in the study area - The study area - The study should make recommendations for new, enhanced or expanded storm flow facilities upstream and down stream that will handle anticipated flows resulting from both OPA 500 and 620 • Thank you for the opportunity to identify additional aspects of the analysis needed for the EA work on the Black Creek Optimization Study.	measures to address the flooding, water quality and erosion issues identified in the Study Area. Given the level of development within the Study Area, it was determined that continuous hydrologic simulation would not provide a useful basis with respect to addressing streambank erosion, as the increased frequency and magnitude of peak flow cannot be addressed through source or lot level controls, which was confirmed through discussions with the City and TRCA. The identification and evaluation of improvement alternatives was carried out to address the noted flooding issues within the Study Area, and the preferred alternative aims to reduce the risk of flooding by increasing the capacity of Black Creek to convey the Regional Storm flows between Highways 407 and 7. Further, a recommendation has been included in the Master Plan to replace the existing culverts at the CNR crossing, which would alleviate flooding of the areas immediately upstream, including the portion of Jane Street in the vicinity of the CNR tracks. The SWM strategies developed for the OPA 500 and 620 areas include both new and expanded SWM facilities. Recommendations regarding design criteria and SWM requirements for these developments are provided in the Master Plan.		
Ontario Realty Corporation - Professional Services 1 Dundas Street West Suite 2000 Toronto, ON M5G 2L5	Lisa Myslicki Environmental Coordinator (416) 212-3768 lisa.myslicki@ontariorealty.ca	 Thank you for circulating Ontario Realty Corporation (ORC) on your Notice of Study Commencement. The ORC is the strategic manager of the government's real property with a mandate of maintaining and optimizing value of the portfolio, while ensuring real estate decisions reflect public policy objectives of the government. As you may be aware, ORC is responsible for managing real property that is owned by the Ministry of Energy and Infrastructure (MEI). Our preliminary review of your notice and supporting information indicates that ORC-managed property is directly in the study area. As a result, your proposal may have the potential to impact this property and/or the activities of tenants present on ORC-managed lands. Attached please find a map that identifies these properties to assist you in identifying and avoiding potential impacts on ORC-managed lands. Potential Negative Impacts to ORC Tenants and Lands – General Impacts: Negative environmental impacts associated with the project design and construction, such as the potential for dewatering, dust, noise and vibration impacts, and impacts to natural heritage features/habitat and functions, should be avoided and/or appropriately mitigated in accordance with applicable regulations best practices and Ministry of Natural Resources (MNR) and Ministry of the Environment (MOE) standards. Avoidance and mitigation options that characterize baseline conditions and quantify 	Thank-you for your comments. We will ensure to follow the MEA Class EA for Master Plans and incorporate your suggestions as best as possible. We will continue to consult and engage with ORC on this project.		

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		Details of appropriate mitigation, contingency plans and triggers for implementing contingency plans should also be present.			
		Impacts to Land holdings			
		 Negative impacts to land holdings, such as the taking of developable parcels of ORC managed land or fragmentation of utility or transportation corridors, should be avoided. If the potential for such impacts is present as part of this undertaking, you should contact the undersigned to discuss these issues at the earliest possible stage of your study. If takings are suggested as part of any 			
		alternative these should be appropriately mapped and quantified within EA report documentation. In addition, details of appropriate mitigation and or next steps related to compensation for any required takings should be present. ORC requests circulation of the draft EA report prior to finalization if potential impacts to ORC-			
		managed lands are present as part of this study.			
		Heritage Management Process & Class Environmental Assessment (EA) Process			
		Should the proposed activities impact cultural heritage features, on ORC managed lands, a request to examine cultural heritage issues which can include the cultural landscape, archaeology and places of sacred and secular value could be required. The Ontario Realty Corporation Heritage Management Process should be used for identifying and conserving heritage properties in the provincial portfolio (this document can be downloaded from the Heritage section of our website: http://www.ontariorealty.ca/What-We-Do/Heritage.htm). Through this process, ORC identifies, communicates and conserves the values of its heritage places. In addition, the Class EA ensures that ORC considers the potential effects of proposed undertakings on the environment, including cultural heritage. Potential Triggers Related to MEI's Class EA The ORC is required to follow the MEI Class Environmental Assessment Process for Realty Activities Not Related to Electricity Projects (MEI Class EA). The MEI Class EA applies to a wide range of realty and planning activities including leasing or letting, planning			
		approvals, disposition, granting of easements, demolition and property maintenance/repair. For details on the ORC Class EA please visit the Environment and Heritage page of our website found			
		 at http://www.ontariorealty.ca/AssetFactory.aspx?did=2240 If the MEI Class EA is triggered, and deferral to another ministry's or agency's Class EA or individual EA is requested, the alternative EA will be subject to a critical review prior to approval for any signoff of a deferral by the proponent. The alternative EA needs to fulfill the minimum criteria of the MEI Class EA. When evaluating an 			
		alternative EA there must be explicit reference to the corresponding undertaking in the MEI Class EA (e.g., if the proponent identifies the need to acquire land owned by MEI, then "acquisition of MEI-owned land", or similar statement, must be referenced in the EA document). Furthermore, sufficient levels of consultation with MEI's/ORC's			
		specific stakeholders, such as the Ontario Ministry of Natural Resources, must be documented with the relevant information corresponding to MEI's/ORC's undertaking and the associated maps. In addition to archaeological and heritage reports, a Phase I Environmental Site Assessment (ESA), on ORC lands should also			
		be incorporated into the alternative EA study. Deficiencies in any of these requirements could result in an inability to defer to the alternative EA study and require completing MEI's Class EA prior to commencement of the proposed undertaking.			

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		 In summary, the purchase of MEI-owned/ORC-managed lands or disposal of rights and responsibilities (e.g. easement) for ORC-managed lands triggers the application of the MEI Class EA. If any of these realty activities affecting ORC-managed lands are being proposed as part of any alternative, please contact the Sales and Marketing Group through ORC's main line (Phone: 416-327-3937, Toll Free: 1-877-863-9672), and contact the undersigned at your earliest convenience to discuss next steps. Specific Comments If the project involves an individual EA and the undertaking directly affects all or in part any ORC-managed property, please send the undersigned a copy of the DRAFT Individual EA report and allow sufficient time (minimum of 30 calendar days) for comments and discussion prior to finalizing the report to ensure that all MEI Class 			
		EA requirements can be met through the EA study.			
		Concluding Comments Thank you for the opportunity to provide initial comments on this undertaking. If you have any questions on the above I can be reached at the contacts below.			
Other Organizations	-				
407 ETR	Craig White	Returned Response Form on March 30, 2009.	Added to Project Mailing List		
	Phone: 905-264-5225 E-mail: cwhite@407etr.com	Would like to be notified for continued involvement in the process.			
	Jeff Booker Phone: 905-265-4070 x 5485 E-mail: jbooker@407etr.com	Would like to be notified for continued involvement in the process.	Added to Project Mailing List		
	Fausto Conforti Phone: 905-265-4070 E-mail: fconforti@407etr.com				
,	Deborah Schulte E-mail: deborahschulte@rogers.com				
	Len Kozachuk E-mail: lkozachuk@rogers.com				
157 London Road Newmarket, ON L3Y 7A7	Kevin Shackleton E-mail: kevin.shackleton@rogers.com				
	Phyllis Santone Phone: 905-265-2343				
Rimwood Estates Homeowners Association 8050 Islington Avenue, Unit 19	Susan Okon Phone: 905-850-0232 E-mail: mariosusan@eol.ca				
Association 15 Bunting Drive	Elvira Caria, Co-Chair (R) (905) 303-9830 (B) (416) 520-5926				
York Regional Municipality	(F) (905) 303-9830 Director, Realty Service Branch (C12 00840)				
Management Board Secretarial 777 Bay Street, 12 th Floor Toronto, ON M5G 2E5					



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Stakenoider	Contact	Comments	Response	Comments	Response	
Transportation Ministry						
Director of Subsidies						
777 Bay Street 12 th Floor						
Toronto, ON M5G 2E5						
724352 Ontario Limited						
Trustee						
Att Real Estate-Ups Canada						
#400 – 6285 Northam Drive						
Mississauga, ON L4V 1X5						
Conservation Authority Metro						
5 Shoreham Drive						
Downsview, ON M3N 1S4						
Serenity Park Cemetery						
Corporation						
228 Deer Run Court						
Woodbridge, ON L4L 9J4						
Penisola Investments Inc.						
89 Adesso Drive						
Concord, ON L4K 2W7						
Minuk Construction & Minuk						
Construction & Engineer						
99 Sante Drive Unit C						
Concord, ON L4K 3C4						
Minuk Const. & Engineering						
Ltd Samuel Minuk Enterprises						
Ltd						
99 Sante Drive, Unit C						
Concord, ON L4K 3C4						
Lape Holdings Inc						
2951 Highway 7						
Concord, ON L4K 1W3						
Unicum Management Corp						
166 Deer Run Court						
Woodbridge, ON L4L 9J4						
Accubid Systems Ltd						
7725 Jane Street, Suite 200						
Concord, ON L4K 1X4						
2748355 Canada Ltd						
c/o Bentall Property Services						
55 University Avenue, #300						
Toronto, ON M5J 2H7						
Inter-Jane Investments Inc						
25 Interchange Way						
Vaughan, ON L4K 5W3						
Toromont Industries Ltd						
3131 Highway 7 West						
Concord, ON L4K 5E1						
IKEA Properties Limited						
1065 Plains Road East						
Burlington, ON L7T 4K1						
Concord Vaughan GP Inc.						
c/o Midland Loan Services, Inc						
Tax Department						
P.O. Box 25965						
Shawnee Mission, KS 66225-						
5965						
Royal Empress Gardens						
91 Fulwell Crescent						
North York, ON M4J 1Y4						



Stakeholder	Contact	Notice of Commencement	nt and Notice of PIF #1	Notice of PIF #2		
StakeHoldel		Comments	Response	Comments	Response	
GPM Real Property (10) Ltd GPM (10) GP Inc 70 University Avenue, Suite 1200 Toronto, ON M5J 2M4	Michael O'Sullivan Director, Asset Management Tel: (416) 864 0040 Ext. 6528 Direct line (416) 864 6528 Fax: (416) 864 1737			Please send me an update on your EA meeting or can I re some information on the Vaughan website?	Sent link to website	
Midvale Estates Limited c/o Gold Park Homes	ran (110) oo i 1701					
55 Silton Raod Unit 2 Woodbridge, ON L4L 7Z8						
2117969 Ontario Inc. 100 Zenway Boulevard Woodbridge, ON L4H 2Y7						
Sevenbridge Development Ltd c/o First Professional Group 700 Applewood Cres. Suite 100 Concord, ON L4K 5X3						
Metrus Properties Limited 30 Floral Pkwy Concord, ON L4K 4R1						
Management Board Secretarial Director of Subsides 777 Bay Street 12 th Floor						
Toronto, ON M5G 2E5 Management Board Secretarial c/o ORC Property Tax Dept						
11 th Floor Ferguson Block 77 Wellesley Street West Toronto, ON M7A 2G3						
1049170 Ontario Ltd. 115 Cidermill Avenue Concord, ON L4K 4G5						
VMS Holdings Inc. 86 Moyal Court Suite 201 Concord, ON L4K 4R8						
Hewquip Inc. 5001 Route Trans-Canadienne Point-Claire, Quebec H9R 1B8						
Bibieffe International Holdings BV 7050 Weston Road, Suite 200						
Vaughan, ON L4L 8G7 Concord Confections Ltd. 345 Courtland Avenue						
Concord, ON L4K 5A6 Star-Flower Properties Inc. Muzzo Brothers Group Inc.						
c/o Weston Road-Rental 30 Floral Pkwy Concord, ON L4K 4R1						
Pride Gate Developments Inc. 3550 Landstaff Road, Suite 200 Woodbridge, ON L4L 9G3						
Roybridge Holdings Limited 100 Zenway Boulevard Woodbridge, ON L4H 2Y7						
Belfin Canada Inc. 151 Creditview Road Woodbridge, ON L4L 9T1						



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Stakenoider	Contact	Comments	Response	Comments	Response	
Boca West Investments			· ·		·	
Limited						
30 Floral Parkway						
Concord, ON L4K 4R1						
Eighty Hanlan Road						
Investments Inc.						
399 Four Valley Drive, Unit #25						
Vaughan, ON L4K 5Y7						
2031860 Ontario Inc Trustee						
c/o Canac Kitchens Division of						
Kohler Canada Co.						
180 – 190 Creditview Road						
Woodbridge, ON L4L 9N4						
2031860 Ontario Inc Trustee						
601 Edgeley Blvd., Unit 9 & 10						
Concord, ON L4K 4G2						
Confederated Properties Ltd.						
601 Edgeley Blvd., Unit 9						
Concord, ON L4K 4G2						
1511519 Ontario Limited						
28 Olive Green Road						
Woodbridge, ON L4L 7L3						
UFCW Local 1000A Building						
Society						
70 Creditview Road						
Woodbridge, ON L4L 9N4						
Liz-Greg Inc.						
70 Sovereign Court Unit 1						
Woodbridge, ON L4L 8M1						
Weston Flooring Ltd.						
87 Westcreek Drive						
Woodbridge, ON L4L 9N6						
1564197 Ontario Limited						
101 Westcreek Drive						
Vaughan, ON L4L 9N6						
Continental Cosmetics and Eq						
390 Millway Avenue						
Concord, ON L4K 3V8						
Little One Holdings Inc						
380 Millway Avenue						
Concord, ON L4K 3L5 Investors Group Trust Co. Ltd.						
c/o Bentall Real Estate Services						
I P						
<u>-</u> '						
10 Carlson Court, Suite 500						
Toronto, ON M9W 6L2						
Summit Real Estate						
Investment Summit Reit						
6295 Northam Drive, Unit 1						
Mississauga, ON L4V 1W8						
1714574 Ontario Limited						
31 Pennsylvania Avenue, Unit 1						
Concord, ON L4K 5V5						
877900 Ontario Ltd.						
345 Millway Avenue						
Concord, ON L4K 4T3						
Marchese Holdings Ltd.						
8 Cairnburg Place						
Woodbridge, ON L4L 3L5						



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Valcosa Holdings Inc.						
301 Millway Avenue						
Concord, ON L4K 7T3						
1095395 Ontario Inc.						
603 Millway Avenue, Unit 1						
Concord, ON L4K 3C4						
GE Canada Real Estate Equity						
Holding Company						
200 Front Street W., Suite 2400						
Toronto, ON M5V 3K5						
GE Real Estate	Claudia Nemi	Returned Response Form April 1, 2009	 Added to project mailing list 			
71 Marycroft Avenue, Unit 31	905-264-6245	Would like to be notified for continued involvement in the process				
Woodbridge, ON L4L 5Y6	Claudia.nemi@ge.com					
1213789 Ontario Ltd.						
463 Applewood Crescent						
Concord, ON L4K 4J3						
Lee Chemicals Ltd.						
441A Applewood Crescent						
Concord, ON L4K 4J3						
Franline Investments Limited						
330 Applewood Crescent						
Concord, ON L4K 4V2						
5 Paces Inc.						
440 Edgeley Blvd.						
Concord, ON L4K 4G4						
760749 Ontario Limited						
115 Cidermill Avenue Concord, ON L4K 4G5						
768450 Ontario Limited						
115 Cidermill Avenue						
Concord, ON L4K 4G5						
Orlando Corporation				Please forward a copy of the material presented at PIF #2	Sent link to website	
6205 Airport Road				1 lease forward a copy of the material presented at 1 if #2	• Gent link to website	
Mississauga, ON L4V 1E3						
Hirono Development Inc						
c/o 30 Floral Pkwy						
Concord, ON L4K 4R1						
Tilzen Buidings Ltd						
Standard Builders Limited in						
Trust						
3655 Keele Street						
Toronto, ON M3J 1M8						
Metrus Group Inc Trustee						
30 Floral Pkwy						
Concord, ON L4K 4R1						
Alrob Holdings Inc.						
30 Moyal Court						
Concord, ON L4K 4R8						
Baifor Property Management						
Ltd.						
830 Rowntree Dairy Rd, Unit 10						
Woodbridge, ON L4L 5V2			_			
First Vaughan Investments Ltd						
700 Applewood Cres Suite 100						
Concord, ON L4K 5X3						
First Vaughan Inv. Ltd Ruland						
Properties Inc. 700 Applewood Cres., Suite 100						
Concord, ON L4K 5X3						
CONCOID, ON LAK SAS						



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
Stakenoider		Comments	Response	Comments	Response
Stellarbridge Management Inc.					
111 Creditstone Road Concord, ON L4K 1N3					
Concord, ON L4K 1N3 Commemorative Services of					
Ontario					
#500 – 65 Overlea Blvd.					
Toronto, ON M4H 1P1					
89 Sherwood Avenue					
Scarborough, ON M1R 1N7					
Luigi Bros Paving Company Limited					
1827 Drew Road					
Mississauga, ON L5S 1J5					
1034933 Ontario Inc.					
126A Peelar Road					
Concord, ON L4K 2C9					
F. Barci Holdings Mayla Contracting Ltd.					
114 Peelar Road					
Concord, ON L4K 2C9					
Franden Holdings Ltd.					
215 Doughton Road					
Concord, ON L4K 1R1					
832720 Ontario Inc.					
220 Doughton Road Concord, ON L4K 1R4					
Shanghavi Investments					
Limited					
#4 & 5 – 96 Maplecrete Road					
Concord, ON L4K 1A4					
785343 Ontario Limited					
150 Ferrand Drive, Suite 801 Toronto, ON M3C 3E5					
I & M Pandolfo Holdings Inc, In					
Trust					
7601 Jane Street					
Concord, ON L4K 1X2					
Berkley Commercial (Jane) Inc.					
20 Rivermede Road, Suite 204					
Concord, ON L4K 3N3 Morgan Mae Enterprises					
Limited					
1111 Finch Ave. W., Suite 450					
North York, ON M3J 2E5					
70 Moorecraig Road					
Peterborough, ON K9J 6V7					
1175777 Ontario Limited 111 Creditstone Road					
Concord, ON L4K 1N3					
541896 Ontario Limited					
60 Talman Court					
Concord, ON L4K 3B2					
8083 Jane Street Ltd.					
8083 Jane Street Concord, ON L4K 2M7					
Concord, ON L4K 2M7 Comer Group Limited					
50 Fernstaff Court, Unit 8					
Concord, ON L4K 3L6					
2 Laura Road					
North York, ON M3N 1Z6					



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
Stakelloluel	Contact	Comments	Response	Comments	Response
2960 Teston Side Road					
Maple, ON L6A 1S1					
Berdia Invesments Co Limited					
550 Cranbrooke Avenue					
Toronto, ON M5M 1P1					
8633 Jane Street					
Vaughan, ON L4K 2M6					
1442514 Ontario Inc.					
3000 Langstaff Road, Suite 18					
Concord, ON L4K 4R7					
Graci Charles					
Graci Graziella					
10 Sugarbush Court					
Woodbridge, ON L4L 2Z2					
Rycoline Inc.					
145 Westcreek Drive					
Vaughan, ON L4L 9N6					
Appa Investments Inc.					
41 Antonia Court					
Woodbridge, ON L4H 1C9					
2128347 Ontario Inc.					
177 Westcreek Drive					
Vaughan, ON L4L 9N6					
Westcreek Holdings Inc.					
70 Gibson Drive, Unit 13 Markham, ON L3R 4C2					
Anland Properties Inc. 127 Pine Valley Crescent					
Vaughan, ON L4L 2W3					
606578 Ontario Limited					
Marbon Holdings Inc.					
46 Ashbridge Cir					
Vaughan, ON L4L 3R5					
606578 Ontario Limited					
227 Westcreek Drive					
Woodbridge, ON L4L 9T7					
Marbon Holdings Inc.					
46 Ashbridge Cir					
Vaughan, ON L4L 3R5					
JRD Property MGT Inc.					
200-211 Westcreek Drive					
Woodbridge, ON L4L 9T7					
2088806 Ontario Inc.					
1 Green Manor Cres					
Woodbridge, ON L4L 9R2					
1129666 Ontario Inc.					
221 Creditview Road					
Woodbridge, ON L4L 9T1					



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2	
Stakerloider	Contact	Comments	Response	Comments	Response
General Public and Property	Owners				
Public Member / Property		Returned Response Form on March 24, 2009. Added to project.	ect mailing list		
Owner # 1		 Would like to be notified for continued involvement in the process. 	Joe maining not		
		Property is directly affected by this study.			
Public Member/ Property		Returned Response Form on March 26, 2009. Comment ack	nowledged		
Owner # 2		Would like to be notified for continued involvement in the process. Added to project	ect mailing list		
		UPS's most immediate concerns is that in the implementation of any			
		new stormwater management system, there be no interruption to its			
		plans and operations. The second concern is simply to draw the			
		attention of the City of Vaughan the timelines that would have to be met if Section 3.7 of the Memorandum of Understanding entered			
		into between the City of Vaughan, the Region of York and UPS is to			
		be implemented. Please feel free to contact us for further			
		information.			
Public Member / Property		Returned Response Form on March 26, 2009.			
Owner # 3		Would like to be notified for continued involvement in the process.			
		UPS's most immediate concerns is that in the implementation of any			
		new stormwater management system, there be no interruption to its			
		plans and operations.			
		The second concern is simply to draw the attention of the City of Vouchan the timplines that would have to be met if Section 3.7 of			
		Vaughan the timelines that would have to be met if Section 3.7 of the Memorandum of Understanding entered into between the City of			
		Vaughan, the Region of York and UPS is to be implemented. Please			
		feel free to contact us for further information			
Public Member / Property		E-mail sent to Saad Yousaf and Joe Puopolo on March 24, 2009. Added to project to Saad Yousaf and Joe Puopolo on March 24, 2009.	ect mailing list		
Owner # 4		Royal empress Gardens is the owner of 8.5 Acres of land located at			
		the easterly gateway of the City of Vaughan Corporate Centre and			
		have an approved project on these lands. I would appreciate you			
		keep me informed of all new developments of the Class			
		Environmental Assessment Plan.			
Public Member / Property			or rainwater harvesting is a		
Owner # 5		· · · · · · · · · · · · · · · · · · ·	ctice that has been d as in Table 25 for existing		
		ů i ,	e development		
			ble 25 recommends, there are		
			with implementation in		
		, ,	reas and cannot be enforced		
			difficult to quantify given		
		barrels. One of the unit that I know of holds 180 liters. Your study issues with lor	ng-term use		
		area includes some commercial, residential and future residential			
		areas. Between Weston/Rutherford/Langstaff and 400 there are a			
		lot of homes. Let say we take for example 10 000 homes and each one uses one water barrel that is equivalent to 1800 000 liters of			
		water. The same could be applied to commercial area where huge			
		warehouses generate a lot of storm water. I strongly believe in			
		community involvement to the point of having the ability of			
		management of water and ability to work with community to control			
		the flow. The benefit will be two fold water conservation and storm			
		water management. I hope you can take this into consideration to			
		be an alternative or part of the solution or part of the new storm			
		water management. With government involvement, initiative and			
		incentive and at times mandatory regulations Canada was able to			
Public Member / Property		accomplished great things. • E-mail sent to Joe Puopolo on May 14, 2009: • Added to proje	oct mailing list		
Public Member / Property Owner # 6		 E-mail sent to Joe Puopolo on May 14, 2009: Please add me to the Study mailing list. I will not be able to attend 	sot mailing list		
oi <i>ii</i> o		the May 20 meeting, but as a land owner in the study area, I would			
		be very interested in being kept apprised of the various issues.			
Public Member / Property		Would like to be notified for continued involvement in the process. Added to project the second se	ect mailing list		
Owner # 7		, and the property of the prop	3		
Public Member / Property		Would like to be notified for continued involvement in the process. Added to project	ect mailing list		
Owner # 8					



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2		
Stakerloider		Comments	Response	Comments	Response	
Public Member / Property Owner # 9		Would like to be notified for continued involvement in the process.	Added to project mailing list			
Public Member / Property Owner # 10		Would like to be notified for continued involvement in the process.	Added to project mailing list			
Public Member / Property Owner # 11		Would like to be notified for continued involvement in the process.	Added to project mailing list			
Public Member / Property Owner # 11		 Requested to be added to the project mailing list and asked fo information on the project. 	Added to project mailing list	PIF #2 Asked for information on the project.	 Information from both Public Open House was sent by the Project Team. 	
Owner # 11		information on the project. I would like to obtain a copy of the presentation. Please forward to the mailing address below.	Display materials provided.	 Asked for information on the project. It has not been demonstrated clearly why the existing Peelar Road culvert is not being upgraded to allow passage of the Regional Storm event similar to the proposed improvements to other existing culverts upstream including the Iceplex driveway, Doughton Road and Highway 7. The proposed open channel (as shown on Figure ALT F4) that will convey the Regional storm flows (between the Iceplex driveway and the existing storm pond at the northeast corner of Highway 7 and Jane Street) needs to be extended further south from the existing Iceplex driveway to the existing 407 culvert, this will therefore contain the regional storm flows and related floodplain such that a significant portion of my lands can be developed, similar to what is proposed upstream of the Iceplex driveway culvert. My lands should be treated fairly and in the same manner. During the August 19th, 2005 rainstorm, there was no flooding that occurred south of the existing culvert from the Iceplex private driveway to the existing culvert at Highway 407. The existing culvert at the Iceplex Driveway was the major problem which caused the significant flooding of Jane Street upstream of this point. This culvert is only 5 to 6 feet in diameter and is not large enough to take even a small rainstorm. There is always debris, garbage and silt that block the flow. This is what caused the major flooding (during the August 2005 storm) of Jane Street upstream from the existing Iceplex culvert, and this is the main reason why the City and TRCA are now undertaking this study and spending hundreds of thousands of dollars. The existing capacity of the culvert at the Iceplex private driveway is severely deficient, it can only pass a 2-year flow, therefore the required improvements to this culvert should be considered as a high priority (as soon as possible) as this is the main reason why Jane Street flooded during the August 19, 2005 storm. Peelar Road t	House was sent by the Project Team. 1. The results of hydraulic (HEC-RAS) modelling undertaken for the Study indicate that the Regional Storm flood depth at the Peelar Road crossing of Black Creek is controlled almost entirely by backwater effects caused by the existing culvert beneath Highway 407. Consequently, the suggested replacement of the Peelar Road culvert with a larger structure or bridge would not reduce the Regional Storm flood depths significantly. 2. As noted, the Regional Storm flood depth at Peelar Road is influenced significantly by the flow constriction at the Highway 407 culvert. As a result, the flood depth in this area would not be reduced by extending the open channel proposed under Alternative F4 to the Highway 407 culvert. 3. The results of hydraulic modelling undertaken as part of the Study indicate that the existing culvert at the Iceplex entrance is drastically undersized and contributed significantly to the cause of flooding during the August 19 th , 2005 storm event. Accordingly, this culvert was identified as a priority for replacement with a larger structure and an evaluation of a range of alternative configurations was subsequently carried out to determine the size of structure necessary to convey the peak flows associated with significant storm events without substantial flooding of adjacent properties and infrastructure. The results of the evaluation indicated that the structures necessary to accommodate the 100-year and August 19 th , 2005 storm events include 5 x 3 m and twin 5 x 3 m box culverts, respectively, while passage of the Regional Storm event will require a bridge crossing. It should also be noted that the hydraulic model developed for Black Creek does not account for blockages at any of the existing culvert structures. Furthermore, the model simulatation carried out for the August 19 th , 2005 storm event was validated using recorded high water marks observed during the storm, which indicates that considerable flooding occurred downstream of the Iceplex culvert.	

Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2		
- Stakenorder		Comments	Response	Comments	Response	
				range of 0.6m higher than what AECOM mapping has identified. This will result in a significant reduction of the resulting flood plain limits along existing Peelar Road and therefore will allow safe access to my property. Please verify the existing grades at Peelar road and re-calculate the flood plain mapping. Additional topographic surveying was carried out to verify existing elevations along Peelar Road. The results of the survey indicate that the elevation of Peelar Road is up to 0.6 m higher than identified on the flood plain mapping provided by TRCA and, as a result, these elevations were not accurately represented in the hydraulic model developed for Black Creek. The hydraulic model has been updated to include the revised topographic data and the resulting flood plain limits have been redelineated. The results of the topographic survey and the corresponding flood plain revisions are shown on the attached Figure 1. As illustrated, the changes to the flood plain limits at Peelar Road are relatively minor, while those upstream and downstream of the roadway generally remain unchanged. 8. It seems that the proposed bridge structures required to pass the Regional Storm flows at Highway 7, Doughton Road and the Iceplex driveway are excessive, the sizes of the bridges was not identified. We suggest two twin concrete box culverts (cast-in-place) approximately 5m x 5m each in size. This improvement should also be recommended for the existing culvert at Peelar Road. 9. What are the proposed Interim Improvements to the existing substandard sections of the Black Creek (existing sections which can only accommodate 2-5 year storm events between Highway 7 and Highway 407) as the preferred alternative can only be addressed as redevelopment occurs (over the next 25 years) since a significant amount of land will be required to construct the proposed open channel along the east limits of Jane Street. This existing section of Black Creek can only accommodate a 2 year storm even and improvements to it should therefore be c	(e.g., photos, high water mark data, etc.), at this location or others within the Study Area. Notwithstanding the above, a recommendation to remove the accumulated debris, trash and sediment from the area upstream of the lceplex culvert will be included in the Master Plan report such that the hydraulic conditions at this location can be improved. 4. As noted above, the lceplex culvert is undersized and cannot accommodate runoff generated by significant storm events, including the August 19 th storm. Accordingly, the measures necessary to improve this culvert are considered to be a priority by the City and the Study Team. As a result, the replacement of this structure was included as part of the evaluation of alternatives to address the flooding issues identified in this area. 5. As noted, the flood depths at the Peelar Road crossing are impacted significantly by backwater effects caused by the Highway 407 culvert and cannot be reduced appreciably through the installation of a larger structure at this location. 6. Although the portion of Jane Street between Interchange Way and Highway 7 is a sag in the roadway and currently within the Regulatory flood plain, the results of hydraulic modelling indicate that the implementation of the proposed flood improvement alternatives for the 100-year, August 19 th and Regional Storm events would significantly improve the flood conditions at this location. As a result, the flood depths at this location would be minor. 7. Additional topographic surveying was carried out to verify existing elevations along Peelar Road. The results of the survey indicate that the elevation of Peelar Road is up to 0.6 m higher than identified on the flood plain mapping provided by TRCA and, as a result, these elevations were not accurately represented in the hydraulic model developed for Black Creek. The hydraulic model has been updated to include the revised topographic data and the resulting flood plain limits have been re-delineated. The results of the topographic survey and the correspo	



Stakeholder	Contact	Notice of Commencement and Notice of PIF #1		Notice of PIF #2		
Stakerioluei		Comments	Response	Comments	Response	
					 8. In order to convey the flows generated by the Regional Storm event, the proposed bridge structures at Highway 7, Doughton Road and the Iceplex entrance must completely span the proposed channel above the corresponding water level elevation at each location (bridge span of approximately 30 – 40 m). Further, the installation of a twin 5 x 5 m box culvert at these locations, as well as at Peelar Road, would not significantly reduce the Regional Storm flood depth. 9. City to provide input. 10. As noted, the replacement of the existing Iceplex culvert with a larger structure would not substantially reduce flood depths on adjacent properties and roads for a significant event such as the August 19th, 2005 storm. City to provide input. 11. City to provide input. 	



Appendix F

Notice of Public Information Forum #1 and Display Materials Presented





AECOM

300 – 300 Town Centre Boulevard, Markham, ON, Canada L3R 5Z6 T 905.477.8400 F 905.477.1456 www.aecom.com

May 7, 2009 Project Number: 108203 - 90057

Dear Sir/Madame:

Re: Notice of Study Public Information Forum - Black Creek Stormwater Optimization Master Plan - Class Environmental Assessment Study

The City of Vaughan, in consultation with the Toronto and Region Conservation Authority, is undertaking a Stormwater Optimization Master Plan Class Environmental Assessment (EA) Study of the Black Creek subwatershed within the City of Vaughan, as shown on the attached Map. The goal of the Study is to determine what stormwater management measures (including source, conveyance and end of pipe controls) can be implemented to improve stormwater runoff quantity and quality, and minimize erosion and flooding potential. The preferred alternative(s) will be determined based on engineering requirements, environmental considerations, and public input received during the Study.

The City has retained AECOM to complete the Master Plan Class EA Study, which is being conducted in accordance with the Master Plan process as outlined in the *Municipal Engineers Association's Municipal Class Environmental Assessment* document (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, an assessment of the problem and opportunities, evaluation of alternative solutions, assessment of potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Opportunities to provide input to the planning and design process is provided throughout the Study. A Notice of Study Commencement inviting initial input was issued on March 05, 2009. To further facilitate public input, two Public Information Forums (PIF) will be scheduled as part of this Study. The first PIF will be held as follows:

Date: May 20, 2009 **Time:** 7:00 pm to 9:00 pm

Location: Black Creek Pioneer Village, South Theatre

1000 Murray Ross Parkway, Toronto, ON M3J 2P3

The purpose of the first PIF is to introduce the project and provide information pertaining to the goals and objectives of the Study, the problems and opportunities to be addressed and the existing conditions in the Study area. Representatives from the City of Vaughan and the consulting team will be available at the PIF to explain the information presented, discuss any issues or concerns you may have, and receive information for consideration as part of the investigations and analyses.

The Study Team is interested in receiving any comments that you may have about the Black Creek subwatershed. Should you have any questions or comments, require further information or wish to be added to the Study mailing list, please contact one of the following Study Team members:

Mr. Saad Yousaf, P.Eng.

City of Vaughan Project Manager

Development/Transportation Engineering Department

2141 Major Mackenzie Drive

Vaughan, ON L6A 1T1

Phone: 905.832.8585, Ext: 8251

Fax: 905.832.6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng.

Project Manager AECOM Canada Ltd.

300 Town Centre Boulevard, Suite 300

Markham, ON L3R 5Z6

Phone: 905.477.8400, Ext. 430

Fax: 905.477.1456

Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the *Freedom of Information and Protection of Privacy Act*. With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Sincerely,

AECOM Canada Ltd.

Joe Puopolo, P.Eng. Project Manager

joe.puopolo@aecom.com

JP:pc

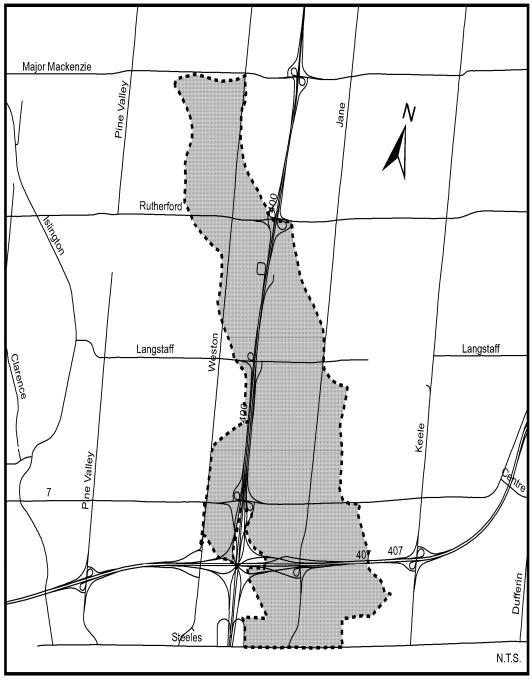
cc: B. Robinson, Commissioner of Engineering and Public Works, City of Vaughan

A. Pearce, Director of Development / Transportation Engineering, City of Vaughan

M. Frieri, Development Supervisor, Engineering Planning & Studies Division, City of Vaughan

S. Yousaf, Project Manager, City of Vaughan





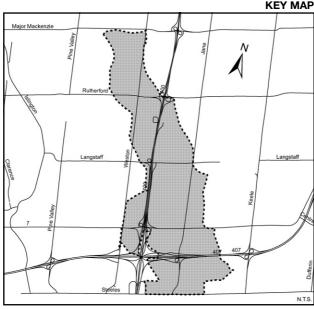
Key Map - Limits of Study Area



Notice of Public Information Forum

Black Creek Storm Water Optimization Master Plan Class Environmental Assessment Study

The City of Vaughan, in consultation with the Toronto and Region Conservation Authority, is undertaking a Storm Water Optimization Master Plan Class Environmental Assessment (EA) Study to determine what storm water management measures (including source, conveyance and end of pipe controls) can be implemented to improve storm water runoff quantity and quality, and minimize erosion and flooding potential in the Black Creek subwatershed within the City of Vaughan as shown on the Key Map below. The preferred alternative(s) will be determined based on engineering requirements, environmental considerations, public input and information gathered during the study.



Limits of Study Area -----

The City has retained AECOM to complete the Master Plan Class EA Study. The Study is being conducted in accordance with the Master Plan process as outlined in the *Municipal Engineers Association's Municipal Class Environmental Assessment* document (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, an assessment of the problem and opportunities, evaluation of alternative solutions, assessment of potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Opportunities to provide input to the planning and design process is provided throughout the Study. A Notice of Study Commencement inviting initial input was issued on March 05, 2009. To further facilitate public input, two Public Information Forums (PIF) have been proposed as part of this Study. The first PIF will be held as follows:

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The Study Team is interested in receiving any comments that you may have about the Study. Should you have any questions or comments, require further information or wish to be added to the study mailing list, please contact one of the following Study Team members:

Mr. Saad Yousaf, P.Eng. City of Vaughan Project Manager Development/Transportation Engineering Department

2141 Major Mackenzie Drive Vaughan, ON L6A 1T1 Phone: 905-832-8585 Ext: 8251

Fax: 905-832-6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng. Project Manager AECOM 300 Town Centre Blvd., Suite 300 Markham, Ontario L3R 5Z6 Phone: 905-477-8400 Ext. 430 Fax: 905-477-1456

Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the *Freedom of Information and Protection of Privacy Act.* With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Andrew Pearce, Director of Development & Transportation Engineering

This notice was issued on May 07, 2009

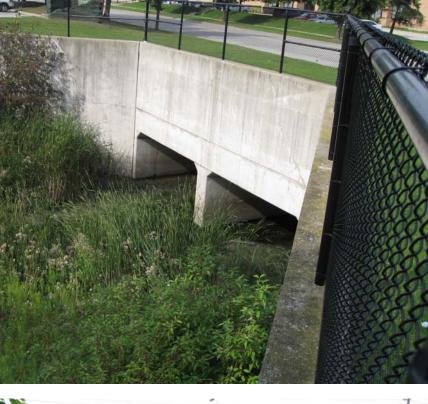














Black Creek Stormwater Optimization Study Master Plan Class Environmental Assessment

Welcome

- ❖ Please sign in on the sheet provided, then feel free to walk around and view the display boards.
- ❖ If you have any questions, our staff will be pleased to discuss the Study with you.
- ❖ Comment sheets are provided for those who wish to provide comments in writing. Please place your completed sheets in the Comment Box or mail/fax them to one of the identified Study Team Members (see below) by June 5, 2009.
- Thank you for your involvement in this project.
- ❖ For additional information, please contact one of the following Study Team Members:

Saad Yousaf, P.Eng.
Project Manager
City of Vaughan
2141 Major MacKenzie Drive
Vaughan, ON L6A 1T1

Tel: 905-832-8585 ext. 8521

Fax: 905-832-6145

E-mail: Saad. Yousaf@vaughan.ca

Joe Puopolo, P.Eng. Project Manager

AECOM

300 Town Centre Boulevard, Suite 300

Markham, ON L3R 5Z6

Tel: 905-477-8400 ext. 430

Fax: 905-477-1456

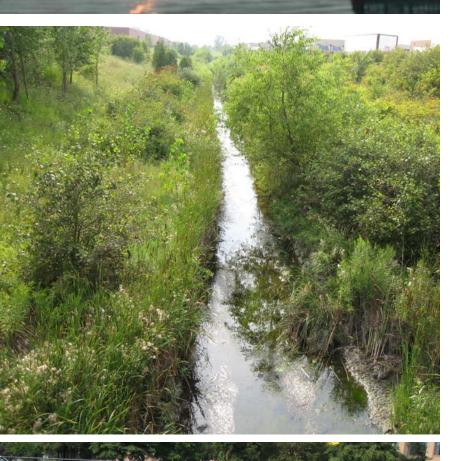
E-mail: Joe.Puopolo@aecom.com















Study Background

- ❖ The City of Vaughan has initiated the Black Creek Stormwater Optimization Study to determine what measures can be implemented to improve stormwater quality and quantity, and minimize erosion and flood potential.
- T HIGHWAY 7
- ❖ The first step of the Study was to characterize the existing conditions within the Study Area through the following tasks:
 - Collection and review of relevant background information;
 - Field investigations to address data gaps; and
 - Geomorphic, hydrologic, and hydraulic analyses.
- ❖ Subsequent to the characterization of existing conditions, the Study Team will identify and evaluate a range of alternative solutions to address the flooding, erosion, and water quality issues observed within the Study Area.
- ❖ This Public Information Forum (PIF) presents the existing conditions, the Problems and Opportunities to be addressed, and the Master Planning process that must be followed as part of the Class Environmental Assessment.

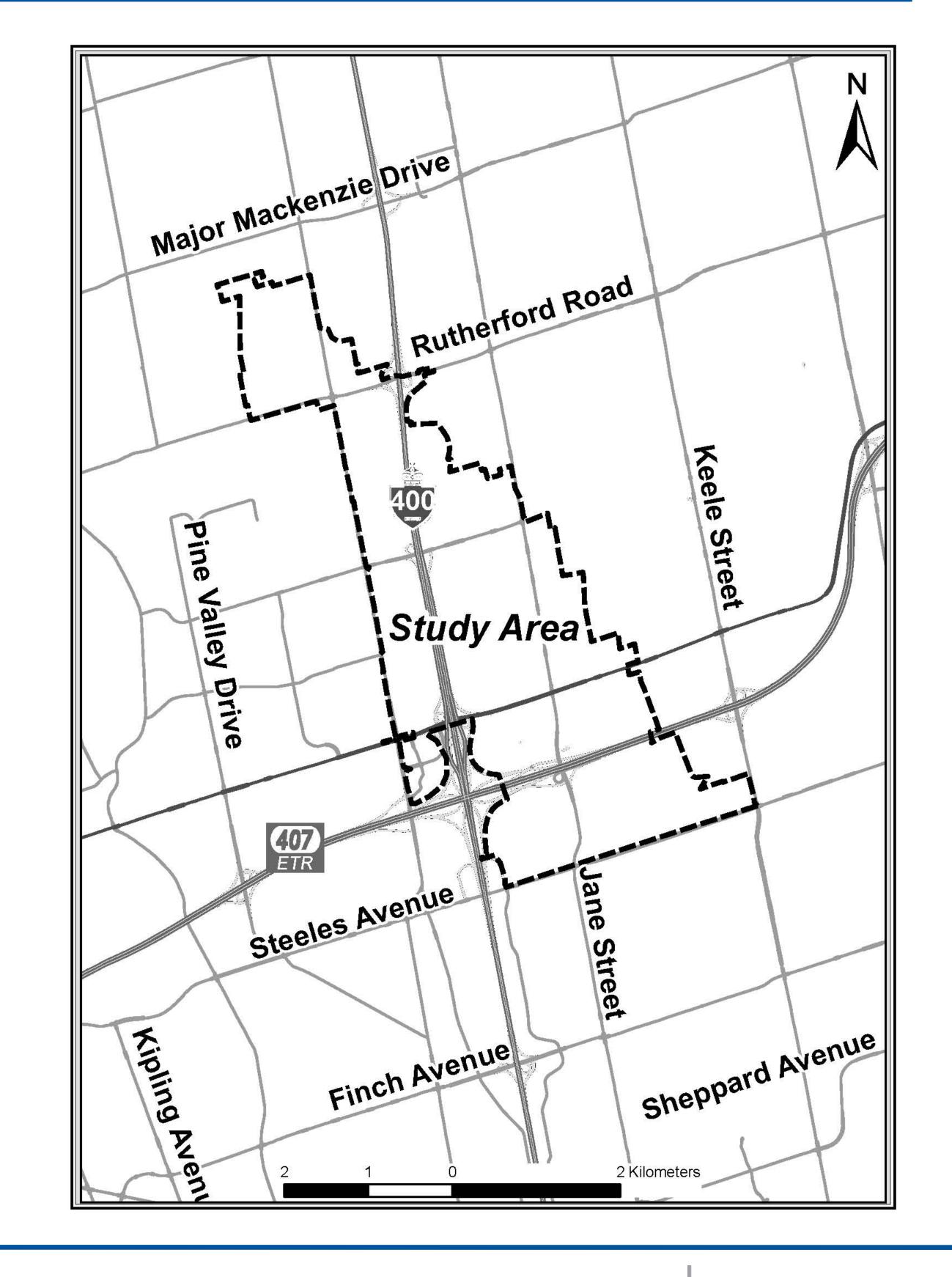






Study Area

- ❖ The Study Area consists of the portion of the Black Creek subwatershed that is located within the City of Vaughan, which covers an area of approximately 1,500 hectares.
- The Black Creek subwatershed comprises a component of the Humber River watershed.
- ❖ The Study Area is almost entirely urbanized, and is zoned predominately for commercial and industrial uses, with some residential areas located north of Rutherford Road.
- ❖ Much of the Black Creek channel north of Highway 7 has been altered through realignment to facilitate development in the past.





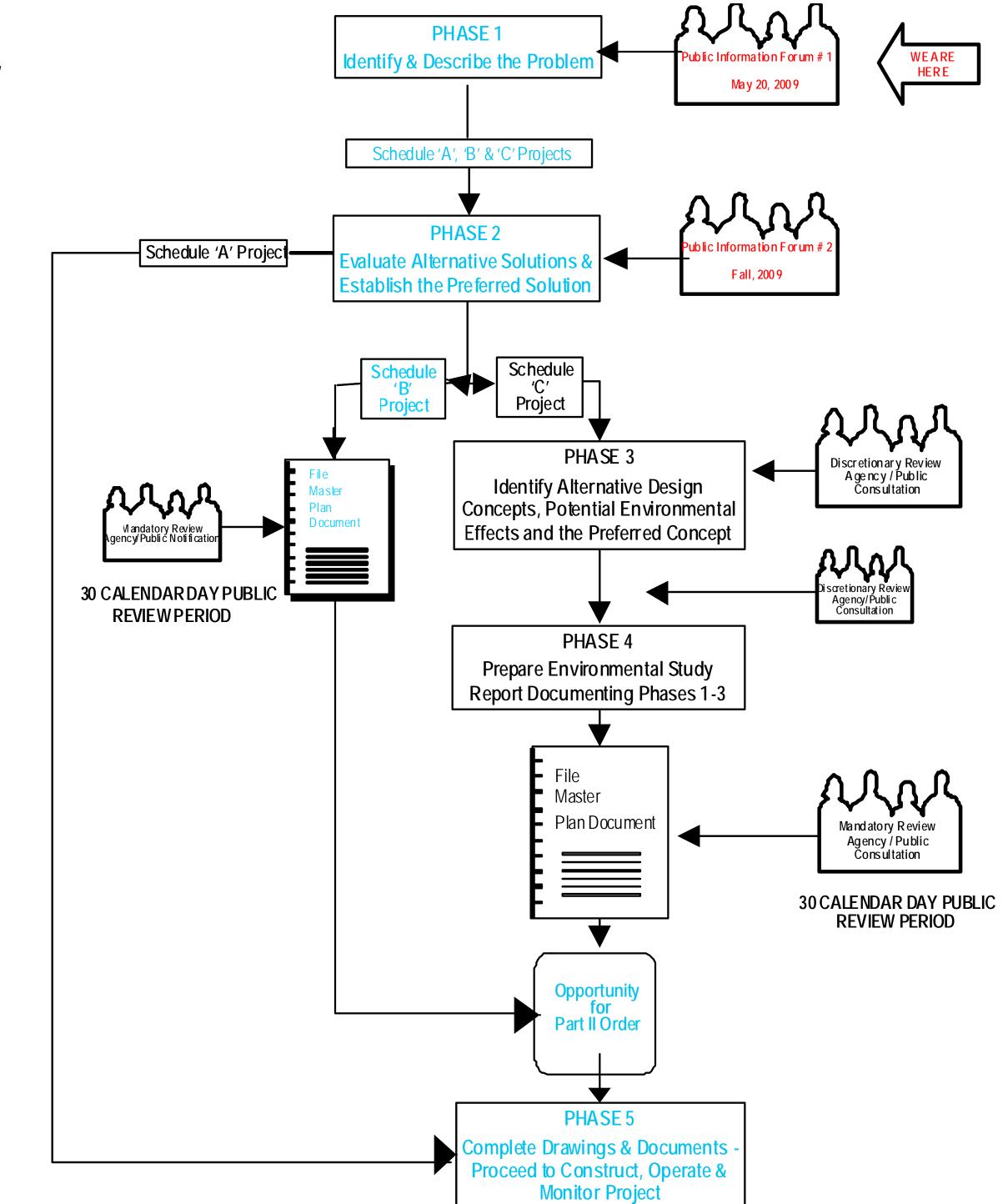






Master Plan Class EA Process

- ❖ This Study is being conducted in accordance with the requirements of the approved *Municipal Engineers Association Class EA* Master Plan process.
- ❖ The Municipal Class EA is approved under the Environmental Assessment Act and enables the planning of municipal infrastructure projects in accordance with an approved procedure designed to protect the environment.
- ❖ The Master Planning process allows for the integration of the Class EA planning principles with the infrastructure requirements for existing and future land uses.
- ❖ The Federal Canadian Environmental Assessment Act (CEAA) is not expected to be triggered as a result of this Study.











Existing Conditions – Land Use



- **❖** Other notable features in the Study Area include:
 - Portions of Highways 400, 407, and 7;
 - CN York Subdivision Railway
 - Vellore Village
 - Beechwood Cemetery
- Current and future development initiatives planned within the Study Area involve the following:
 - OPA 620 Lands
 - Vaughan Corporate Centre
 - TTC Spadina Subway Extension
 - Vellore Urban Village
 - Area between Highway 400 and Weston Road, south of Rutherford Road









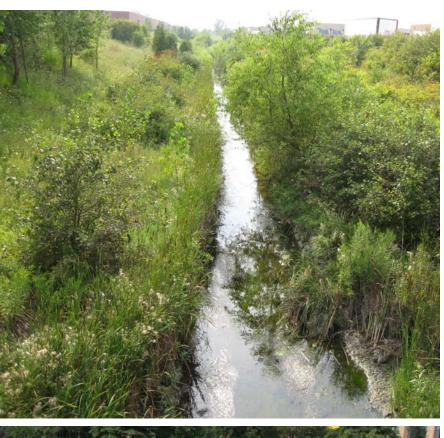


Existing Conditions - Drainage

- ❖ The developed areas within the Study Area are serviced by a municipal storm sewer system, while drainage for undeveloped areas in the southern portion of the Study Area generally occurs as sheet flow that enter into ditches, swales, and tributaries of Black Creek.
- ❖ Development though much of the Study Area has incorporated stormwater management controls, including limited on-site detention and water quality enhancement, as well as a number of end-of-pipe detention facilities.
- Black Creek has been significantly altered north of Highway 7 through multiple realignments undertaken to facilitate development.
- Hydrologic and hydraulic modelling was undertaken to estimate peak flows generated within the Study Area and the resulting water levels in Black Creek for major storm events.















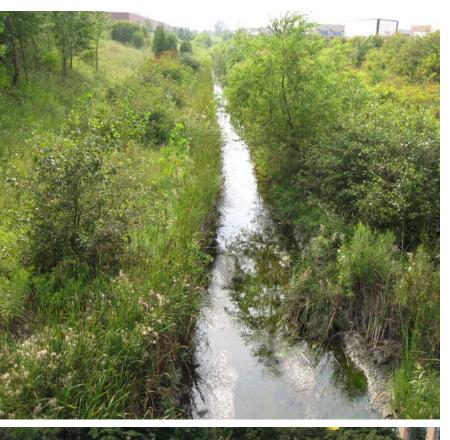


Existing Conditions - Drainage

- The results of field investigations and the subsequent hydraulic analysis carried out as part of the Study indicate the following:
 - The most restrictive segment of Black Creek within the Study Area occurs between Highway 7 and Highway 407, where the channel and culvert capacities generally range from less than a 2-year event to the 100-year event.
 - Many of the buildings along Jane Street and adjacent to the engineered channel between Jane Street and Highway 400 are vulnerable to flooding under the Regional Storm (refer to map).
 - Upstream of Highway 400, the channel and culverts that form Black Creek provide sufficient capacity to convey flows generated by a storm event equivalent to that which occurred on August 19, 2005.
 - The August 19, 2005 storm was greater in intensity than a 100-year event.

















Existing Conditions - Natural Environment

- ❖ Most of the natural cover native to the Study Area (i.e., wooded areas, wetlands, meadows, etc.) has been removed or altered for agricultural purposes, followed by urban development.
- ❖ Natural heritage features in the Study Area are generally confined to the Black Creek valley system, particularly between Steeles Avenue and Highway 407; local natural features exist northeast of Highway 7 and Jane Street, along with a portion of the Vellore Woods.
- ❖ The portion of Black Creek in the Study Area is characterized as a small to intermediate warmwater habitat, and has historically provided habitat for 18 species of fish, including redside dace, white sucker, fathead minnow, creek chub, and rainbow and fantail darter.
- **❖** A number of barriers to fish passage currently exist along Black Creek.
- ❖ Notwithstanding the existing stormwater management measures, water quality is generally poor, as is typical for urban areas, and contains high concentrations of suspended solids, metals, nutrients, and bacteria.
- **❖** Locations of considerable erosion have been observed within the more natural portion of Black Creek between Steeles Avenue and Highway 7 (refer to map).















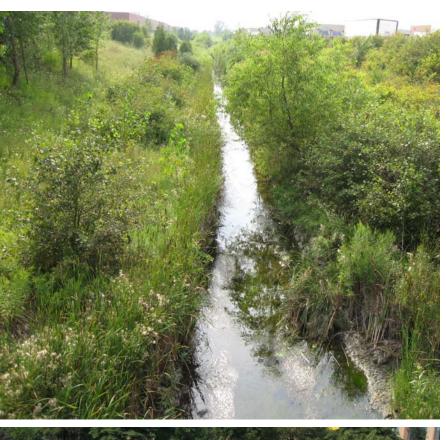


Problems and Opportunities

- ❖ Nothwithstanding the existing stormwater management controls, degraded water quality, flooding of adjacent properties/municipal infrastructure and localized erosion present an ongoing concern with the Study Area.
- ❖ An opportunity exists to develop a comprehensive strategy to improve the water quality of the Creek, and implement appropriate flood control and erosion protection measures for the properties within the Study Area for the benefit of current and future residents of the area while maintaining and enhancing the aquatic and terrestrial habitats.
- ❖ In order to develop and implement a successful strategy, a comprehensive subwatershedbased approach is most appropriate to ensure that the full range of concerns, objectives and potential solutions are recognized and reconciled.











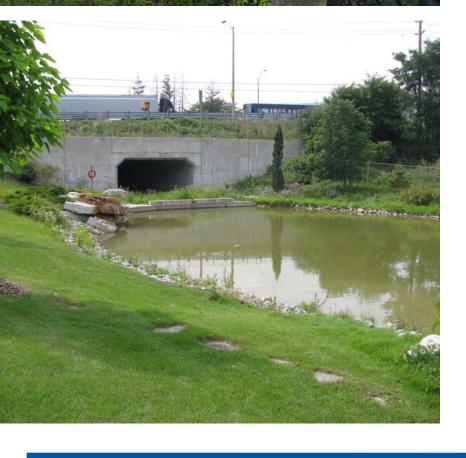












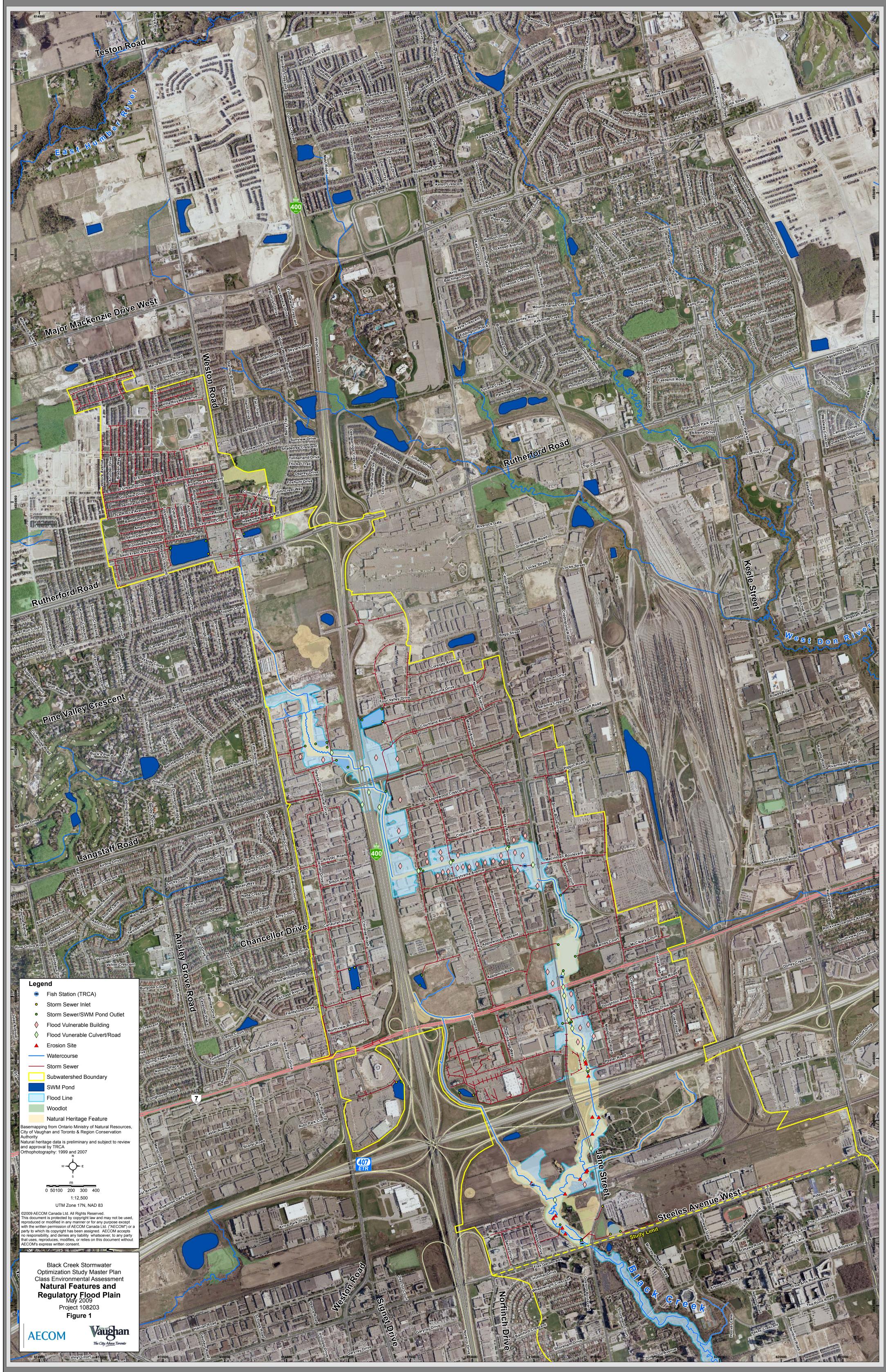
Black Creek Stormwater Optimization Study Master Plan Class Environmental Assessment

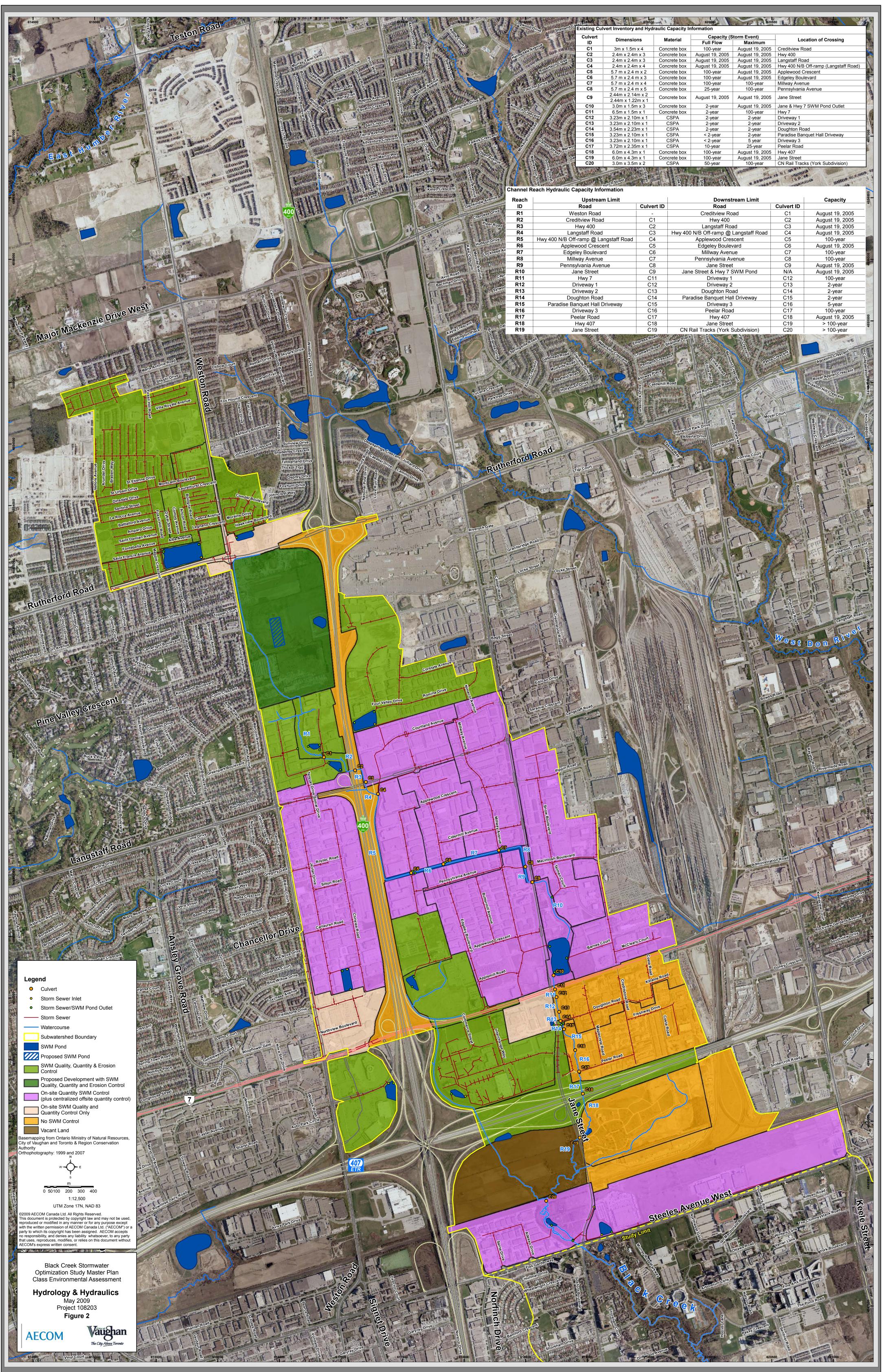
Next Steps...

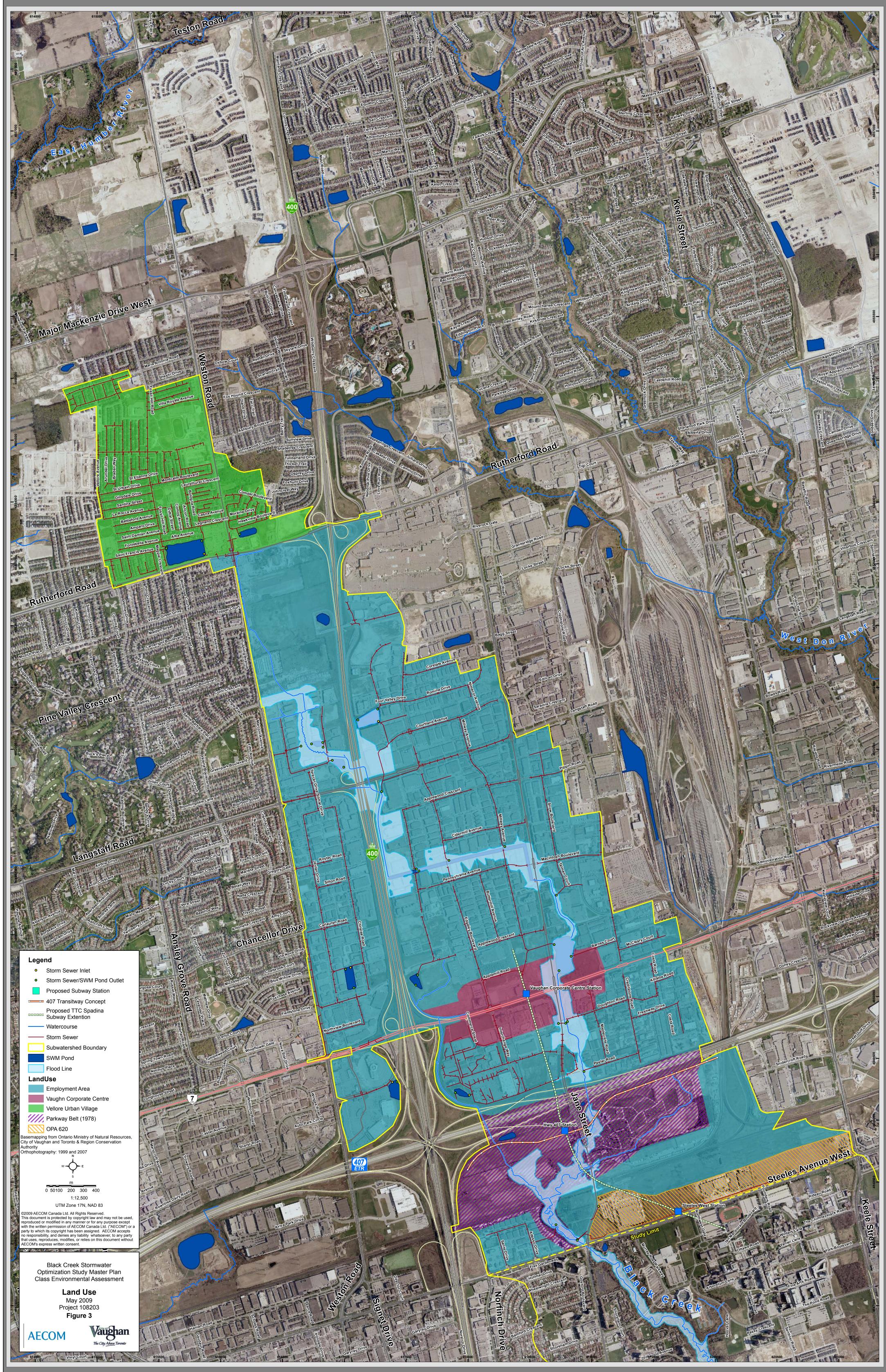
- ❖ A set of alternative solutions and evaluation criteria will be developed to address identified issues, based on the existing conditions observed and the comments received from the public and other stakeholders.
- ❖ The alternative solutions will be evaluated using criteria and indicators developed by the Study Team and a preferred solution will be determined.
- ❖ The evaluation process and the preferred solution will be presented at the second PIF in the Fall of 2009 for comments and input from the public.
- ❖ A Master Plan Document summarizing the study will be prepared and filed for 30 calendar days for agency and public review after the second PIF.
- ❖ Please provide your comments on a comment sheet and place it in the Comment Box, or send it to us by fax, e-mail or mail by June 5, 2009.











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Master Plan Class Environmental Assessment

FIGURE NUMBER 108203 May 2009

PROJECT NUMBER

108203

FIGURE NUMBER

DATE

May 2009

FILE NAME: BLACK CREEK FLOOD

N:\Projects\2009\90057\2009\WorkInProgress\Documents\TRCA Data\Flood Plain Mapping & HEC-RAS\Black Creek flood plain mapping.dwg Layout:Layout2 Plotted: May 19, 2009 @ 12:15pm by walkerj



Appendix G

Notice of Public Information Forum #2 and Display Materials Presented



AECOM 300 – 300 Town Centre Boulevard Markham, ON, Canada L3R 5Z6 www.aecom.com

905 477 8400 tel 905 477 1456 fax

February 19, 2010

Dear Property Owner:

Project No: 60114437 - 90057

Regarding: Notice of Final Public Information Forum -

Black Creek Stormwater Optimization Master Plan

Class Environmental Assessment Study

The City of Vaughan, in consultation with the Toronto and Region Conservation Authority, is undertaking a Stormwater Optimization Master Plan Class Environmental Assessment (EA) Study of the Black Creek subwatershed within the City of Vaughan, as shown on the attached Map. The goal of the Study is to determine the stormwater management measures (including source, conveyance and end-of-pipe controls) that can be implemented to improve stormwater runoff quantity and quality, and minimize erosion and flooding potential within the Study Area. The preferred alternative(s) will be determined based on engineering requirements, environmental considerations, and public input received during the Study.

The City has retained AECOM to complete the Master Plan Class EA Study, which is being conducted in accordance with the Master Plan process as outlined in the *Municipal Engineers Association's Municipal Class Environmental Assessment* document (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, an assessment of the problem and opportunities, evaluation of alternative solutions, assessment of potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Opportunities to provide input to the planning and design process are provided throughout the Study. A Notice of Study Commencement inviting initial input was issued on March 05, 2009 and the first Public Information Forum (PIF) was held on May 20, 2009. The first PIF introduced the project and provided background information pertaining to the goals and objectives of the Study and outlined the problems and opportunities to be addressed. The first PIF also detailed the existing conditions within the Study area. In keeping with the requirements of the Class EA process, the second of two PIFs will be held as follows:

Date: March 11, 2010

Time: 7:00 p.m to 9:00 p.m.

Location: Black Creek Pioneer Village, Weston Theatre

1000 Murray Ross Parkway, Toronto, ON M3J 2P3



The purpose of the second PIF is to present the alternative solutions developed along with their evaluation results. Further, the overall elements of the Master Plan, including the preferred solution, will be presented. Representatives from the City of Vaughan, the Toronto and Region Conservation Authority and AECOM will be available at the PIF to explain the information presented, discuss any issues or concerns you may have, and receive information for consideration in the Study.

The Study Team is interested in receiving any comments that you may have about the Black Creek subwatershed. Should you have any questions or comments, if you require further information or wish to be added to the Study mailing list, please contact one of the following Study Team members:

Mr. Saad Yousaf, P.Eng. City of Vaughan Project Manager 2141 Major Mackenzie Drive Vaughan, ON L6A 1T1

Phone: 905-832-8585 Ext: 8251

Fax: 905-832-6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng., PMP AECOM Project Manager 300 Town Centre Blvd., Suite 300

Markham, ON L3R 5Z6 Phone: 905-477-8400 Ext. 430

Fax: 905-477-1456

Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the *Freedom of Information and Protection of Privacy Act*. With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Sincerely,

AECOM Canada Ltd.

Joe Puopolo, P.Eng., PMP Project Manager

joe.puopolo@aecom.com

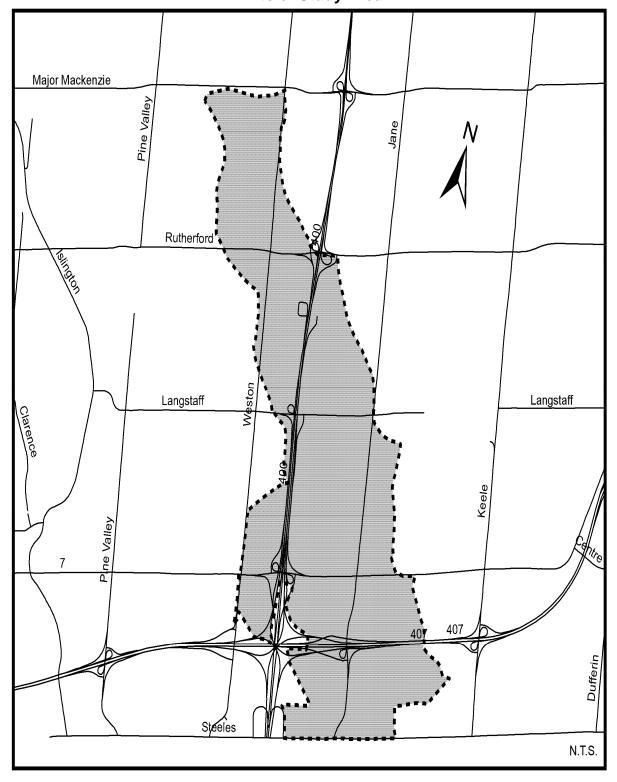
JP:pc Attach.

cc: B. Robinson, Commissioner of Engineering and Public Works, City of Vaughan A. Pearce, Director of Development / Transportation Engineering, City of Vaughan

M. Frieri, Development Supervisor, Engineering Planning & Studies Division, City of Vaughan

S. Yousaf, Project Manager, City of Vaughan

Key Map Limits of Study Area



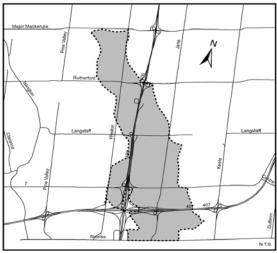




Notice of Final Public Information Forum Black Creek Storm Water Optimization Master Plan Class Environmental Assessment Study

The City of Vaughan in consultation with the Toronto and Region Conservation Authority, is undertaking a Storm Water Optimization Master Plan Class Environmental Assessment (EA) Study to determine the storm water management measures (including source, conveyance and end-of-pipe controls) that can be implemented to improve storm water runoff quality, and minimize erosion and flooding potential in the Black Creek subwatershed within the City as shown on the Study Area map below. The preferred alternative(s) will be determined based on engineering requirements, environmental considerations, public input and information gathered during the study.

STUDY AREA MAP



Limits of Study Area -----

The City has retained AECOM to complete the Master Plan Class EA study. The Study is being conducted in accordance with the Master Plan process as outlined in the Municipal Engineers Association's *Municipal Class Environmental Assessment* document (October 2000, as amended in 2007). The Master Plan Class EA process includes public and review agency consultation, an assessment of the problem and opportunities, evaluation of alternative solutions, assessment of the potential effects on the environment, and identification of reasonable measures to mitigate any adverse effects.

Opportunities to provide input to the planning and design process are provided throughout the Study. A Notice of Study Commencement inviting initial input was issued on March 05, 2009 and the first Public Information Forum (PIF) was held on May 20, 2009. The first PIF introduced the project and provided background information pertaining to the goals and objectives of the Study and outlined the problems and opportunities to be addressed. The first PIF also detailed the existing conditions within the Study area. In keeping with the requirements of the Class EA process, the second of two PIFs will be held as follows:

Date: March 11, 2010

Time: 7:00 p.m. to 9:00 p.m.

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1000 Murray Ross Pkwy, Toronto, ON M3J 2P3

The purpose of the second PIF is to present the alternative solutions developed along with their evaluation results. Further, the overall elements of the Master Plan, including the preferred solution will be presented. Representatives from the City of Vaughan, the Toronto and Region Conservation Authority and AECOM will be available at the PIF to explain the information presented, discuss any issues or concerns you may have, and receive information for consideration in the Study. You will also be presented with the Study schedule and the next steps.

Comments and information regarding this project are being collected by the Study Team in accordance with the requirements of the *Ontario Environmental Assessment Act*. If you wish to receive information or to be added to the study mailing list, please contact one of the following Study Team members:

Mr. Saad Yousaf, P.Eng. City of Vaughan Project Manager 2141 Major Mackenzie Drive Vaughan, ON L6A 1T1

Phone: 905.832.8585, Ext: 8251

Fax: 905.832.6145

Email: saad.yousaf@vaughan.ca

Mr. Joe Puopolo, P.Eng., PMP AECOM Project Manager 300 Town Centre Blvd., Suite 300 Markham, ON L3R 5Z6 Phone: 905.477.8400, Ext. 430

Fax: 905.477.1456

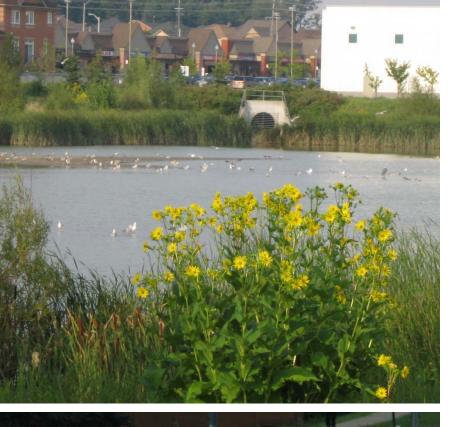
Email: joe.puopolo@aecom.com

Please note that information related to this Study will be collected in accordance with the *Freedom of Information and Protection of Privacy Act*. With the exception of personal information, all comments received will become part of the public record and may be included in Study documentation prepared for public review.

Andrew Pearce, Director of Development & Transportation Engineering
This notice was issued on February 25, 2010

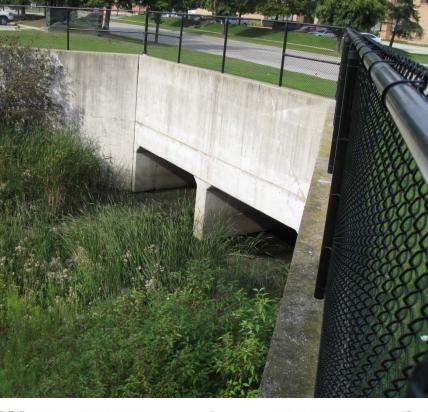














Welcome

- ❖ Please sign in on the sheet provided, then feel free to walk around and view the display boards.
- ❖ If you have any questions, our staff will be pleased to discuss the Study with you.
- **❖** Comment sheets are available for those who wish to provide comments in writing. Please place your completed sheet in the Comment Box or mail/fax it to one of the identified Study Team Members (see below) by March 26, 2010.
- Thank you for your involvement in this project.
- ❖ For additional information, please contact one of the following Study Team Members:

Saad Yousaf, P.Eng.
Project Manager
City of Vaughan
2141 Major MacKenzie Drive
Vaughan, ON L6A 1T1
Tol. 205 222 2525 2xt 2524

Tel: 905-832-8585 ext. 8521

Fax: 905-832-6145

E-mail: Saad. Yousaf@vaughan.ca

Joe Puopolo, P.Eng., PMP

Project Manager

AECOM

300 Town Centre Boulevard, Suite 300

Markham, ON L3R 5Z6

Tel: 905-477-8400 ext. 430

Fax: 905-477-1456

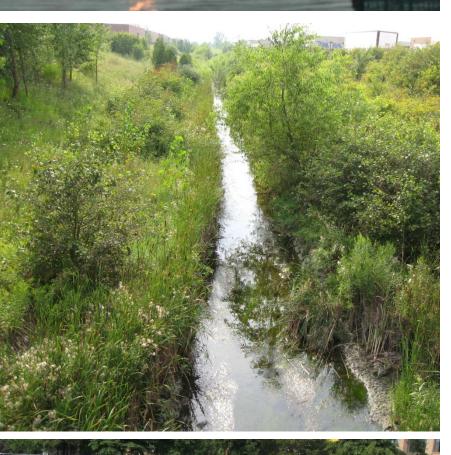
E-mail: Joe.Puopolo@aecom.com















Study Background

- ❖ The City of Vaughan has initiated the Black Creek Stormwater Optimization Master Plan Class EA Study to determine what measures can be implemented to improve stormwater quality and quantity, and minimize erosion and flood potential.
- ❖ The first step of the Study was to characterize the existing conditions within the Study Area through the collection of relevant background information, field investigations and technical analyses (i.e., hydrology, hydraulics, natural environment, geomorphology).



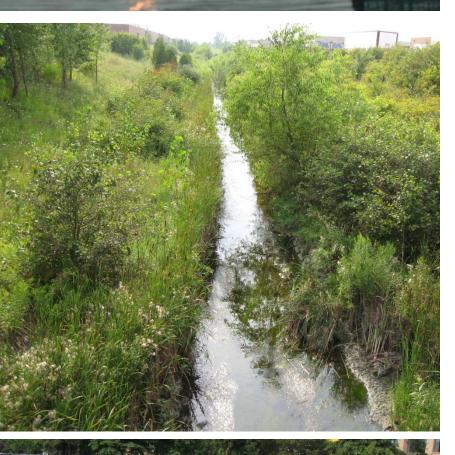
- ❖ Following the characterization of existing conditions, the Study Team has identified and evaluated a range of alternative solutions to address the flooding, erosion, and water quality issues observed within the Study Area.
- ❖ The purpose of this Public Information Forum (PIF) is to present the alternative solutions developed to address these issues, the evaluation methodology and the preferred Master Plan strategy, as well as to provide an opportunity for the public and government agencies to comment on the current undertaking.









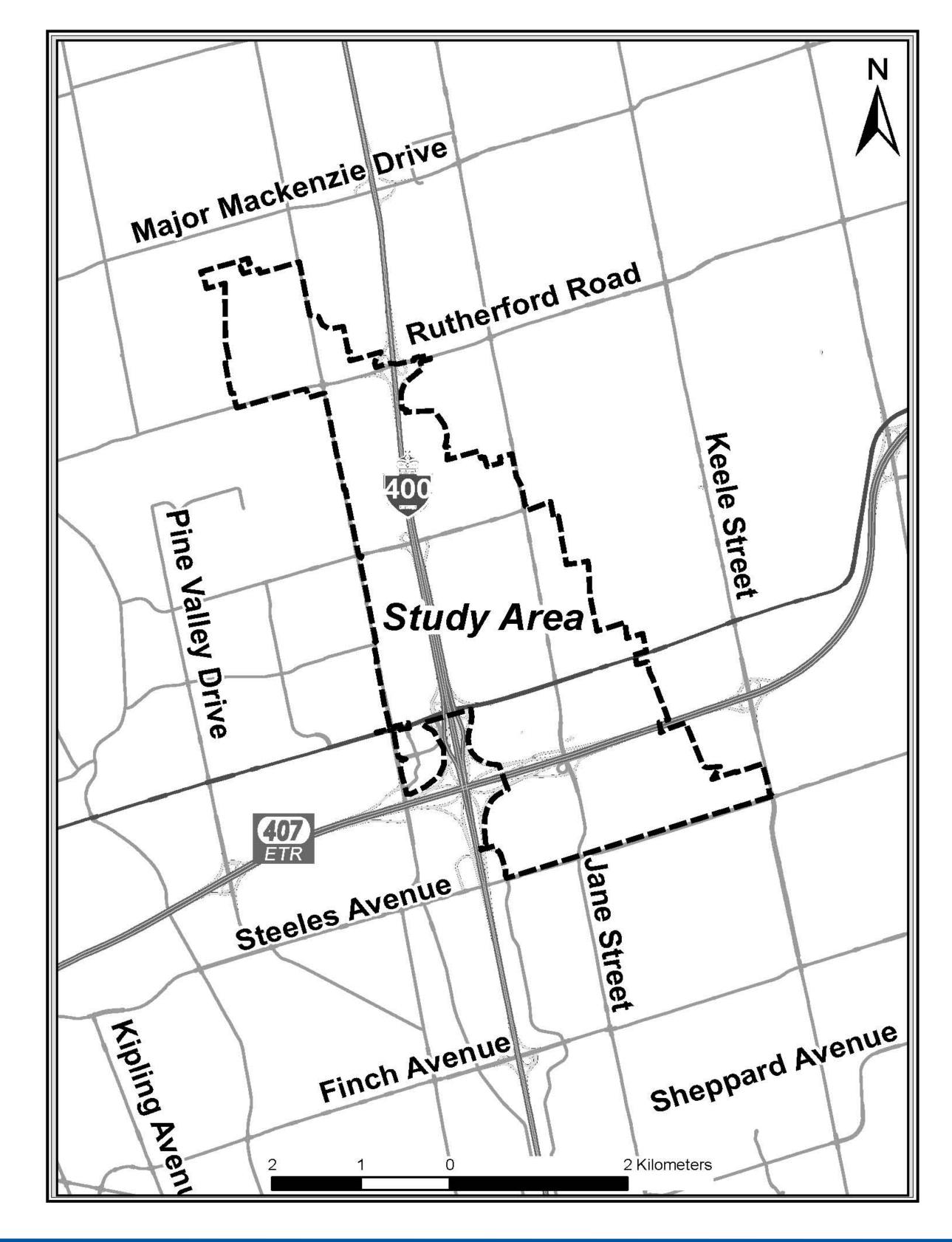






Study Area

- ❖ The Study Area consists of the portion of the Black Creek subwatershed that is located within the City of Vaughan, which covers an area of approximately 1,500 hectares.
- The Black Creek subwatershed comprises a component of the Humber River watershed.
- ❖ The Study Area is almost entirely urbanized, and is zoned predominately for commercial and industrial uses, with some residential areas located north of Rutherford Road.
- ❖ Much of the Black Creek channel north of Highway 7 has been altered through realignment to facilitate development in the past.

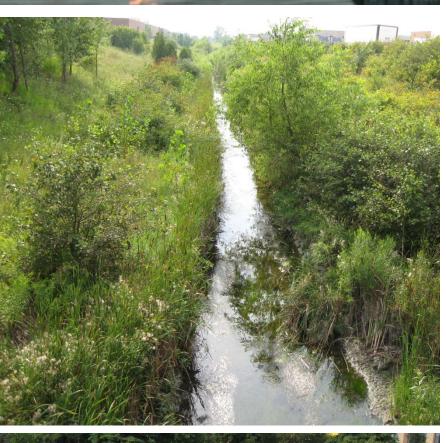










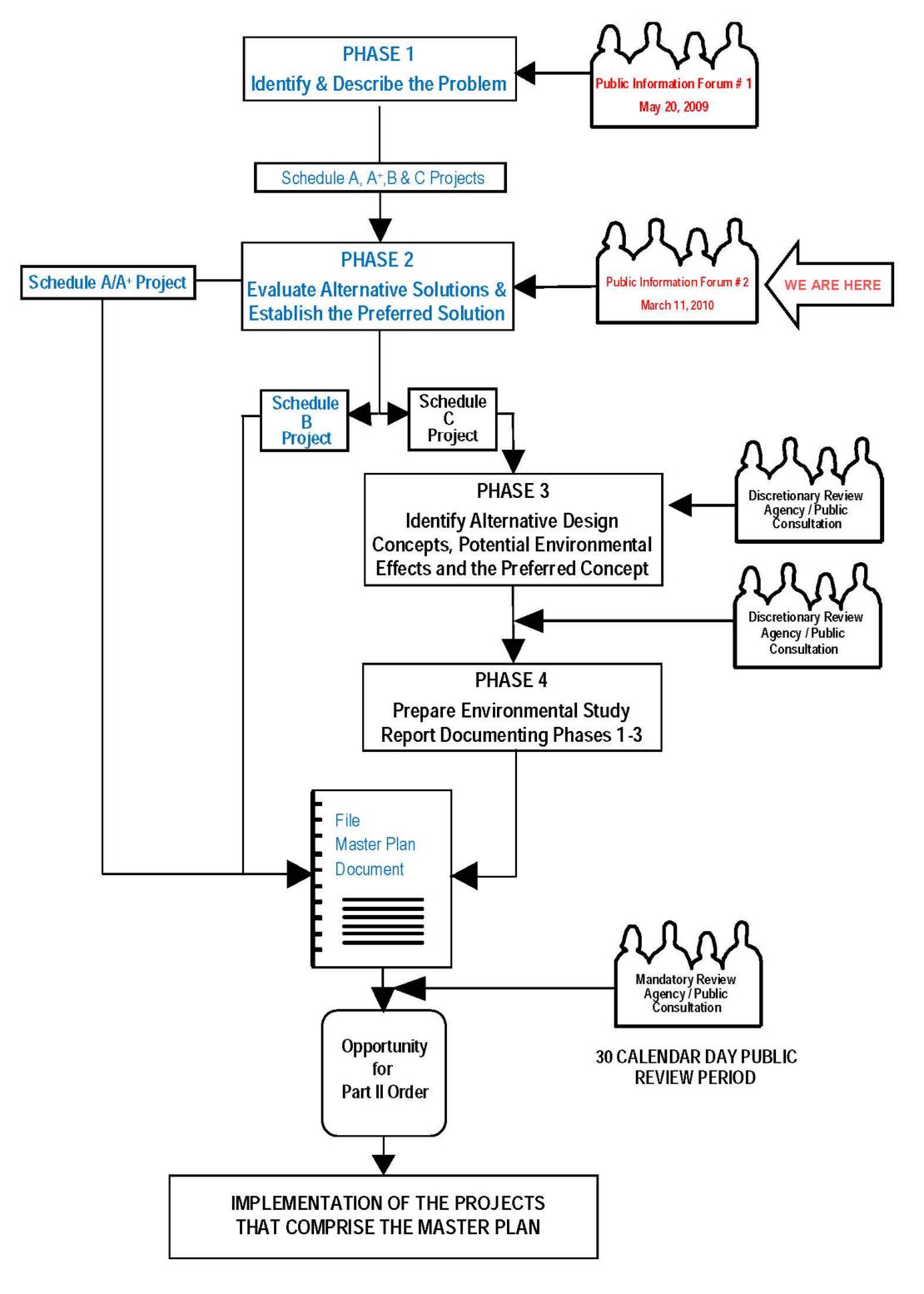






Master Plan Class EA Process

- ❖ This Study is being conducted in accordance with the requirements of the approved *Municipal Engineers Association Class EA* Master Plan process.
- ❖ The Municipal Class EA is approved under the Environmental Assessment Act and enables the planning of municipal infrastructure projects in accordance with an approved procedure designed to protect the environment.
- ❖ The Master Planning process allows for the integration of the Class EA planning principles with the infrastructure requirements for existing and future land uses.
- ❖ The Federal Canadian Environmental Assessment Act (CEAA) is not expected to be triggered as a result of this Study.



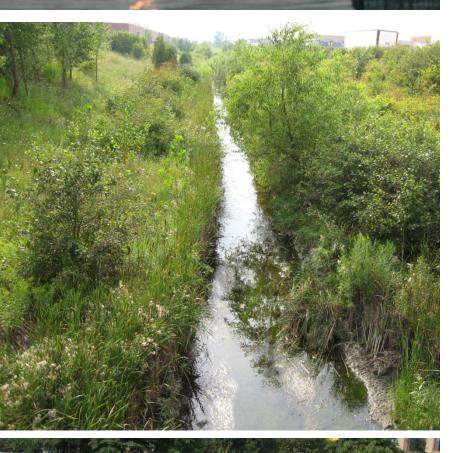
NOTE: Municipal Class EA process followed for the current study is highlighted in blue.









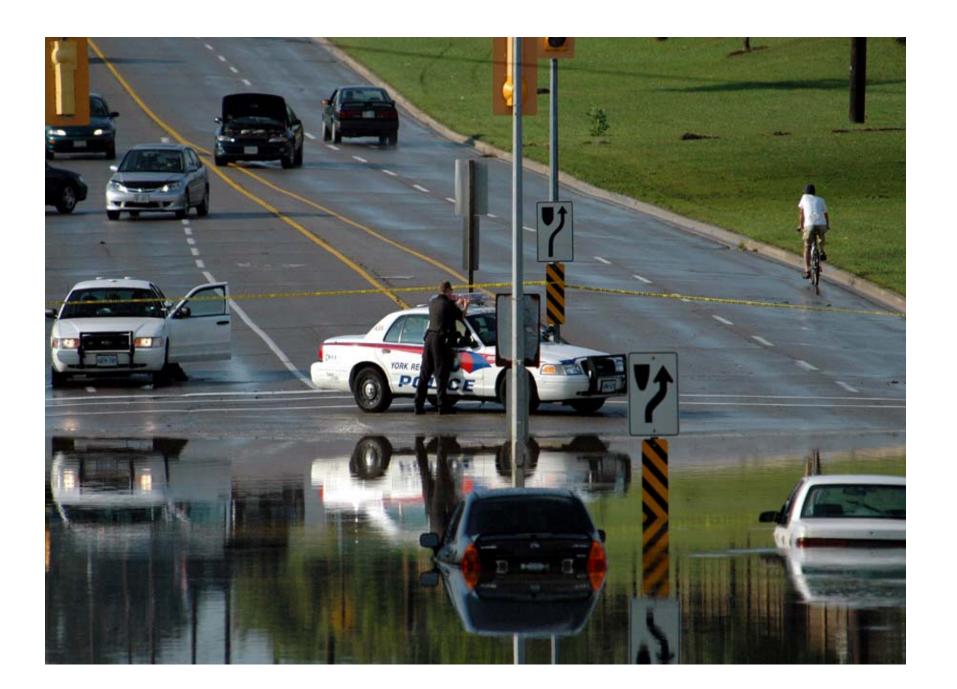






Problems and Opportunities

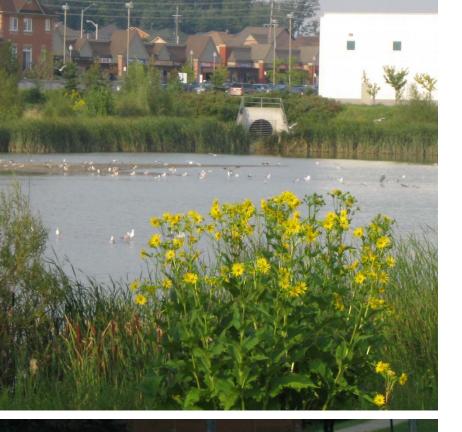
- ❖ Notwithstanding the existing stormwater management (SWM) controls, development through significant portions of the Study Area occurred prior to the adoption of modern SWM practices. The inclusion of lot level, conveyance and end-of-pipe facilities has not prevented localized flooding and erosion or degraded water quality.
- ❖ In addition, a number of proposed development initiatives are scheduled for implementation within the Study Area, which must be considered as part of this Study. Therefore, further to addressing the current flooding, erosion and water quality issues, the Study also examined the implications of future development within the upper Black Creek subwatershed.



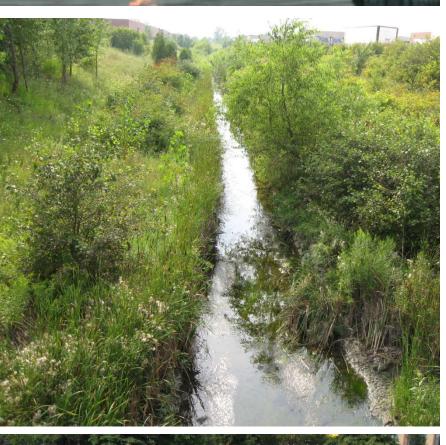
- ❖ An opportunity exists to develop a comprehensive strategy that will implement appropriate flood control and erosion protection works for the properties within the Study Area as well as measures to improve the water quality of Black Creek, while maintaining and enhancing the aquatic and terrestrial habitats.
- ❖ In order to develop and implement a successful strategy, a comprehensive subwatershed-based approach is most appropriate to ensure that the full range of concerns, objectives and potential solutions are recognized and reconciled.















Identification of Alternative Solutions - Flood Improvements

- ❖ The proposed flood improvements strategy consists of a combination of remedial measures and recommendations for further investigations, as shown on Figure 1.
- ❖ The alternatives developed to address flooding of buildings, roadways and municipal infrastructure along the portion of Black Creek adjacent to Jane Street are described below and illustrated on the associated Figures.

Alternative F1 - Do Nothing: No improvements would be implemented and the status quo would be maintained.

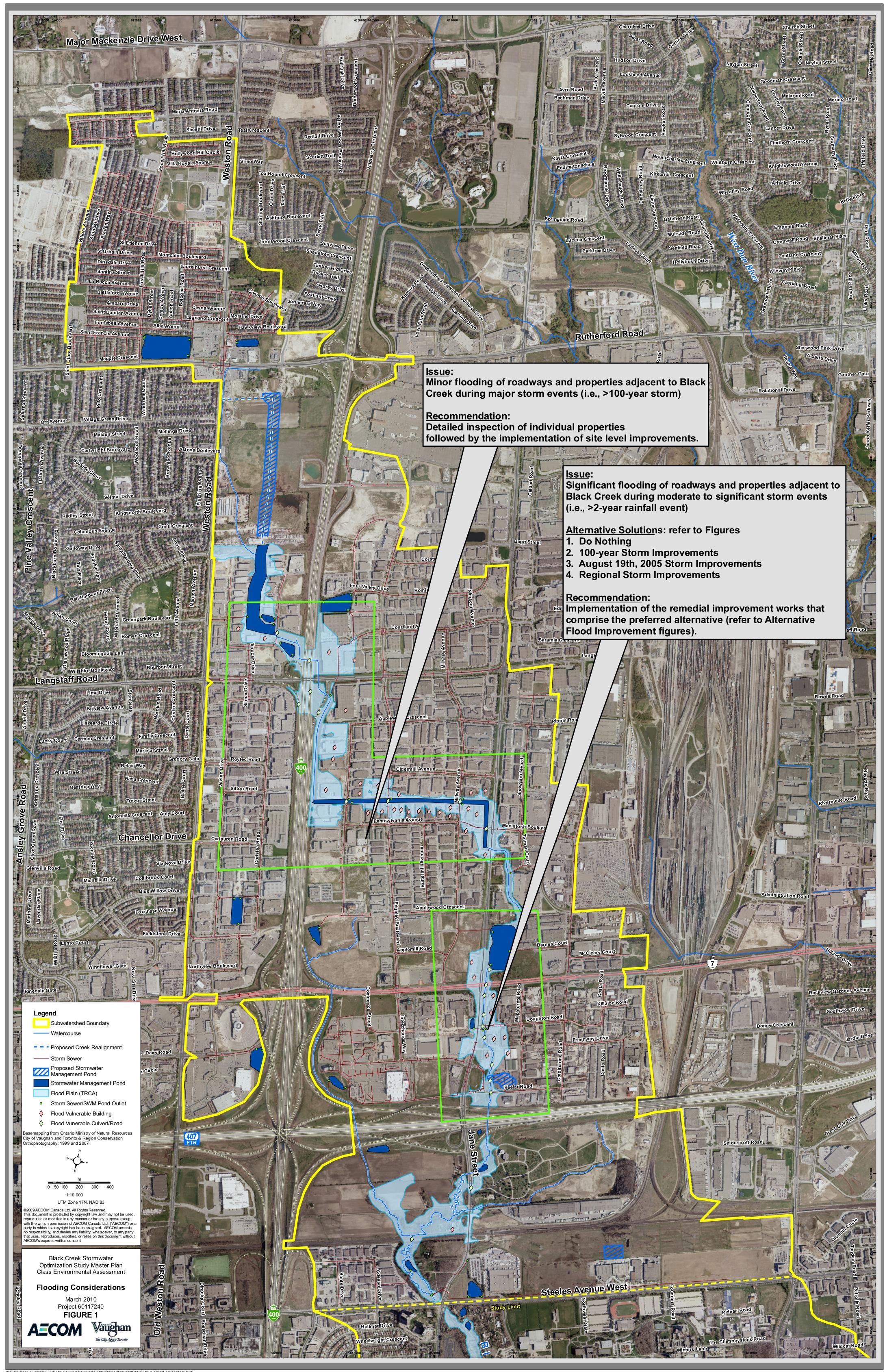
<u>Alternative F2</u> – 100-Year Storm Improvements: The objective of this alternative is to provide sufficient capacity within Black Creek to convey the runoff generated by a 100-Year storm event. The proposed works involve the replacement of two existing culverts with 5x3 m concrete box structures (or equivalent).

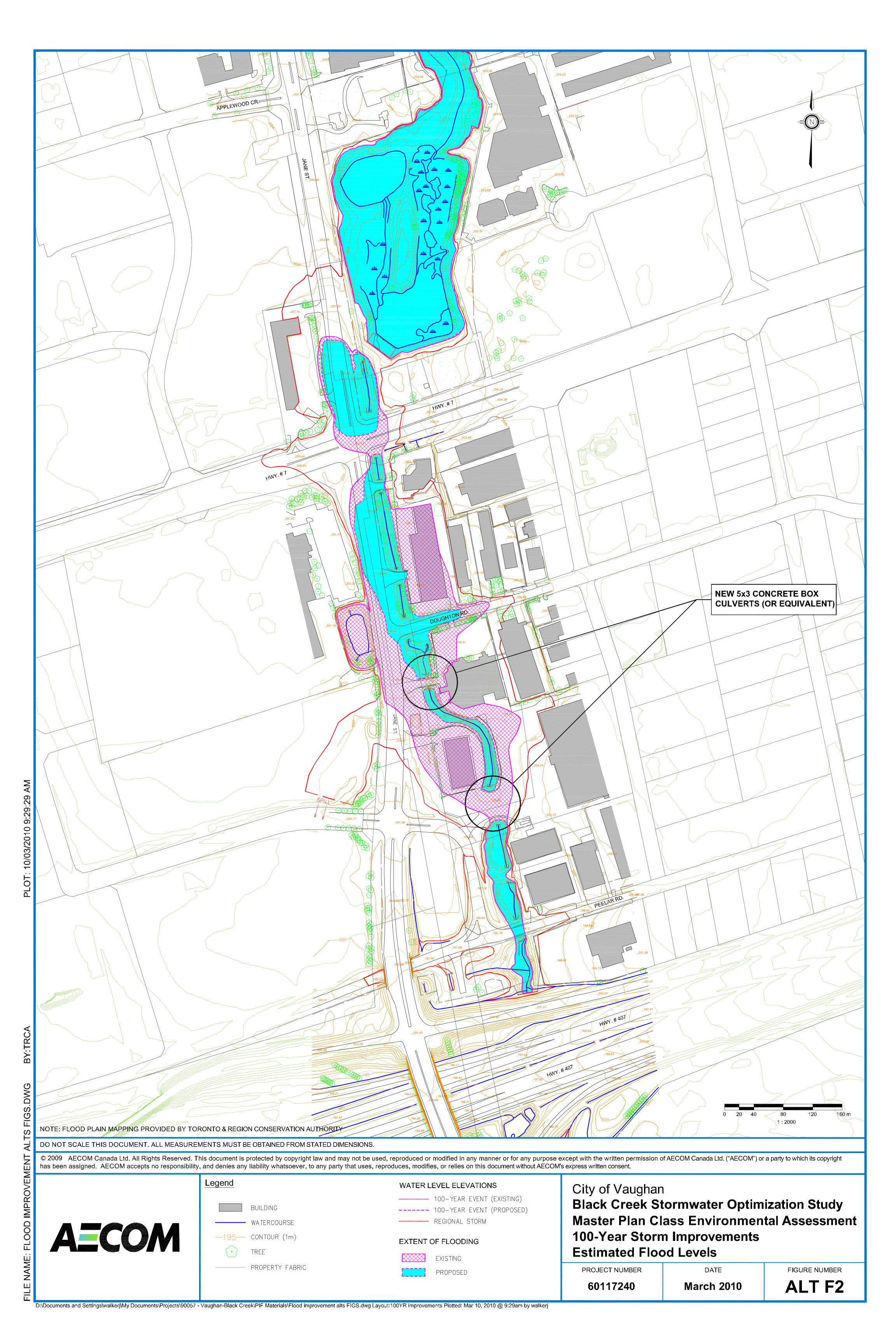
<u>Alternative F3</u> – August 19th, 2005 Storm Improvements: The objective of this alternative is to provide sufficient capacity within Black Creek to convey the runoff generated by the August 19th, 2005 storm event. The proposed works involve the replacement of three existing culverts with twin 5x3 m concrete box structures (or equivalent).

<u>Alternative F4</u> – Regional Storm Improvements: The objective of this alternative is to provide sufficient capacity within Black Creek to convey the runoff generated by the Regional Storm (Hurricane Hazel), thereby accommodating the future development of the Vaughan Metropolitan Centre (VMC). The proposed works involve the construction of a new naturalized channel to replace the existing segment of Black Creek between Peelar Road and the Edgeley Pond outlet structure, with bridges at all roadway crossings.

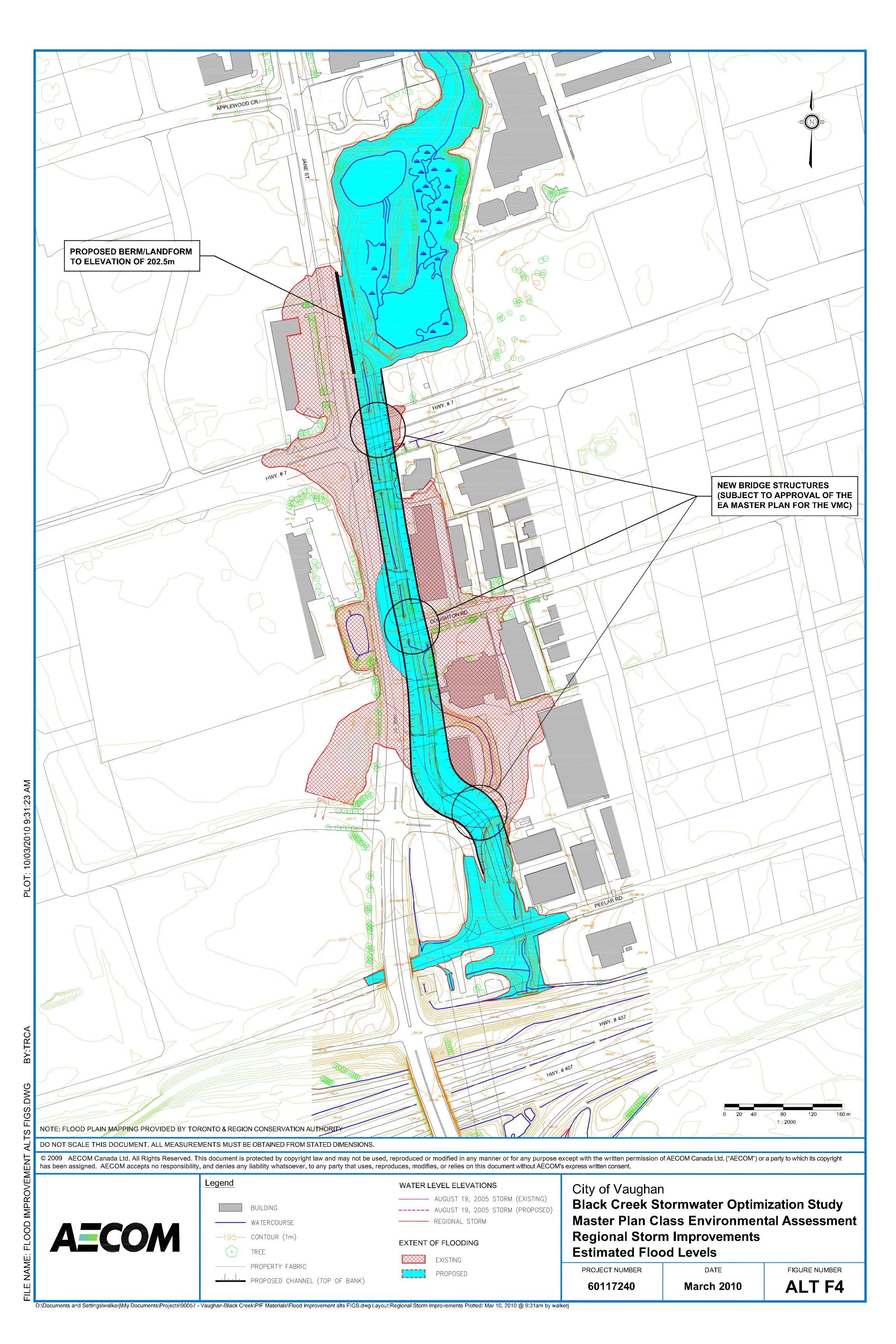


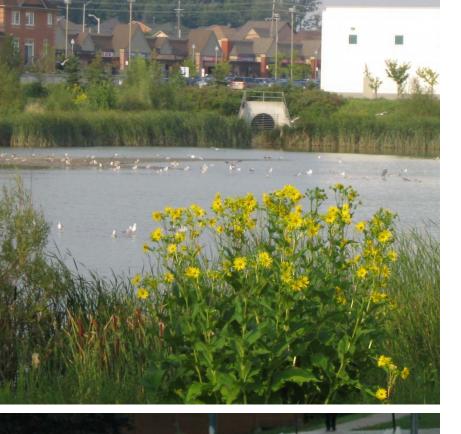




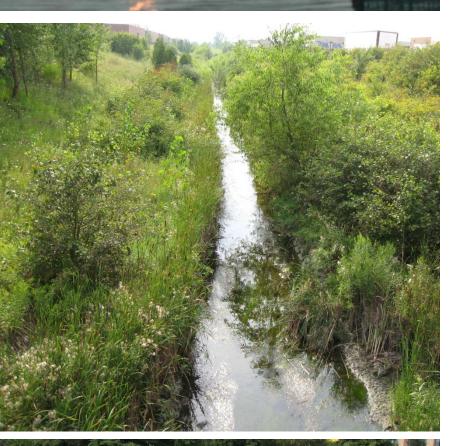














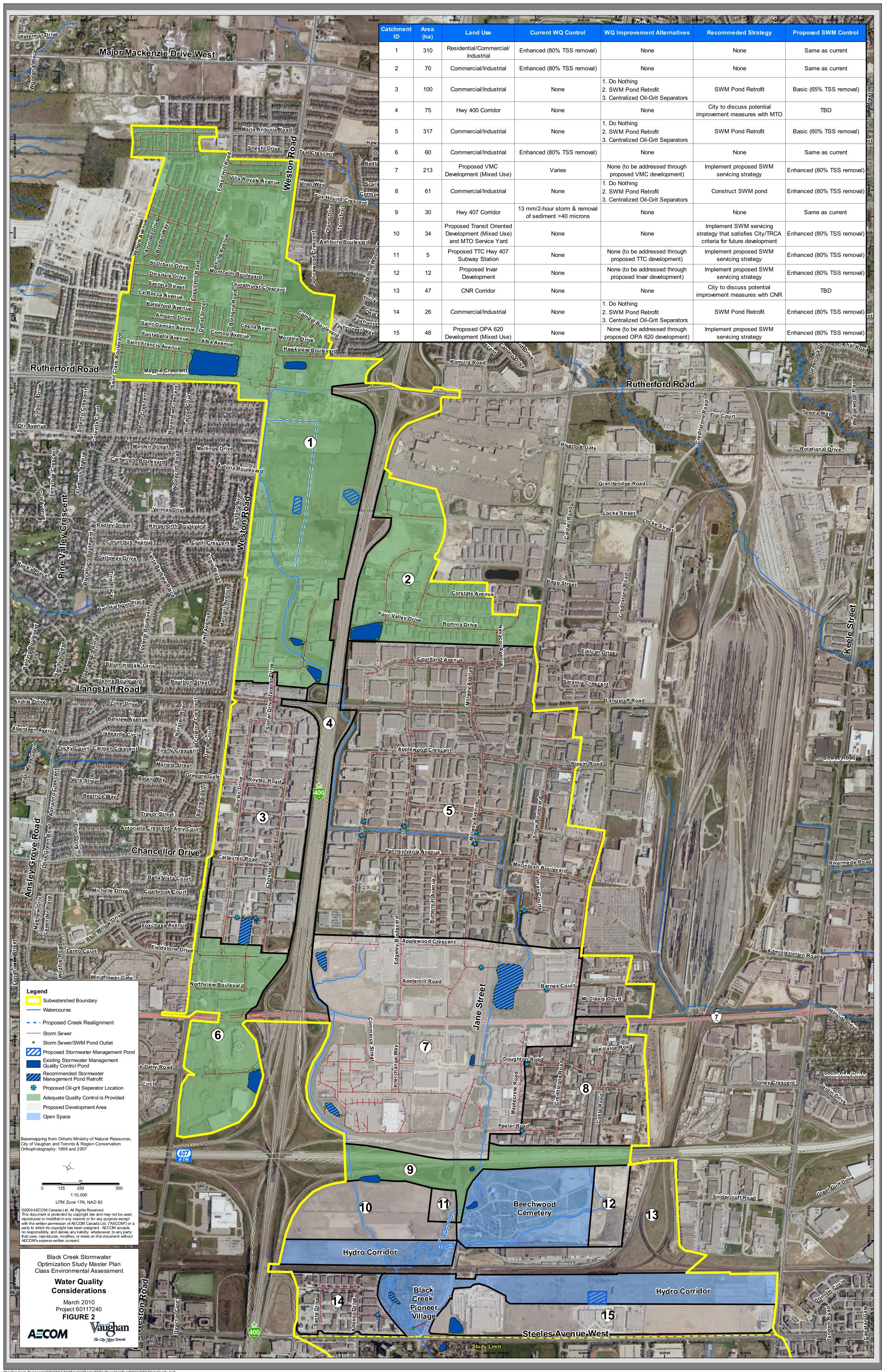


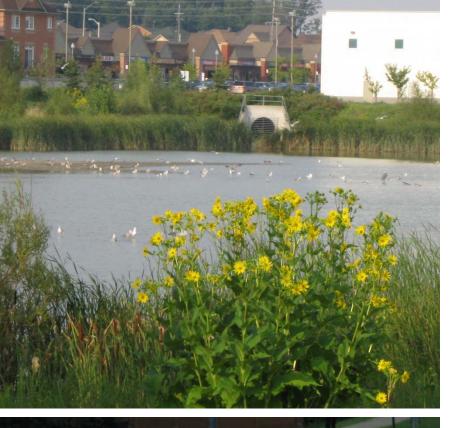
Identification of Alternative Solutions - Water Quality Improvements

- ❖ As indicated on Figure 2, the level of water quality protection currently provided varies widely across the Study Area. Many of the older industrial areas were developed prior to the adoption of modern stormwater management (SWM) practices and, accordingly, provide limited or no water quality enhancement.
- ❖ In order to improve the quality of runoff contributing to Black Creek, several enhancement measures were considered for catchment areas that do not currently provide suitable water quality control measures.
- The proposed water quality improvement measures include:
 - Alternative WQ1 Do Nothing: No improvements would be implemented and the status quo would be maintained.
 - Alternative WQ2 SWM Quality Ponds: Additional quality control would be incorporated through:
 - i. Retrofit of existing SWM ponds;
 - ii. Further expansion of the existing SWM ponds to be retrofitted as part of the VMC and OPA 620 development initiatives to provide treatment for external areas; and
 - iii. Construction of a new SWM pond to service the VMC development, which will provide treatment for external areas.
 - Alternative WQ3 Centralized Oil-Grit Separators: Additional quality control would be incorporated through:
 - i. Installation of centralized oil-grit separators within City lands; and
 - ii. Retrofit of existing SWM ponds and construct a new SWM pond to service the VMC development.

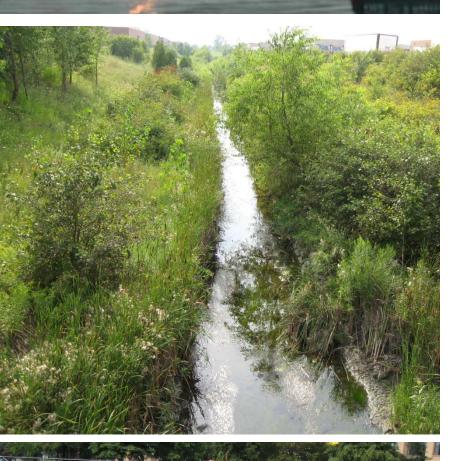
















Identification of Alternative Solutions - Channel Erosion Improvements

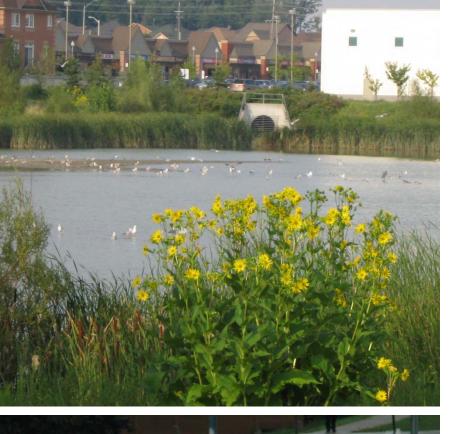
- Bed and bank erosion is widespread along the natural reaches of the Black Creek channel and its tributaries (refer to Figure 3).
- ❖ In order to address the channel erosion issues observed within the Study Area, the following improvement alternatives were identified:
 - Alternative E1 Do Nothing: No improvements would be implemented and the status quo would be maintained.
 - <u>Alternative E2</u> Additional SWM Control: This alternative involves the implementation of additional SWM measures to provide erosion protection through further lot level, conveyance and end-of-pipe controls.
- Alternative E3 In-stream Restoration Strategies: The objective of this alternative is to address erosion issues through the implementation of in-stream restoration measures.
- ❖ The above-described alternatives for channel erosion improvement measures were screened to ensure that each is technically feasible and addresses the problem/opportunity statement. Alternatives E1 and E2 are not technically feasible and cannot address the channel erosion issues identified within the Study Area and, therefore, were not considered for further evaluation.
- ❖ Accordingly, Alternative E3 In-stream Restoration Strategies has been included as a component of the preferred solution for the Master Plan.



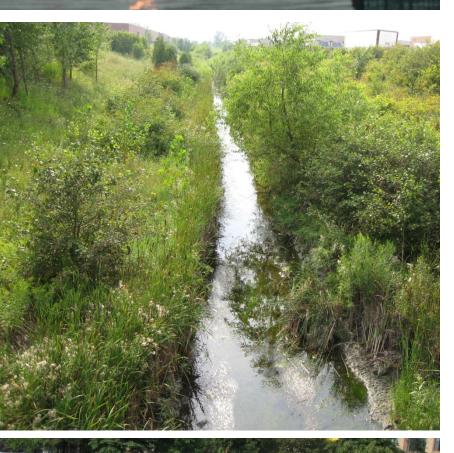




Erosio Site	n Reach	Erosion Observations	Cause of Erosion	Recommended Restoration Strategy	Lead Organization	Cost Estimate	Priority
ES1	1	Significant erosion is occurring along outer bank of meander near the existing storm sewer outfall and cobblestone deflector.	Natural erosion along outer bank of meander, with concentrated flow near the edge of the outflanked cobblestone deflection berm.	Replace rip-rap deflection berm with cobble riffle, construct flow retarding bars along upstream end of meander and install brush mattress along eroding bank.	City of Vaughan (in consultation with landowner - TRCA)	\$30,000 - 50,000	Low
ES2	1	Undercutting of bank has resulted in the collapse of an old wooden fence into the channel.	Natural erosion along outer bank of meander is causing undercutting and subsequent collapse of fence.	Remove collapsed segment of fence from channel and install live stakes along eroding bank.	City of Vaughan (in consultation with landowner - TRCA)	\$10,000	Low
ES3	1	Gabion baskets along west bank near SWM pond overflow spillway have been undermined and are collapsing into channel.	Degradation (down-cutting) and natural erosion along outer bank of meander, exacerbated by periodic pond overflow.	Remove gabion baskets, re-grade bank to match adjacent portions of the channel and install live stakes.	City of Vaughan (in consultation with landowner - TRCA)	\$10,000 – 20,000	Medium
ES4	1	Discontinuous rip-rap and filter cloth lining banks have narrowed channel and exacerbated bank erosion.	Increased velocities through narrow channel, and local flow obstructions have concentrated flow along banks.	Remove rip-rap and filter cloth, restore bank and install live stakes along bank.	City of Vaughan (in consultation with landowner - TRCA)	\$10,000 – 20,000	Low
ES5	1	Erosion is occuring along ~2m high outer bank of meander.	Erosion along outer bank of meander is the result of natural fluvial processes.	No restoration proposed, given natural fluvial process and no immediate risk to public safety or property.	N/A	N/A	N/A
ES6	West Tributary	Erosion of gravel road embankment causing the transport of fill material into channel and localized bed scour at outlet of culvert.	Surface runoff has formed rills and outflow from perched culvert is causing incised gully into gravel road embankment.	Install erosion blankets on the road fill embankments and increase plantings along the lower portion of the downstream embankment to help trap sediment.	City of Vaughan (in consultation with landowner - MEI, as part of proposed development)	\$10,000	Low
ES7	2	Erosion along the outer bank of the meader at the toe of the CN Rail embankment, where channel is forced to bend sharply westward.	Trajectory of flow from upstream segment of bed-armoured channel is angled directly into railway embankment.	Install and monitor erosion pins along outer bank of meander to determine the rate of erosion, followed by the implementation of appropriate erosion protection measures.	City of Vaughan (in consultation with landowner - CN Rail)	\$10,000 – 15,000	High
ES8	2	Improperly placed boulders, debris and cobble weirs have exacerbated local bank erosion.	Boulders, debris and cobble weirs have reduced the channel capacity and are deflecting flow into un-armoured portions of banks.	Remove the flow-obstructing materials from the channel to increase capacity and consider the installation of bioengineering measures along un-armoured banks.	City of Vaughan (in consultation with landowner - MEI, as part of proposed development)	\$20,000 – 40,000	Low
ES9	2	High valleyside cut-bank is gradually being undercut along outer meander bank, above which private property extends to the crest of the slope.	Degradation (down-cutting) and natural erosion along outer bank of meander, exacerbated by local bed steepness and seepage from lower valley-side.	Install and monitor erosion pins along outer bank of meander to determine the rate of erosion, followed by the implementation of appropriate erosion protection measures.	City of Vaughan (in consultation with landowner - MEI, as part of proposed development)	\$10,000 – 15,000	High
ES10	2	High valleyside cut-bank below a Hydro One transmission tower is gradually being undercut along the outer bank of a meander.	Natural erosion along outer bank of meander.	The proposed realignment of Black Creek to facilitate the TTC Spadina Subway Extension project (Hwy 407 station) will address the erosion issues identified at this location.	Toronto Transit Commission	To be funded by TTC	Medium
ES11	2	Erosion along outer bank of meander, at the edge of a farm access driveway and residential property.	Natural erosion along outer bank of meander.	The proposed realignment of Black Creek to facilitate the TTC Spadina Subway Extension project (Hwy 407 station) will address the erosion issues identified at this location.	Toronto Transit Commission	To be funded by TTC	Low
ES12	East Tributary	Considerable erosion is occurring along the northern bank of the channel, approximately 1m from the base of an existing Hydro One tower.	Degradation (down-cutting), widening and local retrogressive erosion (head-cutting).	The proposed realignment of Black Creek to facilitate the TTC Spadina Subway Extension project (Hwy 407 station) will address the erosion issues identified at this location.	Toronto Transit Commission	To be funded by TTC	High
ES13	3	Localized bank instability along the berm between the channel and Beechwood Cemetery pond.	Natural widening of historically narrowed and straightened channel segment.	Realign and re-size the channel in the vicinity of the pond and protect the berm from future erosion through installation of geotextile and rip-rap.	City of Vaughan (in consultation with landowner - Beechwood Cemetery)	\$75,000 – 100,000	High
ES14	3	Erosion is occuring along ~2m high outer bank of meander.	Degradation (down-cutting) and natural erosion along outer bank of meander.	No restoration proposed, given natural fluvial process and no immediate risk to public safety or property.	N/A	N/A	N/A
ES15	3	Minor erosion is occurring along the toe of the valley-side, above which the eastbound on-ramp to Hwy 407 is set back ~30m.	Natural erosion along the toe of the steep valley-side.	Install and monitor erosion pins along outer bank of meander to determine the rate of erosion, followed by the implementation of appropriate erosion protection measures.	City of Vaughan (in consultation with landowner - MTO)	\$10,000	Low
ES16	4	Severe undercutting of alternate banks, which has caused the banks to collapse and the creation of obstructions to flow.	Degradation (down-cutting) of banks, which has led to channel entrenchment and thalweg sinuosity within the historically straightened reach.	Install and monitor erosion pins along outer bank of meander to determine the rate of erosion, followed by the implementation of appropriate erosion protection measures.	City of Vaughan (in consultation with landowner)	\$10,000 – 15,000	Medium
ES17	4	Gabion basket retaining wall has been undermined by scouring of the channel bed, which has resulted in significant structural instability.	Degradation (down-cutting) and erosion of foundation soils of the gabion basket retaining wall.	Geotechnical assessment to be carried out, followed by the replacement of the retaining wall structure and the construction of a stable pool-riffle sequence within the channel.	City of Vaughan (in consultation with landowner)	\$350,000	High
ES18	4	An unused road crossing has been overtopped and breached by floods, resulting in partial channel blockage by rubble, debris and fallen trees and inundation of a mature forest upstream of the crossing.		habitats are restored.	City of Vaughan (in consultation with landowner)	\$50,000 – 75,000	Low











Evaluation Methodology

- ❖ A set of alternative solutions and evaluation criteria has been developed to address identified issues, based on the existing conditions observed and the comments received from the public and other stakeholders.
- ❖ The alternative solutions have been evaluated using criteria and indicators developed by the Study Team, as described below, in order to determine the preferred solution.
 - <u>Technical</u> Having regard for the technical suitability/longevity, and other engineering aspects of the alternative solution.
 - Natural Environment Having regard for protecting the natural and physical components of the environment (i.e., air, land, water and biota), including natural and/or environmentally sensitive areas.
 - Social Environment Having regard for residents, neighbourhoods, businesses, community character, social cohesion and community features.
 - Cultural Environment Having regard for historical/archeological remains and heritage features.
 - Financial Having regard for the capital and future costs of the alternative solution.
- ❖ The assessment criteria established for each of the above-noted categories were used to comparatively evaluate the alternative solutions, where appropriate, and identify a recommended solution for each through a net effects analysis.



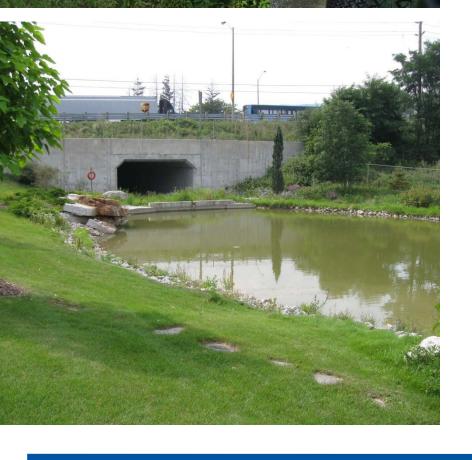












Components of the Preferred Solution

The preferred solution consists of a combination of the recommended improvement alternatives selected to address the flooding, water quality and erosion issues identified within the Study Area.

Issue	Preferred Solution	Rationale	Estimated Cost
Flooding	Alternative F4 – Regional Storm Improvements The objective of this alternative is to provide sufficient capacity within Black Creek to convey the runoff generated by the Regional Storm (Hurricane Hazel), thereby accommodating the future development of the Vaughan Metropolitan Centre.	Although this alternative has the highest capital, property acquisition and annual operations & maintenance (O&M) costs, it is the only alternative that addresses the problem and opportunities defined for the Study.	\$13,000,000
Water Quality	 Alternative WQ2 – SWM Quality Ponds The objective of this alternative is to provide additional quality control where necessary, and would be incorporated through the following measures: Retrofit existing SWM ponds; Further expansion of the existing SWM ponds to be retrofitted as part of VMC and OPA 620 to provide treatment for external areas; and Construction of a new SWM pond to service VMC, which will provide treatment for external areas. 	Although this alternative involves moderate capital, and annual O&M costs, a high potential for the need to acquire property, and a moderate potential for effects on the natural environment, it is the most effective alternative for addressing the problem and opportunities defined for the Study.	\$11,000,000
Channel Erosion	Alternative E3 – In-stream Restoration Strategies The objective of this alternative is to address erosion issues through the implementation of in-stream restoration measures.	As indicated, this is the only alternative that is technically feasible and addresses the problem and opportunity defined for the Study.	\$750,000

Note: Estimated costs for the implementation of the preferred solution to address each of the identified issues do not include property acquisition costs.

❖ A summary of the comparative evaluation carried out to select the preferred solution for the proposed flooding and water quality improvements is provided on Tables 1 and 2.















SWM Criteria for Future Development

In addition to the proposed improvement alternatives being considered to address the ongoing flooding, water quality and channel erosion issues in the Study Area, the following SWM criteria are proposed for future development.

Target Criteria	Small New/Infill Development (i.e., area < 5 ha)	Large New Development (i.e., area > 5 ha)	
Quality Control	Enhanced level of protection (i.e., 80% TSS removal), as per MOE Stormwater Management Planning and Design Manual (2003).		
Quantity Control	Control post-development flows to pre-development levels for all storms up to and including the 100-year storm event, as per the Unit Flow Equations prescribed for the Humber River Watershed.		
Erosion Control	At a minimum, runoff from a 5 mm storm must be retained on- site, which can be achieved through the Water Balance criteria.	At a minimum, runoff from a 25 mm storm must be detained for at least 48 hours.	
Water Balance	A minimum of 5 mm of rainfall must be retained on-site through BMPs for low impact development.	Retain stormwater on-site to the extent practical to maintain predevelopment annual runoff volume. A minimum of 5 mm of rainfall must be retained on-site through BMPs for low impact development.	

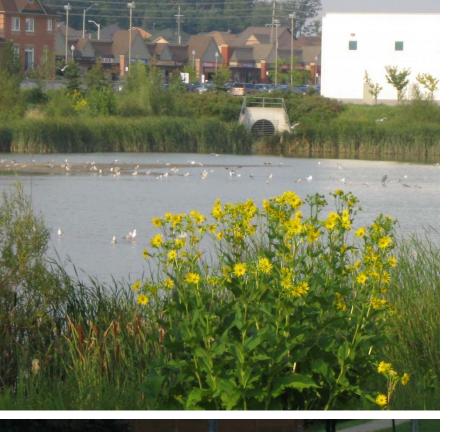
Notes: 1. Proposed SWM criteria for future development based on the requirements and guidance provided by TRCA, MOE, and the City of Vaughan.

- 2. TRCA's SWM criteria are currently being updated and are subject to change.
- ❖ Proposed Best Management Practices (BMPs) that are recommended to satisfy the above-noted SWM criteria are described in the Low Impact Development SWM Planning and Design Guide (CVC/TRCA, 2010) and the Stormwater Management Planning and Design Manual (MOE, 2003), and include:
 - On-site SWM facilities (i.e., wet/dry ponds)
 - Green roofs
 - Rooftop/parking lot storage
 - Rainwater harvesting

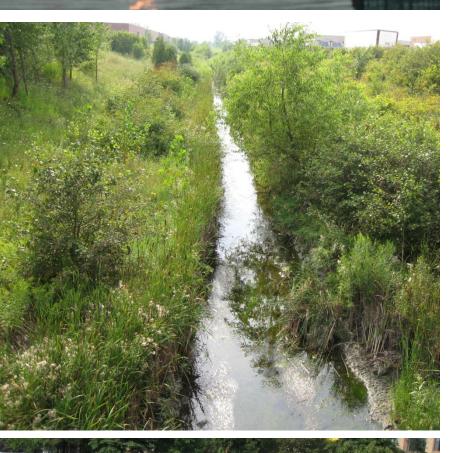
- Infiltration facilities (i.e., basins, chambers)
- Enhanced grass swales
- Bioretention facilities
- Pervious pavement















Next Steps...

- ❖ In order to confirm the preferred solution, comments from this PIF will be considered along with those received from review agencies. Please provide your comments on a comment sheet and place it in the Comment Box, or send it to us by fax, e-mail or mail by March 26, 2010.
- **❖** A Master Plan Document summarizing the study will be prepared and filed for 30 calendar days for agency and public review after this PIF.
- ❖ Review agencies and the public will be notified of the completion of the Study at the appropriate time in order to review the Master Plan Document.
- ❖ Should you have any questions or concerns, please contact either of the Project Managers.
- ❖ If you feel after consulting with the City of Vaughan or AECOM that your concerns remain unresolved, you can make a request to the Minister of the Environment to require that the project comply with Part II of the *Environmental Assessment Act* before proceeding. This request must be submitted in writing to the Minister and copied to the City of Vaughan before the end of the 30-day review period.
- ❖ If there are no outstanding Part II Order requests at the end of the 30-day review period, the City of Vaughan may proceed with implementing the Schedule A/A⁺ and B elements outlined in the Master Plan.
- ❖ All Schedule C undertakings must complete Phases 3 and 4 of the Class EA process prior to implementation.







Appendix H

Black Creek Gabion Retaining Wall – Visual Inspection Memorandum (August, 2010)



Memorandum

То	Joe Puopolo, P.Eng.	Page 1	
CC	Jim Walker, P.Eng., Jovan Vu	kotic, P.Eng.	
Subject	Visual Inspection Report – Black Creek Gabion Retaining Wall		
From	Behnam Mehraie, P.Eng. (AE	COM)	
Date	August 17, 2010	Project Number 60117240	

As part of the *Black Creek Stormwater Optimization Study*, the City of Vaughan has requested that AECOM carry out a visual inspection of the gabion wall located at the northeast corner of Jane Street and Peelar Road along the east bank of Black Creek.

A site inspection was completed on July 7, 2010, by structural and water resources engineering staff of AECOM. The observations from the inspection as well as structural recommendations for remediation of the gabion wall are summarized below.

Site Inspection Observations

- This gabion wall is acting as the retaining wall of the adjacent parking lot which belongs to a
 commercial/industrial property (refer to *Figure 1*). The total length of the wall cannot be
 measured due to piled up garbage and construction debris on top of the embankment fill along
 the length of the wall (refer to *Figure 2*). In order to identify the location of observations, stations
 were marked along the wall starting at the south end extending north.
- Between stations 0.0 to 17.0 m the wall is in good to fair condition. There are two holes of approximately 200 x 300 mm along the embankment fill behind the wall at stations 3.0 m and 6.5 m (refer to *Figure 3*). The creek bed and the toe of the wall are in good condition without visible signs of deformation or overturning (refer to *Figure 4*).
- Between stations 17.0 and 29.0 m the wall is in poor condition with severe deformation. The top
 of the wall has overturned forward approximately 1.2 m with 600 mm sagging at station 22.0 m
 (refer to *Figure 5* and *Figure 6*). This deformation can be attributed to the following reasons:
 - Significant erosion was observed below the gabion wall under the deformed area with an approximately 0.35 m deep x 0.65 m wide gap. The bottom gabion baskets are in poor condition and have been significantly undermined by creek flows (refer to *Figure 7*).
 - Dumped soil and construction debris along the edge of the parking lot and piled up garbage and debris on top of the embankment fill adjacent to station 22.0 m could be contributing additional surcharge load to the top of the gabion wall (refer to *Figure 8*).
 We also assume that piled up snow and ice during winter due to snow shovelling at this location could have contributed to deformation of the gabion wall.



- The backfill soil gets steeper approaching from south to north, which creates additional earth pressure and as the result contributes to the overturning of the wall.
- The western portion of the parking lot is draining behind the wall, where significant deformation was observed (refer to *Figure 9*).
- Construction debris and garbage were noted along the creek bed upstream of deformed area of gabion wall (refer to *Figure 10*).
- Creek flows are also contributing to undermining of the gabion wall at the location where the most significant deformation was observed.

Remediation Recommendations

Based on our visual inspection we recommend taking **immediate actions** on the following items to avoid sudden failure of the wall:

- i) Replace the deformed portion of the gabion wall approximately between stations 17.0 and 29.0 m with new gabion wall or a similar system acceptable to Conservation Authority. Further treatment of embankment fill and soil below the wall may also be required at this location.
- ii) Remove the debris and garbage from top and behind of the gabion wall.
- iii) Remove the dumped soil from the top of slope along the edge of the parking lot adjacent to station 22.0 m.
- iv) Fill the holes at stations 3.0 and 6.5 m behind the top of the gabion wall on the embankment fill to avoid accumulation of water and further erosion behind the wall.
- v) Some re-grading of the parking lot may be required to direct local surface runoff from the parking lot to Peelar Road.
- vi) Remove debris and garbage from creek bed along the wall and upstream of the gabion wall location. It is recommended that the creek alignment is modified along this segment of the channel to avoid any direct contact of the flow with the gabion wall.

The above observations and recommendations are based on our visual inspection only. Further investigations will be required for detailed design stage and prior to construction phase.

Prepared by: Behnam Mehraie, M.Eng., P.Eng.





Figure 1 1 Gabion wall facing North

Figure 2 🛧 Piled up construction debris and garbage between stations 17.0 and 29.0 m



Figure 3 🛧 Void behind the wall

Figure 4 🛧 Gabion wall between stations 0.0 m and 17.0 m in good to fair condition



Figure 5 🛧 Deformed area of the wall

Deformed area of the wall facing north





Figure 7 ↑
Erosion below the wall and poor condition of the gabion basket



Figure 8 ↑

Dumped soil and construction debris at parking level between stations 17.0 and 29.0 m



Figure 9 ♠
Parking lot facing North



Figure 10 ↑
Construction debris and garbage at upstream

JW:mf